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Japan Report

(FOUO 15/81)

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CONTENTS

ECONOMIC

SCIENCE AND TECHNOLOGY

POLITICAL AND SOCIOLOGICAL

MEDIA ON PARTY PRESIDENTIAL ELECTION SYSTEM

Problem of Deciding on Party

Tokyo MAINICHI DAILY NEWS in English 4 Feb 81 p 3

[Article by Takehiko Takahashi in "Nagatacho Doings" column: "Painful Problem of Deciding on Party Presidential Election System"]

[Text] The biggest problem for the Liberal-Democratic Party at the present time is the party presidential election system.

The DLP held its party convention on Jan. 23. Although it had intended to formulate the policy on the party presidential election system by then, there were differing views within the party and an agreement could not be reached. For that reason, only an interim report was submitted. Approval was obtained at the convention for a definite conclusion to be reached during March.

Becoming the president of the Liberal-Democratic Party means to become the prime minister. Therefore, the method of selecting the party president is important not only for the LDP but also for Japanese politics as a whole.

In the past, the Diet members affiliated with the LDP and one representative of each prefecture cast votes for the party president. In opposition to this, the then Prime Minister Takeo Miki proposed an election method in which there would be wide participation by the party members. Since this became the condition for Prime Minister Miki's withdrawal, the present system was adopted during the administration of his successor, Takeo Fukuda.

According to this method, all the party members participate in a preliminary voting that selects the two top candidates. The Diet members affiliated with the LDP would then vote to decide which of the two candidates would become the party president.

Initial Trial

This method was carried out for the first time in 1978. As the result, Masayoshi Ohira and Takeo Fukuda were chosen as the top two candidates. Nevertheless, because Fukuda (then the prime minister) placed second in the number of votes, he withdrew as a candidate in the final voting. Accordingly Ohira was elected and Fukuda resigned as prime minister. The Ohira administration was born.

During the election campaign, however, a large amount of money is said to have changed hands and factional strife was carried into the local districts. The number of "party members" also constituted a problem. Children and nonexisting persons were listed among the "party members." The managers of enterprises listed their employees as "party members" and voted en bloc.

Since then, Fukuda has been strongly opposed to this preliminary voting system. But as long as the system exists, those aiming to become the next party president must make preparations. Because of this, the party membership at one time reached 3 million.

Last year following the sudden death of Ohira, the present Prime Minister Zenko Suzuki was selected as party president through talks conducted among the party leaders. With this as a turning point, the membership decreased drastically. It is now estimated at being about 1,200,000.

It is said that Toshio Komoto was the most active in gathering party members in preparation for the election. Among the present 1,200,000 members, it is believed that

500,000 are Komoto supporters. For one thing, despite the drastic decrease in membership, the party members in Hyogo Prefecture, where Komoto's constituency is located, remain unchanged at 150,000, much more than in other constituencies.

This problem is being discussed by the party's reform promotion headquarters centering on Ryutaro Nemoto. It was decided at the last party convention that "maintenance of the present system will be the premise for carrying out necessary reforms." Hence it would be most difficult to reach a conclusion that the preliminary voting, participated in by all the party members, should be abolished.

Party Dues

How to cope with this problem is the problem that now exists. Among the plans under study are adoption of stricter qualifications for party members, more appropriate voting system (by direct vote instead of voting by mail), and more suitable election campaigning. Also under consideration is a raise of party dues (which have newly become 3,000 yen).

Maintenance of the preliminary voting is being strongly desired by the local chapters of the LDP. This is mainly because of financial reasons. Of the 3,000 yen in dues, 1,000 yen is handed to prefectural federations, 1,000 yen to city, town and village chapters, and the remaining 1,000 yen goes to the LDP headquarters. Thus this is a big source of revenue for the local organizations.

If the final plan to be drawn up during March calls for a continuation of the preliminary voting system, the factions within the LDP are likely to commence brisk activities. In such a case, Prime Minister Suzuki will be placed in the most painful position. Unless he clarifies his intention to become a candidate in next year's party presidential election, the other candidates will take over. If he makes it known that he will not become a candidate, his leadership as prime minister and party president will drop from that moment.

In this sense too, this problem of the party presidential election system provides the LDP with its biggest headache.

(The writer is an adviser to the Mainichi Newspapers and former chief editorial writer).

Reform of Election System

Tokyo THE DAILY YOMIURI in English 7 Feb 81 p 2

[Editorial]

A proposal for reform of the House of Councilors election system has been compiled by a subcommittee of the ruling Liberal-Democratic Party's Election System Study Council.

The proposal calls for: (1) maintaining the existing local constituency system, but altering the current local districts into electoral districts; (2) abolishing the national constituency system and introducing a proportional representative system to determine winners in proportion to votes amassed by each party; and (3) asking the voter to name in one vote the candidate he supports in the electoral district and the party he backs in the proportional representative system.

Although the proposed reform involves some problems, it is worth considering because it will help to improve the current national constituency system which costs an enormous amount of money and work.

A Question Of Will

The big question is whether the political parties have the will to reform the upper house election sys-

tem. If they have the will, then the proposal worked out by the LDP should be debated.

Although the subcommittee's proposal adopts a modified one-vote system, it allows the voter to name a candidate of one party in the electoral district and a different party in the proportional representation system.

In principle, under the one-vote system, the winning candidates in the national constituency are determined in proportion to votes amassed by each party in the local district. But the problem with this system is that it contravenes Article 43 of the constitution which stipulates that both houses shall consist of elected members, representatives of all the people.

Voters may be unhappy with this system, saying that there is no reason why they have to vote for the same party in both constituencies. The LDP's subcommittee has therefore proposed a system which allows the voter to name a candidate of one party in the electoral district (currently local district) and a different party in the proportional representation system (currently national constituency).

But the proposed new system still has a flaw because it does not reflect the will of voters who do not wish to support any candidate in the electoral district although they want to back a party in the proportional representation system. Under the proposed reform, any ballot not carrying the name of a candidate in the electoral district becomes invalid.

No Foolproof System

There is no foolproof election system. All the parties are urged to make steady efforts to eliminate the evils of the current system by putting aside their own political interests.

The reform bill should be submitted to the current Diet session if the proposed new system is to be introduced from the next upper house election to be held in 1983. Although there are two years to go before the next election, deliberations on the bill should be carried out swiftly to allow time for the parties to prepare for the revised election system and to explain the new system properly to the voters.

CSO: 4120

POLITICAL AND SOCIOLOGICAL

SUZUKI PLANS REVAMPING OF CABINET

Tokyo THE DAILY YOMIURI in English 17 Feb 81 p 4

[Article by Raisuke Honda in "Political Beat" column: "Cabinet Reshuffle"]

[Text] While the Diet is in the midst of deliberations on the fiscal 1981 budget, the Liberal-Democratic Party (LDP) has already begun rippling in anticipation of a cabinet reshuffle and party lineups this summer.

At his New Year press conference, Prime Minister Suzuki, when asked about his plans for a cabinet reshuffle, said: "I am very poor at handling personnel affairs and am naturally aversed to dealing with such matters, so that I now have no intention at all to reshuffle the cabinet."

Judging by common sense, however, his having "no intention at all" about reshuffling the cabinet should be considered a sort of "political lie." Instead, the premier must have always been pondering over when to carry out a reshuffle, the first one since the inauguration of the Suzuki administration.

Except for the Miki administration, which lacked a strong political base within the LDP, successive LDP cabinets in the past have been coincidental in carrying out their first reshuffles, respectively, after a period of about one year after the inauguration.

This is largely because each administration at the time of its inauguration is bound to allocate cabinet posts in the form of "rewards" to praise those who did much for the birth of the administration.

For this reason, the cabinet members of each administration at the time of its inauguration often include those "forcibly imposed" by influential intraparty factions.

Each prime minister, therefore, tends to want to reshuffle his cabinet as early as possible so as to become able to wield his own leadership effectively.

The LDP currently refrains outwardly from discussing a possible cabinet reshuffle.

Reflecting behind-the-scenes moves on the matter, however, Yuko Kurihara, the deputy secretary-general of the LDP, reportedly told Premier Suzuki early this month that he had better carry out a cabinet reshuffle at an early date, in April or May, if possible.

But Suzuki then was reluctant to accept the proposal, saying it would be "very difficult" to go ahead with Kurihara's suggestion, according to the premier's close aides.

It is unclear whether the expression "very difficult" meant the difficulty in conducting an early cabinet reshuffle or that in conducting any reshuffle irrespective of its timing.

Most political analysts agree that if Premier Suzuki is determined to reshuffle the cabinet, he would likely do so around late July or August following such diplomatic schedules as a North-South summit conference in June and industrial democracies' summit in Ottawa in July.

Suzuki appears of a mind to fire, if possible, such "trouble-making" cabinet members as Justice Minister Seisuke Okuno, who has repeatedly caused commotions over his remarks in favor of amending the constitution, and Science and Technology Agency Director-General Ichiro Nakagawa, who is known for his "hawkish" remarks on defense issues.

A reshuffle of the Suzuki cabinet, however, would be certain to bring a knotty problem to the fore over how to treat Suzuki's two major rivals now being "contained" within the cabinet: Administrative

Management Agency Director-General Yasuhiro Nakasone and Economic Planning Agency Director-General Toshio Komoto.

Should Suzuki oust Nakasone and Komoto from the cabinet in a reshuffle, they might intensify factional maneuvering to antagonize Suzuki in next year's LDP presidential election.

In the case of Suzuki trying to retain the two within the cabinet, both Nakasone and Komoto would ask for more important posts, such as vice-prime minister or foreign minister.

In addition, Susumu Nikaido, one of the so-called "gray officials" in the Lockheed payoff scandal, whom Suzuki dared to name the party's executive board chairman, is expected to demand a cabinet post should there be a reshuffle.

Meanwhile, International Trade and Industry Minister Rokusuke Tanaka, one of the senior members of the faction led by the premier himself, has declared: "I will never give up my present post in the event of a cabinet reshuffle."

Under the circumstances, the premier may well have felt it extremely difficult to go ahead with a reshuffle.

Nevertheless, Suzuki will find the decision on carrying out a revamping of the cabinet as well as party lineups unavoidable in response to increasing voices within the LDP calling for a reshaping of the Suzuki government.

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POLITICAL AND SOCIOLOGICAL

MITI MINISTER TANAKA'S POLITICAL STRATEGY DISCUSSED

Tokyo MAINICHI DAILY NEWS in English 18 Feb 81 p 4

[Article by Takehiko Takahashi in "Nagatacho Doings" column]

[Text] The ban on the export of munitions is being opposed by MITI Minister Rokusuke Tanaka. He is going so far as to declare that if the arms export ban is legislated into law, he will resign as MITI minister. It is said that this is because he believes that it will be a big plus for his career to go on record as having "staked his political career to oppose the enactment of a law prohibiting the export of armaments."

MITI Minister Tanaka's recent political activities have been attracting the attention of the political world. He busily made a round of calls on influential figures in the political and financial worlds in order to create the Suzuki administration. When it was established, he assumed the important economic cabinet post of MITI minister.

Although he is a member of the Suzuki faction, Tanaka has organized a group called "Study Society of the New Generation." It is described as a group to study policies, but a secretary general has been named and regular meetings are being held. Participating in it are not only members of the Suzuki faction but also from other factions. It is looked upon as "the start of a Rokusuke Tanaka faction."

Tanaka is inherently a proponent of factions. It may be that he is carrying on the late Prime Minister Masayoshi Ohira's way of thinking. According to Tanaka, Ohira during his lifetime urged Tanaka on three occasions to form his own faction. Tanaka, who was most faithful to Ohira, says that he is only carrying out Ohira's thinking.

The understanding of Prime Minister Suzuki was obtained prior to the start of the "Study Society of the New Generation." Tanaka says that the new group is intended to strengthen support for the Suzuki administration.

No matter what Tanaka says, however, the other executives of the Suzuki faction are critical of Tanaka's activities. In order to counteract Tanaka's policy study group, five other study groups have been formed within the Suzuki faction on "security," "financial rehabilitation," "development of human resources," "social development" and "change of industrial structure." By stepping up the activities of these groups, the intention is to isolate Tanaka's policy study group.

'As A Politician'

A person who was close to Rokusuke Tanaka at the time when he was once chief cabinet secretary spoke of "Tanaka as a politician" as follows:

"Mr. Tanaka is a person who never looks back on the past. When he sets a certain target, he engages in terrific activities to attain that goal."

This description of MITI Minister Tanaka seems to be correct. After the death of Hayato Ikeda, Shigesaburo Maeo became the representative of the Kochikai (Ikeda faction). Tanaka started action to make this Ohira's faction and he achieved this by carrying out what was called a coup d'etat. In the Fukuda-Ohira preliminary voting for the party presidency, Tanaka engaged in hectic efforts to assure Ohira's victory. Tanaka's activities might also be considered as having been the fuse for the creation of the Suzuki administration.

In this way, as soon as one target is set, Tanaka begins to act furiously. What is he aiming at now? As a politician, he must

undoubtedly have the party presidency and premiership as the ultimate goal, and is seeking to attain various targets during the stages leading to the final aim.

The probable target in the first stage is to completely overpower his rival in the Suzuki faction—Kiichi Miyazawa. For that purpose, it is necessary to expand the influence that is being called the "Rokusuke Tanaka faction" and to win over the majority in the Suzuki faction to his side. This has taken the form of the establishment of the "Study Society of the New Generation" and the providing of financial assistance to younger Diet members.

The second stage is most likely to obtain the post of chief cabinet secretary again. This post is most effective in aiming for the premiership. The only LDP president who has not served once as chief cabinet secretary is the present Prime Minister Zenko Suzuki.

Among those aiming for the post of chief cabinet secretary right now are Shintaro Abe of the Fukuda faction (chairman, Policy Affairs Research Council), and two who are called "new leaders," Noboru Takeshita and Ganri Yamashita. The latter two are members of the Kakeui Tanaka faction.

When Rokusuke Tanaka states that he will "stake his post as MITI minister" to oppose the legislation of the prohibition of arms export into law, his attitude is winning support not only in the LDP but also in the economic world. Some persons are regarding this as Rokusuke Tanaka's strategy to approach becoming the "chief cabinet secretary."

CSO: 4120

POLITICAL AND SOCIOLOGICAL

JSP THEORISTS MOVE TO AVOID FACTIONAL STRIFE

Tokyo ASAHI EVENING NEWS in English 12 Feb 81 p 3

[Text]

Theses and discussions by theorists both inside and outside the Japan Socialist Party concerning the report on JSP policy in the 1980s drafted by the Socialist Theory Center are being published in the March issue of the "Gekkan Shakaito" (Monthly Japan Socialist Party), which will go on sale on Feb. 14.

Opinions both for and against the report are being published in the monthly magazine. This is the first time that a full-scale discussion on the matter has been published in the party organ.

The leftist Shakai Shugi Kyokai (Socialism Association) headed by Itsuro Sakisaka is very critical of the report, but the association's theorists, including the editor of the "Shakai Shugi" (Socialism), the association's magazine, have shown themselves more flexible in the debate over the report.

The report of the Socialist Theory Center took a new look at "The Road to Socialism in Japan," the party platform drafted in the 1960s, and drafted a new basic policy to cope with the changes in domestic and international conditions in the 1980s.

The report is critical of "The Road," which assumes a Soviet type of socialist construction. The confrontation between the Shakai Shugi Kyokai, which supports "The Road," and the rightists within the party who basically support the report, is growing.

The fact that some people in the association are willing to discuss the report seems to be an attempt on the part of the association to reduce party infighting.

Those within the party who have published theses in the March issue of "Gekkan Shakaito" are Diet members Shigeru Ito, Torao Takazawa, Ichiro Hino and Masao Hori. Those outside the party are professors and assistant professors, including Hideaki Ouchi (Tohoku University), Takao Kamakura (Saitama University), Yutaka Fukuda (Hosei University and editor of "Shakai Shugi") and Ikuro Takagi (Yamagata University).

CSO: 4120

POLITICAL AND SOCIOLOGICAL

FIRST MAJOR TEST FOR SUZUKI

Tokyo ASAHI EVENING NEWS in English 5 Feb 81 p 3

[Article by Michisada Hirose]

[Text] Prime Minister Suzuki, who has been spared factional strife within his ruling Liberal-Democratic Party since he was named party president in July last year, faces his first major test. As the head of the Party Reform Headquarters, he must make a decision by the end of March on the question whether to maintain the primary election system for selecting the party chief or to abolish it, an issue over which the intraparty factions differ. Work to settle the matter got under way Wednesday.

Although the LDP is the most mature party in Japan, its recourse to expediency in handling party affairs is often surprising. The presidential election rules, which were revised in 1977, call for the selection of the party chief by means of two elections every two years. All the LDP members are entitled to vote in the primary elections, which are designed to select two candidates for the presidency. The candidates then face a vote by the LDP members of the Diet. But the two-stage formula has never operated as prescribed.

Primary elections were held in 1978, but as incumbent Prime Minister Takeo Fukuda bowed out of the race after coming in second in the primaries, Masayoshi Ohira won the presidency without having to face a vote by the LDP Diet members. Primaries were canceled in 1980 since no one but Prime Minister Suzuki registered himself as a candidate.

The LDP is more often run on the basis of the factional balance of power at a given time than according to the official rules. (The late LDP Vice President Etsusaburo Shiina valued the flexibility resulting from this practice, saying that it served to avoid a breakup of the party.)

The five major LDP factions' views on the primary election system are as follows:

Fukuda faction: Fukuda, leader of this group, believes that the system should be abolished on the basis of a decision by Suzuki. Citing his experience in 1978, he contends that too many of the rank and file LDP party members, who are entitled to vote in the primaries, are "temporary members" whom the intraparty factions have recruited by paying party membership fees on their behalf. Thus, he says, the system merely spreads factional woes nationwide.

Shintaro Abe, No. 2 man in the Fukuda faction and chairman of the LDP's Policy Board, argues in the same vein, but what he really wants is an immediate and definite decision whether the system is to be kept in existence or abolished.

For the past two years, the Fukuda faction has not been recruiting party members. But if Suzuki decides to retain the system, Abe will have a free hand and will launch a nationwide recruitment drive to rise to the top when Suzuki steps down.

Komoto faction: Toshio Komoto, director-general of the Economic Planning Agency and leader of this faction, and his predecessor, former Prime Minister Takeo Miki, assert that to abolish the primary election system would be a betrayal to those who have joined the party for the chance to participate in the selection of the LDP president. The system was created by Miki to "make the LDP a party open to the outside and to end the factional chiefs' back room talks to choose the party leader."

After his disastrous defeat in the 1978 presidential contest, Komoto, working through the alumni organizations of his alma mater, Nihon University, has been the most energetic recruiters of party members among the presidential aspirants. Of the 1,400,000 LDP members, 600,000 are said to be Komoto supporters. The cancellation of primary elections in 1980 was in a part a tactical move by the other factions to contain him. Despite his strength at the rank

and file level, he has yet to find ways of winning in the second election by the LDP Diet members.

Nakasone faction: At a recent general meeting, this group decided that the primary election system should be abolished in view of its serious demerits, but the faction may support its continuation if a way of removing these demerits is found. Yasuhiro Nakasone, director-general of the Administrative Management Agency and leader of the faction, proposed the public election of the Prime Minister when he was young and, together with Miki, worked to make the LDP a party open to the outside. But because his recruitment efforts have not been so successful since his 1978 presidential defeat, he has come to seek his path to the presidency in talks among the factional leaders.

Tanaka faction: This group has yet to decide its position on the primary election system. For one thing, the faction has yet to decide on the man to support for the post-Suzuki party presidency. A belief in the strength of the 101-member faction is another factor. The group is confident that it can recruit a sufficient number of party members any time if it should be necessary. No other man has more know-how about winning presidential contests than former Finance Minister Noboru Takeshita, a ranking member of the faction, since, as chairman of the National Organization Committee, he took charge of practical matters connected with the holding of the primary elections in 1978, such as bolstering local party organizations and making lists of party members.

Suzuki faction: This faction's principal concern is not to let the process of intraparty debate on the primary election system erode the present all-party cooperation and factional harmony. It believes that there will be iess intraparty trouble if the system is kept in being, with devices made to lessen its demerits, than if it is abolished.

The focal question is whether Suzuki will be able to get Fukuda to agree to the retention of the system. Fukuda's adamant position is strongly supported in the party. Fukuda may be preparing for the day when former Prime Minister Kakuei Tanaka returns to the party. Despite the expansion of the Tanaka faction, the other factions are certain to oppose Tanaka's making a comeback to power. But what if he ran in the primary elections? Would the rank and file party members turn him down? Fukuda may be worried about their reaction.

CSO: 4120

POLITICAL AND SOCIOLOGICAL

COLUMNIST DISCUSSES NATIONAL DAY, PATRIOTISM, DEFENSE

Tokyo MAINICHI DAILY NEWS in English 10 Feb 81 p 2

[Article by Hideo Matsuoka in "Zooming-In" column]

[Text] The Education Ministry is one of the supporting organizations behind the celebration activities on National Foundation Day on Feb. 11. The ministry's participation will no doubt do much to stir up the spirit of the sponsors of celebration programs. With the ministry sanction, they will try to put extra zing into the day's festivities, and will be content more than on other National Foundation Days that they have contributed significantly to implanting patriotism in the nation.

There is criticism that it is improper for the Education Ministry, which is in charge of educational matters, to be supporting celebration activities of National Foundation Day. Three years ago, the Prime Minister's Office was among the supporting organizations of National Foundation Day programs. If the government office directly under the prime minister could be a supporter, why could not the Education Ministry? National Foundation Day is a legally designated holiday, and thus it would not be particularly surprising if somebody argued that the day's celebrations should be publicly supported by the government as "affairs of the state." When this type of argument wins general support, the advocates will call for direct government sponsorship of festivities, as it was with the old Kigensetsu (the prewar and wartime National Foundation Day), also observed on Feb. 11, the day we now observe Kenkoku Kinenbi, translatable also as National Foundation Day.

As it is, it is too late to oppose governmental support, be it by the Prime Minister's Office or the Education Ministry, of National Foundation Day celebrations once the day, scrapped right after the war, has been restored. Once reintercalated, it has been a foregone conclusion that the day would acquire official status, and its observance would be under government sponsorship. If such government involvement is uncondonable, we should not have allowed the legislation of National Foundation Day. That we could not prevent the legislation means we lost. Losers must pay for the consequence. Ruing about the defeat does not help.

Still, we are concerned about the purpose of the National Foundation Day celebrations. Enhancement of patriotism seems to be the foremost purpose. Is patriotism such a fragile state of mind that people need to get together once every year in ritualistic gatherings to make sure they still have it? Such gatherings are the proof of degeneration of patriotism. Those who attend National Foundation Day ceremonial gatherings are the people who's minds are losing grip on patriotism. People who are not sure they have patriotism gather together once a year to collectively confirm the presence of patriotism in their minds. Such are the National Foundation Day meetings.

We do not need National Foundation Day to enhance our patriotism. Does Britain have a National Foundation Day? Does West Germany have it? France has Bastille Day to mark the French Revolution, but no National Foundation Day. America has Independence Day. It will be grossly outrageous and impolite to say the peoples of these countries are low in patriotism because their countries have no National Foundation Day.

Dubious Anniv.

Bastille Day on July 14 and America's Independence Day on July 4 are based on facts of modern history. What about Feb. 11 for Japan's National Foundation Day? It is putatively the day of the coronation of Emperor Jimmu, the first in Japan's Imperial Dynasty. If we concede that Emperor Jimmu did exist, he lived in the Jomon Period (several thousand years from 7000 or 8000 B.C.). There was no established calendar in those prehistoric years, and hence no Feb. 11 — unless future archaeology proves otherwise. The plain fact is that the prewar Kigensetsu was set for Feb. 11 in the Meiji Era. It was established, moreover, as early as the fifth year of Meiji, no doubt taking advantage of the chaos in which Japan's first modern government was still struggling in its shakedown efforts. How come we still solemnly uphold the historically dubious anniversary set up with apparent lack of prudence and reason?

Anything that becomes an existence through official decision will actively assert its right to exist and, through such assertion, enlarges its existence. Such examples include National Foundation Day and the Self-Defense Forces. To be frank, National Foundation Day is not a serious phenomenon that, as some people fear, would substantially precipitate a national swing to the right.

Most people take it as just another holiday, and rarely regard it as a special occasion for getting patriotically keyed up. At most, they have only fleeting regard for those who are actively maneuvering to solemnize the day. Even then they think the pro-National Foundation Day activists devote their time to the cause because they have little else to do.

Of course you can argue that setting up an official National Foundation Day is one of the major moves to set the clock back, along with the campaign to give state patronage to Yasukuni Shrine and the legislation of the Imperial era name. But these moves stop short of directly threatening the daily living and lives of the people. Those who do not agree with these moves can opt to stand on the sideline, refusing to be involved.

They do not have the same option with the Self-Defense Forces. That is, they are not allowed to stand on the sideline to watch how it develops, without themselves being involved. Merely by existing, the SDF eats up an enormous amount of taxes. Every move it makes requires additional funding with tax revenues. The SDF is organized in anticipation of a war which necessarily imperils the lives of the Japanese.

The SDF, true to its organizational purpose, should be structured to suit wartime needs. It is only natural that SDF higher-ups demand that the SDF be allowed to possess capabilities to serve such needs. Creating the SDF is meaningless if it is to be restricted in the execution of war. In this sense, the controversial statement of Goro Takeda, chairman of the SDF Joint Staff Council, is very reasonable.

For instance, the "defensive warfare" to which the government binds the SDF is the height of strategic or tactical folly. It is no strategy or tactic at all. A purely defensive war means fighting on Japanese territory. The whole of Japan will be turned into a battleground. Bombs will rain down on us. Takeda, in the Hoseki magazine interview, asked if the nation approves such a strategic choice. It was a very apt question to ask.

Defense requires offense. Positively attacking enemy bases, warships and others is an effective defense. In this sense, the SDF should be equipped with offensive weapons. Strategy should also be switched to an offensive one from the present defensive one, if the SDF is to effectively defend the nation. Takeda must have had these considerations in his mind when he was answering the Hoseki interviewer.

A Joke

He also said: "A defense cost limited to the equivalent of 1 percent of GNP is meaningless. At least we should have 3 percent..." Takeda later explained he made the remark as a joke. I think he was showing his true color when he made the remark, and later tried to hide it as a joke. In critic Ikutaro Shimizu's book *Nippon yo, Kokka tare* (Japan, Be a State), the Military Science Research Council concludes expressly that Japan must spare the equivalent of 3 percent of GNP for defense. Takeda's 3-percent advocacy cannot be an unrelated coincidence.

Although Takeda did not say so, the Military Science Research Council in Shimizu's book exhorts: "To have a really worthwhile defense power, Japan must do away with its three nonnuclear principles and possess nuclear arms." For the SDF to be really capable of

safeguarding Japan, it will ultimately have to go nuclear in its armament. Any attempt to preserve national security by armed force is insufficient without nuclear armament.

Liberal-Democrats and Democratic Socialists say they do not want Japan to become a major military power, but they do want Japan to possess a certain amount of military power. But how much is "a certain amount"? For advocates of defense efforts, there is no limit to "a certain amount" of armament. They envision a major military power when they talk of their own country as having a certain amount of armament.

Chairman Takeda of the Joint Staff Council has taught us of the above facts. I almost feel thankful to him for awakening the nation to the danger that lurks in the thinkings of the men of his ilk. The Japanese have the wisdom to know the type of message they should read from Takeda's scare statement.

CSO: 4120

POLITICAL AND SOCIOLOGICAL

'FUKUDA STOCK' CONTINUES TO RISE

Tokyo MAINICHI DAILY NEWS in English 11 Feb 81 p 4

[Article by Takehiko Takahashi in "Nagatacho Doings" column]

[Text] Three former prime ministers have seats in the National Diet. They are Kakuei Tanaka, Takeo Miki and Takeo Fukuda.

In Miki's case, his faction has now become the Komoto faction and Miki's voice in political affairs has been declining.

Both Tanaka and Fukuda have continued to maintain their position as boss of a large faction. But Tanaka is a defendant in a criminal case involving the Lockheed scandal. Therefore, no matter what strength he may display within his own faction or what fuss the mass media may make over him, Tanaka is unable to stand formally and openly on the political stage for the time being.

Fukuda remains unscathed. When the Liberal-Democratic Party carried out its first presidential election with the participation of all party members, Fukuda lost to Masayoshi Ohira in the preliminary voting. Thereupon Fukuda flatly withdrew his candidacy in the main voting by LDP Diet members and resigned from the premiership.

At present the LDP is restudying the presidential election system. This has resulted partly from voices asking if an election system in which the incumbent prime minister (Fukuda) could lose to another candidate (Ohira) is appropriate.

Following the sudden death of Prime Minister Ohira, the Suzuki administration was born. It was Fukuda who gave the O.K. sign for Suzuki's selection as LDP president.

Kiichi Miyazawa was chosen as the chief cabinet secretary, the chief clerk of the Suzuki cabinet. Miyazawa was not on good terms with Ohira. Nor did Tanaka have goodwill toward Miyazawa. Under these circumstances, it can be surmised that Miyazawa's selection as chief cabinet secretary must have had the support of Fukuda.

It is said that Prime Minister Suzuki is in close contact with Fukuda in the policy phase, particularly in the phase of diplomacy. Tanaka is displeased by this. The Tanaka faction (which goes by the name of the "Thursday Club") has swollen to 101 members but in the background of this is Tanaka's veiled threat that "if you listen only to Fukuda, we'll shake the Suzuki administration with the force of numbers."

Suzuki's Supporter

Fukuda, who was in severe confrontation with Ohira, is now a supporter of the Suzuki administration. Fukuda says jokingly that this is because "I now feel a dislike of war." The meaning is that he has become weary of intraparty feuds.

Fukuda looks with favor on Prime Minister Suzuki. If criticism of Suzuki's attitude arises—for example, regarding his replies to Diet interpellations, Fukuda defends Suzuki by saying, "he is still in the process of study." This may be because Prime Minister Suzuki respects Fukuda as the supreme adviser of the Suzuki cabinet.

If Foreign Minister Masayoshi Ito cannot attend the inauguration ceremony of President Chun Doo Hwan of the Republic of Korea, it seems that maneuvering is taking place for Fukuda to go. There is also a move under way to have Fukuda go to Washington as Suzuki's special envoy and hold talks with President Reagan before Prime Minister Suzuki makes his visit to the United States.

Fukuda's going to the

Republic of Korea is still a tentative plan but his going to the United States seems practically decided.

Fukuda is saying that "Prime Minister Suzuki made a wise move in visiting the ASEAN member countries first. Ohira did not do this." It is surmised that it was probably Fukuda himself who urged Prime Minister Suzuki to make this ASEAN visit.

At a gathering held at a Tokyo hotel the other day, Fukuda lectured on the subject, "Japan in the World." In his speech, Fukuda said, "This must be a year in which 30 percent of attention is given to domestic affairs and 70 percent to diplomacy." He exhorted his listeners, who are regarded as the "new leaders," to be "equipped with a world outlook and long-range viewpoint."

At the end of last year Fukuda played golf at Miyazaki and successfully achieved a long 13-meter putt. It seems to have made him very happy because he boasts about it to everyone who will listen.

Fukuda seems to be interpreting this as a happy augury that although he has stepped down from the premiership, a bright future still lies ahead. This is in reference to establishing a firm position as Prime Minister Suzuki's mentor.

That the "Fukuda stock" has been rising of late is an undeniable fact.

CSO: 4120

MILITARY

MAJORITY OPPOSE BOOST IN DEFENSE BUDGET

Tokyo THE DAILY YOMIURI in English 10 Feb 81 p 3

[Text] ***More than half the people oppose the considerable increase in defense expenditure in the fiscal 1981 budget, although public opinion is split concerning whether or not to comply with the US demand for an increase in Japan's defense spending, according to a survey by The Yomiuri Shimbun.***

The survey, conducted on 3,000 people for three days from January 23, shows that 53.1 percent do not support the increase of 7.61 percent in the fiscal 1981 defense expenditure over the previous fiscal year, while 30.5 percent support it.

As a result of the increase, the defense appropriation has reached more than ¥2.4 trillion, or 0.9064 percent of Japan's gross national product (GNP).

The increase rate has exceeded that for the welfare appropriation (7.6 percent) for the first time, though only slightly (0.01 percent), prompting opposition parties to criticize the government for giving priority to defense over welfare.

A total of 41.4 percent are in favor of the US demand for an increase in Japan's defense expenditure, saying Japan should comply (8.7 percent) or that compliance to some extent will be unavoidable (32.7 percent).

But slightly more people (44.6 percent) oppose Japan's compliance, saying Japan should refrain from doing so as much as possible (22.5 percent or that it should not do so (22.1 percent).

The percentage of people who favor compliance with the US demand, however, has increased markedly since last February when only 25 percent answered in the affirmative compared with 55.4 percent who replied in the negative.

An overwhelming majority (74.9 percent) oppose Japan's exports of weapons, while 10.7 percent support such exports.

The recent disclosure that Hotta Hagane, an Osaka steel trader, exported semi-finished weapons to South Korea, has become controversial in the Diet.

Also a great majority (71.2 percent) oppose revision of Article 9 of the constitution so as to allow Japan to possess a full-fledged military force, while 13.5 percent favor revision of the article.

Renouncing war, Article 9 stipulates that Japan will never maintain land, sea or air forces or other war potential.

To the question whether or not the capacity of defense forces (SDF) has exceeded that needed for self-defense, 10.4 percent replied that the forces have passed the need, 32.5 percent that they are about to exceed it and 38.6 percent that they have not exceeded it.

Answers to another question show that 38.3 percent are content with the SDF as they are now.

CSO: 4120

MILITARY

HIGH-SPEED HOMING TORPEDO TO BE MANUFACTURED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 78

[Text]

• The Defense Agency will shortly place an order with Mitsubishi Heavy Industries for a homing torpedo "G-RXZ". The homing torpedo is designed to receive sonic wave signals from target ships and identify them as moving vessels, while the torpedo is running. This enables the attacking vessel to steer the torpedo by remote control, ensuring a high percentage of successful strikes.

The Defense Agency has had various parts of the device under manufacture since fiscal 1975, and intends to begin the manufacture of the entire system within fiscal 1980. According to the Agency's schedule, a test model will be completed by fiscal 1983, tests will be carried out from fiscal 1984, and the torpedo should be available to the fleet between 1985 and 1986.

The "G-RXZ" is longer than the conventional torpedo, and the optimum performance includes a speed of 60 knots (about 1.5 times that of conventional types), ranges about 1.2 or 1.3 times those of conventional types, and the distance before homing of more than two times the conventional level. The Agency explains that these levels are higher than those of the "Mark 48", a torpedo the U.S. Navy has recently been equipped with.

Details of the performance of torpedoes are rarely disclosed. Thus, the recent disclosure by the Agency of this numerical data on target performance is thought to be exceptional. Development work will start with the propulsion system and explosive section, and carry on to the homing head (a follower) in fiscal 1981.

CSO: 4120

ECONOMIC

NEED FOR MORE GOVERNMENT INTERVENTION IN INDUSTRIES IS STRESSED

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 3

[Text]

The Ministry of International Trade & Industry has come around to the thinking that in an era of low economic growth, the degree of administrative intervention in certain industries associated with basic materials or energy should be strengthened.

This idea is the essence of its latest concept as to how competition should fare in a period of low economic growth.

In this thinking, the Ministry holds that the very basis of economic growth is maintaining the viability of enterprises. From this standpoint, it recognizes the urgency of stringently applying the Anti-Monopoly Act.

On the other hand, it feels that there is need to step up governmental inervention in certain areas of industries having a vital bearing on economic security, such as steel, petrochemical products and energy.

The Ministry also considers that seeking self-restraint of exports for averting friction in international trading falls within the province of the needed administrative intervention.

As to how such governmental intervention will be carried out, MITI, as one way, contemplates having some specified industries submit to it information on adjusting their facilities as well as their outlooks on supply and demand.

The Ministry intends to present its latest concept to the Industrial Structure Council, governmental advisory body, this autumn for study and approval, and then to implement it as quickly as possible.

As for the Fair Trade Commission, it already is wary of MITI's latest views on "policies on competition in a period of low growth."

"Strengthening administrative intervention, even though aimed at a given field, has strong danger of restricting competition," it cautions.

The areas against which MITI wants to tighten guidance are steel, petrochemical, synthetic textiles, and paper-pulp, for instance.

Its reason is that this is needed not simply from the aspect of ensuring economic security but for realizing their smooth product supply

for benefiting people's living as a whole.

From this thinking, it feels that the Government should be empowered to inform these industries on the supply-demand outlook and instruct them in such a way as to see that there will be no overproduction.

The Ministry now informs the steel industry of a supply-demand guidepost on a quarterly basis, and the steelmakers use this as reference to draw up their own production plans.

MITI, in other words, wishes to broaden this practice to cover the basic materials industries.

Along with this, it cites the necessity of adjusting plant and equipment investments with government guidance.

This is because if the management of basic materials companies should become precarious owing to overproduction, this stands to endanger supply of basic materials, it holds.

It judges that intervention or guidance is vital as to stockpiling of raw materials also from the standpoint of ensuring economic security.

As to trade frictions, the Ministry feels that offering of information by the Government can help preventing them.

For instance, it figures that as to the auto problem, the Government could offer its supply-demand estimates on various countries to the automakers, and offer them assistance to see that their market shares will not increase too sharply in drawing up production and export plans.

Some of the nations of the Organization for Economic Cooperation and Development already are advocating that every nation should draw up an outlook on its auto demand.

MITI's idea thus can be said to be close to such OECD thinking.

CSO: 4120

ECONOMIC

EDITORIAL ON ARMS EXPORT BAN

Tokyo ASAHI EVENING NEWS in English 17 Feb 81 p 9

[Editorial]

[Text]

Agreement was reached between the Government and Opposition parties on the problems of restricting arms exports, which is one of the focal points of the current Diet session, after the Government promised to study a revision of the system and new, effective measures. The Government should outline concrete policies as quickly as possible.

It is the duty of the Diet and the Government to more clearly define both inside and outside the country Japan's stand of severely restricting the export of arms and of pursuing peace. A settlement on the arms export issue should not be made through ambiguous compromises by the various parties. In particular, they must refrain from using the issue as a bargaining tool between the Government and Opposition parties in the final stages of budget deliberations in the Lower House.

The agreement reached between the Government and Opposition parties on this problem in the Lower House Budget Committee consists of three points: (1) revision of the system and new, effective measures to restrict arms exports; (2) continuation of negotiations between the Government and Opposition parties on a bill to ban arms exports; and (3) an investigation on the arms exports which have been exposed. The actual problem, however, of how to draft effective methods to ban arms exports has been left untouched.

In discussing this issue, the Government should use the unified Government policy worked out by the Miki Cabinet as its basis. That policy further strengthened the three principles on arms exports of the Sato Cabinet; after saying that the Government would not approve arms exports to countries engaged in disputes, it called for the placement of restraints on arms exports to other areas as well in line with the principles of the Constitution and the Foreign Exchange Control Law. The Government should strengthen these contents to make the restrictions more severe.

To go a step further and pass a law banning arms exports, as demanded by the Opposition parties, would have great significance. The promulgation of a law banning arms exports would be a proclamation to the world that Japan, as a peaceful nation,

will not export arms. If laws to punish industrial circles engaging in arms exports were strengthened, these circles would exert greater self-restraint. A ban on arms exports would firmly establish Japan's reputation in the international community as a peaceful nation.

Legislative steps to strengthen the contents of the "unified policy" are probably a desirable method to restrict arms exports. But the passage of a law is not the objective. The core of the problem is the steps that should be taken to guarantee restrictions on arms exports.

In the Budget Committee, which is the stage for negotiations between the Government and Opposition parties, there are many other problems under discussion, including the Opposition's demand for tax reductions.

But the Government must not let these other problems become a distraction, nor should it take only a halfway measure on the arms export problem. A clear policy must be drafted. (Feb. 15)

CSO: 4120

ECONOMIC

U.S. COMPUTER INDUSTRY: NEXT TARGET

Tokyo THE DAILY YOMIURI in English 11 Feb 81 p 5

[Article by Marshall Ingwerson]

[Text] "Made in Japan."

It's written between the lines of the American economy, as increasingly keen competition for US industries comes from the Far East.

The next challenge from Japan to America's most dynamic economic hand: the computer industry.

A newcomer to the "high-tech belt" of the Boston suburbs, expected early this year, will be Nippon Electric Company, Japan's largest maker of microcomputers—small, personal computers for home and office use.

Other Japanese companies such as Canon, Cassio and Sharp also are expected to enter the US microcomputer market in 1981.

"There will certainly be a major wave of Japanese products" in the next few years, says Sandy Garrett, an analyst of the electronics industry with the investment firms of Paine, Webber, Jackson Curtis in New York.

But he echoes other experts when he says the Japanese are not likely to take over the US microcomputer market—at least as it exists now.

"I think we'll see a strong Japanese impact on a home computer market that hasn't yet developed," says Michael McConnell, vice-president of the Computerland Corporation retail chain. This market would be for a home computer that could be bought like a stereo from a department or specialty store. It would be easy to use, well under $1,000 in price, and easy to repair, upgrade or exchange.

If there is a computer in every home by the year 2000, or even 1990, as some in the computer business envision, that computer is likely to be Japanese. It is in mass production on this scale that the efficient Japanese manufacturers excel, giving them a pricing edge, US analysts say.

As yet, large-scale demand for home microcomputers is still hypothetical. Programs have not been developed to make them simple and useful enough to win a place in American budgets or family rooms on a massive scale.

Although some limited-capacity models sell for less, the "action" in the personal computer market now is in selling $1,000-$5,000 models to small businesses and professional people.

At this level of the microcomputer business, American firms like Tandy (Radio Shack), Commodore International and Apple Computer still hold an advantage: an edge in technology.

"The state-of-the-art equipment is usually American," McConnell notes. Future innovation is expected to keep the Americans at the forefront of the industry, at least through the decade of the 1980s.

But McConnell, whose own stores are "very interested in Japanese products," predicts the Japanese will take around 30 percent of the personal computer market in a few years, but not the 70 percent that some analysts envision.

Eventually, computers that sell for less than $1,000 generally may be made in Asia while the more expensive computers continue to be made in the US, according to Robert F. Wickham, president of Vantage Research, a firm specializing in market research for the microcomputer industry.

Already American firms are manufacturing their own least-expensive models in the Far East. Commodore introduced its first model built in Japan, the VIC-20, last week in Las Vegas. Radio Shack's TRS-80 Color also is made in Japan.

Japanese companies have some obstacles to overcome in selling computers to Americans. They must adapt their hardware to American applications. Japanese programming needs are different, so the machines themselves tend to differ slightly. The Japanese may sidestep this by making American - style computers to suit the American market.

Another obstacle is finding US retailers to sell and service their computers. Japanese manufacturers are likely to try to tie into existing retail networks. For example, office supply stores are expected to start selling personal computers this year. Many buy supplies from Japanese distributors, who may begin to add Japanese computers to their offerings.

An image of quality workmanship may play a role in selling US consumers on Japanese computers. To the general buying public, choosing between otherwise similar computers, the Japanese reputation for quality work may win them sales. According to Wickham, "They'll trade on their quality image."

But some US analysts say this factor is being overplayed. Adam Osborne, an author, industry critic and entrepreneur, says, "In the computer business, what everybody has long forgotten is that adequacy is all that counts."

Aesthetics, Wickham says, also could help the Japanese. Wickham expects that, under European influence, the Japanese may produce a better-looking "whole, human-engineering package" than US companies. This, he says, could be what sells one computer over another.

America's big computer companies are readying for the challenge from the East. This year US manufacturers plan to make strong moves into the personal computer field. IBM, Hewlett-Packard, Xerox and other powerhouses of the US computer industry have reputations for quality themselves and have formidable networks already established for marketing, distribution, and service.

The Christian Science Monitor News Service

CSO: 4120

ECONOMIC

U.S., EUROPEAN COMPUTER FIRMS ACTIVELY SEEK TIE-UP

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 9

[Text]

American and European computer makers and vendors are aggressively approaching Japanese computer builders, seeking the latter's help in the fields of capital and technology.

Mitsubishi Electric Corp. recently revealed it was approached in August, 1980 by Acsys Ltd., a San Jose-based computer company established by Gene M. Amdahl, founder of Amdahl Corp. The California company sought Mitsubishi's capital participation in the new company.

Mitsubishi flatly rejected the offer, said a spokesman of the Tokyo firm. However, Gene Amdahl is expected to visit Japan again this month to meet Mitsubishi officials. He will meet top officials of other Japanese computer builders to sound out whether they are interested in his company's offer.

Burroughs Corp., the world's second largest computer maker only after International Business Machines Corp., has been soliciting Japanese computer makers to join the company's project to produce computer mainframes in Japan. Chairman W. Michael Blumenthal met top executives of Fujitsu Limited, Hitachi, Ltd., Nippon Electric Co. (NEC) and other major Japanese computer makers and proposed the offer late last year, when the former U.S. Treasury secretary made a 10-day visit to Japan. Japanese businessmen reportedly replied that they would make a consideration on the proposal.

These Japanese companies will give their specific answer to the Burroughs' plan this spring when Blumenthal is to call on Tokyo again.

ICL, Britain's largest computer company, reportedly is souding out some Japanese computer makers on their readiness to make a capital participation in it. The British company last year suffered a nearly 50 per cent profit decline and asked British Petroleum and Royal Dutch/Shell to invest in it. However, the two giant oil companies refused the offer.

These American and European computer makers are greatly attracted by their Japanese counterparts' ample funds and high technological standard.

Gene Amdahl knows well Fujitsu's fund-raising capacity and the high quality of Fujitsu computers as Amdahl has been selling Fujitsu models in the U.S. ICL also is well versed in Hitachi's computer technology through its present technology exchange arrangement.

In the case of Burroughs, it has been approaching Japanese computer makers in an attempt to offset its belated start in development of computers which work on Chinese character programming for which demand is expected to snowball in Japan and China.

CSO: 4120

ECONOMIC

JNR TO BID FOR U.S. HIGH SPEED RAILWAY

Tokyo MAINICHI DAILY NEWS in English 13 Feb 81 p 5

[Text]

Japanese National Railways (JNR) will take part in an international bidding for a high speed rail line that California plans between Los Angeles and San Diego.

The 205-kilometer route is expected to be given the highest priority among 13 routes that the U.S. Department of Transportation plans to construct or improve under the passenger railroad rebuilding act of 1980.

Future plans call for the railway to be extended over a total of 1,074 kilometers.

If the JNR bid is successful the program is expected to develop into the largest plan in which Japan has been involved in U.S. high speed railway programs.

Under the circumstances, Industrial Bank of Japan, a main bank for JNR, is expected to give all-out financial help and call on Bechtel Corp., a major U.S. consulting firm, to tie up with JNR.

California has called on over 100 railway and consulting firms in the U.S., Japan, France and West Germany to take part in the international bidding due Friday for Phase I research.

JNR, banking on its already well-known "bullet train" technology, has decided to take part in the bidding from Japan.

The results of the bidding will be made known in late March and at present, French and West German counterparts are expected to be tough competitors for JNR.

National Railroad Passenger Corp. (Amtrak) is operating five or six trains a day between Los Angeles and San Diego now.

Rail use has come up for review in the United States following the energy crisis and the U.S. federal government enacted the passenger railroad rebuilding act last May to promote existing railroads in various parts of the United States.

CSO: 4120

ECONOMIC

MITI GROUP REPORTS N-ENERGY ONLY ALTERNATIVE TO USING OIL

Tokyo JAPAN TIMES in English 4 Feb 81 p 5

[Text] An internal oil study group of the Ministry of International Trade and Industry (MITI) has prepared an interim report which says that atomic energy is the only alternative energy source capable of competing with oil in terms of price for the time being.

The report also stresses the need for Japan to develop technology to crack residue oil because it will have to import more residue oil, such as naphtha and heavy oil, in the future.

It was prepared by the Oil Problem Study Group which has been studying ways to cope with problems concerning demand for and supply of oil in the 1980s.

The group is expected to present a final report on the study by the end of April. The final report will serve as a basis for formulating Japan's basic policy on oil.

The interim report notes that Japan's ability to obtain supplies of crude oil has remarkably increased since the 1973 oil crisis due to increased Japanese economic assistance and vigorous business activities of Japanese trading houses.

However, it points out risks involved in spot-market oil and limited Japanese participation in development of oil resources abroad.

In this connection, it says that Japanese trading houses dealing in crude oil should act with prudence.

As for possible capital participation of oil-producing countries in the downstream sector such as refining of crude oil, the interim report does not rule out the possibility of Japanese oil companies being controlled by oil producers and says that financially weak businesses would be particularly susceptible to such attempts at capital affiliation.

But it says that oil-producing countries are unlikely to seek capital participation in Japanese firms or entrust them with refining crude oil in the immediate future.

Chinese Requests

Japan will accept Chinese requests for a drastic cut in crude oil exports to this country and a small increase in coal shipments, the Ministry of International Trade and Industry (MITI) said Tuesday.

Formal agreement will be made in March or April when representatives of the Long-Term Japan-China Trade Council meet with their Chinese counterparts.

New oil import quotas will be set at 8.3 million tons a year for 1981 and 1982, down from 9.5 million tons in 1981 accorded under the long-term Japan-China trade agreement and 15 million tons in 1982.

New quotas for coking and steaming coal have not yet been decided by the two countries, but MITI officials said the quotas will be increased.

The present agreement set the import quota of coking coal at 1.5 million tons in 1981 and 2 million tons in 1982 and that of steaming coal at 1-1.2 million tons and 1.5-1.7 million tons in corresponding years.

CSO: 4120

ECONOMIC

LPG STOCKPILING BILL TO BE PROPOSED

Tokyo JAPAN TIMES in English 10 Feb 81 p 10

[Text]

The government will shortly propose to the Diet legislation that would require the nation's importers of liquefied petroleum gas (LNG) to build up stockpiles of this energy source starting this year, it was learned Monday.

According to the bill, the LPG stockpile target for fiscal 1981, starting in April, would be 460,000 tons, and the volume would be increased gradually up to 3 million tons in fiscal 1988.

The proposed 1981 target is equivalent to some 15 days of supply of LPG from abroad in terms of 1980 imports, which totaled about 9.67 million tons.

The draft bill to revise the Petroleum Stockpile Law is scheduled to be approved at today's Cabinet meeting and submitted to the current Diet session.

According to government energy officials, LPG stockpiling is needed because of the growing consumption of this type of energy, which was once supplied at low prices as a worthless associate gas produced at oil fields at home and abroad.

LPG is now in wide use both for household and industrial purposes. For instance, some 18 million households in Japan use LPG for cooking or heating, compared with 14 million households using city gas. Also, about 230,000 taxi cabs, or 90 percent of the nation's total, use LPG as fuel.

Along with the growing consumption of LPG, the nation's dependency on foreign LPG suppliers, mostly Middle Eastern oil producers, increased from 52 percent in 1973 to 67 percent last year. The degree of reliance on foreign suppliers is projected to reach close to 90 percent in a decade.

Therefore, any abrupt supply disruptions from foreign sources would critically affect the users of LPG who cannot easily substitute other sources of energy, energy officials said.

The government intends to require the nation's 13 LPG importers to build up stockpiles and plans to offer diverse financial and tax incentives.

Of some 9.67 million tons of LPG imports, the private importers had voluntarily stockpiled 278,000 tons by the end of last year, or a volume equivalent to 10 days' imports.

CSO: 4120

ECONOMIC

SECURING OIL PRODUCTS FROM OVERSEAS WILL BE PROMOTED

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 5

[Text]

The Ministry of International Trade & Industry is changing its long-observed policy of giving weight to refining oil in places near consumer areas to one of not only offering refining-marketing cooperation to the oil-producing nations but eventually liberalizing import of oil products from them.

In other words, this means that Japan is moving out gradually to liberalize its "closed" oil policy along with the growing desire of these nations to shift the stress of their oil exports from crude oil to petroleum products having higher value added.

From around 1979, the oil-producing nations, centering the Organization of Petroleum Exporting Countries, succesively have drafted plans for establishing refineries for turning out petroleum products.

The oil-producing nations hope to reduce crude oil exports in direct proportion to the increased amount of their exports of petroleum products.

If such a situation arises, crude oil supply and demand globally will become tight.

Another troublesome point is that the petroleum products which the oil-producing countries will export will largely comprise fuel oil. This is because fuel oil is not needed by nations whose industrialization still lags.

On the other hand, with the swift pace of modernization in living in these countries, demand for such products as kerosene and light oils sharply is increasing. This means that these items virtually will not become available for export, with danger of the oil-consuming nations encountering a supply shortage as a result.

For preventing such a situation to arise, MITI feels that there is no other way than for the oil-consuming nations to cooperate in matching and enlarging the oil refining and export situation of the oil-producing nations with the global oil demand structure.

As a start, MITI intends to begin offering oil refining-marketing cooperation to the oil-producing countries through the so-called "oilmen center" to be set up from fiscal 1981.

Under this plan, about 60 officials in charge of oil matters or oil technicians will be invited to Japan from the oil-producing countries, and about 30 Japanese oil technicians will be sent to the oil-producing nations, for undertaking practical studies.

The key point of the study-technical cooperation plan will be heavy oil cracking technology. In the case of Japan, it has been undertaking studies for preventing a shortage of kerosene and light oils from fiscal 1979 and hopes to practicalize such research by fiscal 1983.

MITI wishes to introduce this advanced technology also to the oil-producing countries, and have them, with Japanese technological cooperation, install such cracking facilities in building new oil refining plants.

When such technological cooperation produces anticipated results, Japan then intends to liberalize its restrictions on import of petroleum products.

CSO: 4120

ECONOMIC

MITI INTENDS TO LIFT EMBARGO ON EXPORT OF FUEL OIL

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 5

[Text]

The Ministry of International Trade & Industry is allowing exports of C-type fuel oil for the first time in two years in an attempt to help refiners clear their inventories.

Without inventory reduction by, among exports, petroleum companies will have a possible problem with production of other fuels, such as kerosene.

The MITI policy prompted Mobil Sekiyu K.K. to arrange a deal to export 50,000 kiloliters of the product oil to Singapore. Industry sources said that two other export deals have been arranged to export at least 60,000 kiloliters.

MITI said that it will issue export licenses upon their formal applications. The ministry aims at exporting only to alleviate the domestic problems, which made it unclear if Japanese exports of C fuel oil will continue in a long term.

The C-type fuel's inventory rose to 5,070,000 kiloliters as of December, 1980, reflecting cement and steel makers' increasing consumption of coal instead of the product oil and the general industrial slump.

The product's exports were allowed before the second oil supply crisis, with some volumes sold to the Republic of Korea and others. The crisis, however, forced MITI to ban its exports in the past two years.

CSO: 4120

ECONOMIC

USSR AGREES ON LIQUEFYING GAS DEVELOPED In SAKHALIN

Tokyo JAPAN ECONOMIC JOURNAL in English 3 Feb 81 p 6

[Text]

Sakhalin Oil Development Co. has agreed with the Soviet Union to liquefy natural gas off Sakhalin Island for importing an annual volume of 3 million tons, starting in or after 1986. The partner country accepted the Tokyo-based consortium's proposal that the island's gas be liquefied despite huge costs.

For cost reasons, the Soviet Union originally envisaged the gas transport by pipeline from Sakhalin to Hokkaido Island via Soya Strait. But Japanese studies indicated potential users in Hokkaido cannot consume 5 billion cubic meters of natural gas (equivalent to 3.5 million tons of liquefied natural gas) annually, as proposed by the Soviet.

The LNG plant construction alone will cost an estimated ¥100 billion. The total cost is expected to rise to about ¥1 trillion, including the liquefaction facilities, pipeline spanning 700 kilometers from northeast section of Sakhalin (which is close to the offshore gas reserve) to the island's southwest section), LNG tankers and the fuel receiving facilities.

Following the basic liquefaction agreement, the two sides will start a working committee to develop detail plans, such as plant site selection and transport route. The LNG supply will start in or after 1986, compared to the original Soviet proposal to start natural gas supply in 1985.

The consortium's liquefaction announcement followed two parallel meetings in Tokyo of both top level executives and expert groups.

CSO: 4120

ECONOMIC

TANAKA TAKES HARD LINE ON COAL PROJECT

Tokyo MAINICHI DAILY NEWS in English 13 Feb 81 p 5

[Text]

Rokusuke Tanaka, minister of international trade and industry, said Thursday that if the United States government decides to cancel all of a planned appropriation for a U.S.-Japan-West Germany coal liquefaction project, a strong protest would be filed with Washington.

Tanaka was replying to a question asked by a Japan Socialist Party member at the House of Councillors' Budget Committee meeting about reports that the U.S. government would cancel a planned appropriation for the project to build an SRC (Solvent Refined Coal) demonstration plant in the U.S. jointly with the Japanese and West German governments.

The minister said if Washington actually cancels all of the planned appropriation for the project as reported, it would cause a hitch in Japan's overall energy supply-demand plan.

The U.S. government had promised to bear half the cost of constructing a $1.4 billion SRC II demonstration plant, with the balance divided equally by the Japanese and German governments.

Foreign Minister Masayoshi Ito said the U.S. State Department has not yet decided to reduce its appropriation for the project to nil.

CSO: 4120

ECONOMIC

STEEL CORPORATION SUBMITS BID TO EXPORT ARMS

Tokyo ASAHI EVENING NEWS in English 7 Feb 81 p 1

[Text] The Japan Steel Works, Ltd., the sole supplier of heavy firearms for the Self-Defense Forces, submitted cost estimates on semi-finished howitzer barrels for export to South Korea to an Osaka firm in 1976, the Asahi Shimbun has learned.

JSW and the Ministry of International Trade and Industry have admitted that the estimates were submitted.

JSW had earlier denied it after Junya Yano, secretary-general of the Clean Government Party (Komeito), had brought up the matter in the Lower House Budget Committee on Feb. 4.

The semi-finished howitzer barrels were to be part of the arms parts which Hotta Hagane Co., a specialty steel export firm of Osaka, exported to Daihan Heavy Industries, a South Korean machinery and arms manufacturer, from 1976 to 1979.

As JSW's cost estimates were 50-60 percent higher than the prices other Japanese special steel makers offered, no deal was made. But the Opposition parties contend that the very fact that cost estimates were made on arms parts for export contravened the spirit of the three principles banning arms exports. Thus, a heated debate was expected in the Lower House Budget Committee Friday.

The Asahi Shimbun found out that JSW received an inquiry from Hotta Hagane on Jan. 9, 1976, and submitted the cost estimates on Jan. 16. The inquiry concerned semi-finished barrels for 105-mm and 155-mm howitzers.

The inquiry was accompanied by a request that the arms parts in question were to be produced in accordance with the U.S. military specifications.

Finding the JSW cost estimates too high, Hotta Hagane secured the goods from two other manufacturers, Sanyo Specialty Steel of Himeji City, Hyogo Prefecture, and Kanto Specialty Steel of Fujisawa City, Kanagawa Prefecture.

The Asahi Shimbun also learned that Daihan Heavy Industries made a direct inquiry to JSW in 1977 about comprehensive technical aid on the production of specialty steel, presumably including material for arms, and JSW may have submitted cost estimates.

The value of a contract on such aid would have amounted to several hundred millions of yen. But Daihan reportedly found the JSW cost estimates too high, and no deal was made again.

JSW says the direct inquiry followed repeated Daihan requests for the company to export semi-finished gun barrels, which JSW consistently turned down by citing the constitutional constraints.

JSW says a wholesale internal inquiry has turned up the draft of the cost estimates on semi-finished howitzer barrels in the firm's Muroran plant in Hokkaido.

CSO: 4120

ECONOMIC.

STEEL CORPORATION EXPORTED ARMS TECHNOLOGY TO U K.

Tokyo ASAHI EVENING NEWS in English 17 Feb 81 p 1

[Text]

The Japan Steel Works, Ltd., the only licensed cannon manufacturer in Japan, exported technology on the production of parts for the nation's most advanced tank under a technical tie-up formed with Vickers, a British arms maker, in 1975, a Clean Government Party (Komeito) Dietman alleged Monday.

Koichi Sakai told a session of the Lower House Budget Committee that the technology in question is still used for manufacturing British tanks.

The legislator charged that the technology was exported before the Government imposed legal controls on arms production technology in 1978, but that its export still contravenes the three principles banning arms exports.

According to Sakai's allegation, JSW entered into a technical tie-up with Vickers on the 105-mm rifle gun for the 74 tank, Japan's most advanced tank, in August, 1975. On the basis of the partnership, it exported production technology on such parts as the gun barrel support and the device for absorbing firing shocks, he said.

Responding to the lawmaker's questions, officials of the Ministry of International Trade and Industry and the Defense Agency disclosed that JSW signed a license production contract with the British Defense Ministry in May, 1975, with governmental approval. But they added that they had not been informed of the alleged technical tie-up with Vickers and export of production technology on tank parts.

Prime Minister Zenko Suzuki told Sakai that the Government would decide what to do after an inquiry into his allegation.

Minister of International Trade and Industry Rokusuke Tanaka made it clear that Japan would not enter into the joint development of arms with any foreign country.

The 105-mm rifle gun is widely used for the tanks of NATO countries, such as the British Centurion tank and the American M60 tank.

CSO: 4120

ECONOMIC

DOMESTIC PLANE INDUSTRY TO RECEIVE STIMULUS

Tokyo MAINICHI DAILY NEWS in English 13 Feb 81 p 5

[Text]

Japan's efforts to develop its own military airplanes will speed up the independence of the nation's aircraft industry, which is now in an infant stage, industrial planners say.

Sources at the Ministry of International Trade and Industry (MITI) said the industry should aim to stand on its own feet during the 1990s, taking on more domestic planning and building of military planes.

Technological spillovers from such businesses are significant, and will help the industry to become competitive on the global market, the sources added.

It is expected that the domestic production of a new jet trainer, dubbed MTX, will be the first step towards MITI's goal.

In addition, the ministry will ask the Defense Agency to entrust the development of a jumbo military transport aircraft to the domestic industry.

Under the DA's medium-term defense buildup program ending in 1984, the government last year decided to buy a total of 12 U.S.-made wide-body transport aircraft, the C130s.

On the other hand, MITI Minister Rokusuke Tanaka has proposed that Japan launch efforts for a domestically designed transport plane to cope with the projected rising need in the years ahead.

The MTX project will be the first domestic aircraft in the military field in 10 years. The DA has also opted to build a support combat fighter, the F1, with Japan's own technology.

Up to now, the Japanese aircraft makers have contented themselves with undertaking assembly of Japan's mainstay fighters under license contract with the U.S. manufacturers. They are to construct the F15 Eagle, a next-generation jet fighter.

They have never come across a business chance to use their own technology for commercial aircraft since marketing the YS11 in 1963.

Because of business risks far beyond the capacity of a company or country, they are now teaming up with foreign makers to develop next-generation passenger aircraft, the YX and the XX.

The planned MTX, with Japan-made twin engines and a sonic speed of 0.9, will succeed current models, the T1 and T33. The DA hopes the research stage for the new trainer will start this year, and its deployment will finally total 200 eight years from now.

It is estimated that the MTX project will cost 230 to 290 billion yen.

CSO: 4120

SCIENCE AND TECHNOLOGY

COORDINATION OF SCIENCE, TECHNOLOGY WILL BE STRESSED

Tokyo JAPAN ECONOMIC JOURNAL in English 20, 27 Jan- 3 Feb 81

[20 Jan 81 p 13]

[Text] Japan is heavily pinching its budget, but liberally spending on scientific and technological studies, from April 1.

The Government of Prime Minister Zenko Sukuki will start a long-range national budget retrenchment drive of almost unprecedented severity. For all that, the Government, in compiling the fiscal 1981 national budget, gave exceptional priority treatment to the scientific and technological expenditures, chiefly to five branches — the Prime Minister's Office's Science & Technology Agency, the Ministry of International Trade & Industry's Agency of Industrial Science & Technology, the Ministry of Education, the Ministry of Agriculture, Forestry and Fisheries, and the Ministry of Health and Welfare.

Obviously, a "sense of crisis" of sort had spread over the political, administrative and academic communities that Japan could hardly attain an adequate economic and industrial redevelopment in this difficult decade without its best possible scientific and technological development exertions.

That is why the Government has decided such an unusually liberal permission on scientific and technological expenditures.

Here is a general picture of such liberal scientific and technological appropriations.

Science & Technology Agency

The agency's estimate items given special appropriations on top of the regular ones are:

1) Creation of a "Science and Technology Promotion Coordination Expenditure," for which ¥3 billion-plus was permitted. Intended for effectively coordinating and propelling science and technology promotion activities bureaucratically scattered among many governmental branches, the special item was recognized on condition that the appropriation concerned be used only after consultations with the Council for Science & Technology.

Granting of the special appropriation, to be continued for many years, will redevelop the council's role from its past overall policy consultant service aloof from details into a more closely and carefully concerned screening type of functions, besides intensifying the agency's power.

Prime Minister Suzuki seems to have taken notice of an interim study report saying "Science and technology will be the supporting pillars of Japan's future" that was filed with him last year-end by a liaison council among eight cabinet ministers administratively concerned with science and technology.

Under this special appropriation, a "Creative Science Promotion System," also known as a "Flowing Research System" will be created to encourage the interchange of knowledge and information among researchers of different governmental branches, and also industrial and academic researchers, chiefly to reform the traditional bureaucratic ills of vertical sectionalism against inter-ministerial or agency cooperation and of efficiency-disregarding, no retirement age service practice for governmental scientists and researchers. The basic idea is to intensively promote, within a given time limit of three to five years, "budding" (inceptional) studies really promising to be the main supports of Japan's future industrial technology.

2) Development of Japan's own H-1 series of rockets fueled by liquid hydrogen and oxidized in fuel combustion by liquid oxygen as the carrier of Japan's major application satellites to be orbited during a 10-year period starting in 1985;

3) Development of Japan's own earth resources survey satellite series; and

4) Building of a P-4 Facility, a high-degree safety gene engineering research center.

[27 Jan 81 p 16]

[Text]

Agency of Industrial Science & Technology

Similar special appropriations were given for such estimate items as:

1) Institution of a "Next Generation Industrial Foundation (Building) Technological Development System" applicable to all industries.

The system, requiring ¥120 billion of governmental investments over a 10-year period and allowed a first year appropriation of ¥2,714 million, divided into:

A) Development of four new innovational kinds of industrial materials: i) Fine ceramics made of abundant natural earthen and other materials of silicon, nitrogen, carbon and bauxite types to supersede metals, alloys and hard plastics as extremely heat, pressure and abrasion resistant new materials; ii) High-function, high-polymer materials to innovate industrial processes and save energy, like high-efficiency substance-separation membranes, electrically conductive highly-crystalline, and highly-reactive high polymers; iii) New metallic materials like a high-efficiency crystallization-controlled type of alloy featuring great heat resistance and workability, and a high-efficiency titanium alloy of extremely light weight but great strength; iv) new compound materials combining some plastic and some intensifier to meet pioneering technological needs.

B) Development of new kinds of biotechnology, such as by new challenges to break through difficulties in industrial attempts to utilize biological reactions, massively culture cells, recombine genes, and fuse cells, for application of the results to the chemical, food, pharmaceutical and fermentation industries.

C) Development of new function electronic elements, such as a biological detector element to probe into the mysteries of living things; a super-atomic grid element with an ultra-fine structure of the angrstrom class; and a three-dimensional circuit element as a new environmental effect-resistant element usable against intense radiation, cosmic rays and other special environmental factors by piling up conventional horizontal types of circuits.

2) Two new annual large-scale nationally important technological development projects, instead of only one usually allowed per year, to be subsidized by the agency (or to be specially financed by the agency in the form of a governmental project). One of the new projects is to develop a new ocean bottom manganese nodule resources exploration software-hardware system (for which ¥50 million was appropriated in the first year of the seven-year ¥22 billion project). The other project, to which ¥30 million was allocated, is to develop a super-speed computer system for special scientific and technological purposes, such as processing artificial satellite-telemetered photographic images and nuclear fusion reactor simulation testing results.

The new computer development project, to last eight years and cost a total of ¥31 billion, will be launched at the beginning of 1982 when the present large-scale project to develop a new effective method to produce olefins out of heavy types of crude oil is scheduled to be completed.

Furthermore, much more approprations than in the past were allowed for the existing new non-oil energy develop-

ment and oil energy conservation projects, that is, MITI's fiscal 1974-2000 Sunshine Project and MITI's accompanying fiscal 1978-2000 Moonlight Project.

The fiscal 1981 appropriations of the kind included ¥3.5 billion for brown coal liquefaction process development, ¥1.8 billion, ¥400 million, and ¥2 billion respectively for the solvent liquefaction, Solvolysis, and direct hydrogenation coal liquefying method developments, ¥4.3 billion for solar-cell light-to-electric power conversion, ¥440 million and ¥500 million respectively for hydrogen and wind-power electric power generations, ¥160 million (plus ¥80 million from a special account) for fuel cell development; ¥5.9 billion for high-efficiency gas turbine electric power generation, a project which has already progressed to a 10,000-kw pilot plant construction stage, and ¥2.7 billion for methanol-utilizing electric power plant development.

[3 Feb 81 p 13]

[Text]

Education Ministry

An initial ¥500 million annual appropriation was granted to a ¥75 billion project to build a giant elementary particle acclerator, Tristan (short for a "transporsable ring intersecting storage accelerator in Nippon), at the high energy physics research institute in the research and academic city of Tsukuba.

It will be the world's fourth largest of the kind after three precedents of the U.S., the Soviet Union, and West Europe (CERN or Centre Europeen de Recherches Nucleaires).

Ministry of Agriculture, Forestry & Fisheries

A first annual ¥24 million appropriation was permitted on a seven-year (fiscal 1981-1987) project for effective biological resources utilization technology developments (popularly known as a "Biomass Conversion" project).

Unlike MITI's biotechnology project, this project is a multi-purpose type closely connected with regional economic benefits and will be regionally self-sufficient in character for obtaining not just energy but foodstuffs, livestock feeds, and other useful matters by conversion of biological resources of all sorts.

During the first year, poplar, eucalyptus, and other plants easy for conversion of their substances into fuel oil will be studied in full scale as to how to raise them efficiently. Also to be studied in full are various methods to mass-cultivate a highly proteinous species of plant growing in the wild in Okinawa and a similar highly protein-yielding waterweed species growing on the water surface, and various edible kelp species.

Studies will be simultaneously launched on processes to turn such plant substances into foods or livestock feeds, such as to directly derive leaf protein (chlorophyl protein) from such plants or to produce fermentation proteins by culturing yeast, hay fever bacteria and lichen (filamentous fungi) in saccharized solutions of lumber and rice plant husks or

food processing factory drains.

Discovery of highly-active microorganisms and development of a good oxygen fixing and a membrane treating method will be essential for such studies. So will be regional economic feasibility surveys as well as development of efficient conversion hardware.

Also granted were a ¥957 million appropriation for an oil and electric energy-saving "Green Energy (Farming) Project," and a ¥283 million one for a "Marine Ranching Project" to create undersea plant and animal raising centers. Also permitted was the creation of a first publicly-open national study institute, "Agricultural Research Center."

Health & Welfare Ministry

Appropriated to this Ministry for scientific and research purposes was a total of ¥14,629 million, 10.4 per cent up from the current fiscal 1980.

The researches roughly divide into: A) Studies on circulatory diseases; B) Subsidized studies on cancer; C) Studies on cerebroneurological diseases; D) Studies on officially-listed special diseases (now hard-to-cure or unidentified ones); E) Studies on mental physical handicaps; and F) Studies on health and welfare sciences.

The cerebroneurological study appropriation is conspicuous for its annual increase of 29 per cent. This is because of greater attention paid to muscular dystrophy, mental retardation, and other cerebroneurological troubles in marking the current United Nations International Year of the Handicapped.

CSO: 4120

SCIENCE AND TECHNOLOGY

GOVERNMENT AND PRIVATE RESEARCH, DEVELOPMENT SPENDING ROSE IN FY '79

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text]

Japan's Governmental and private research and development investments during fiscal 1979 (ended March 1980) picked up sharply to approach an official target of 2.5 per cent of the gross national product, it was recently disclosed by the Government's Science and Technology Agency.

According to the Agency, Japan's fiscal 1979 GNP reached ¥177,997.8 billion, a moderate 6.75 per cent up in nominal terms from the preceding fiscal year.

In contrast, the nation's fiscal 1979 research and development investments picked up by a marked 14.3 per cent in nominal terms to attain ¥4,080.1 billion.

That meant an equivalent of 2.29 per cent of GNP attained after four years of growth lag — 2.13 per cent in fiscal 1975, 2.12 both in fiscal 1976 and 1977, and 2.14 in fiscal 1978. The Agency officially reported the findings to the Cabinet.

The Agency believed growth in private spending had accounted for the resurgence.

The Prime Minister's Office broke down the fiscal 1979 total into 27.6 per cent in national and local governmental investments and 72.3 per cent in private investments, with the latter increasing 0.4 percentage point from fiscal 1978.

In May 1977, the Prime Minister's Council for Science and Technology, recommending a basic national policy for long-range national scientific and technology development, set the 2.5 per cent immediate target and a preferable distant target of 3 per cent. At that time, Japan's 2.12 per cent ratio had been problematical under its national policy to re-orient industries into technology, compared with the equivalents of 2.62 per cent for West Germany, 2.52 for the U.S. and 4.49 for the Soviet Union..

CSO: 4120

SCIENCE AND TECHNOLOGY

RELIABILITY DESIGNING OF AUTOMATONS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 pp 11-14

[Article by Yoshimitsu Ito]

[Text]

A number of reference books on reliability have been published. Most of them are based on probability or statistical approaches, which are quite unfamiliar to mechanical designing engineers, most of whom have been trained primarily in mechanical component designing.

On opening several reference books entitled mechanical designing, on the other hand, one will probably find that primarily they deal with calculations about mechanical components. Although calculations are much related with reliability, values in calculations are all taken as determined values in idealized conditions, but hardly as probability densities. The word reliability is certainly mentioned, but only in a daily sense, not at all in a statistical or probability sense. The only exception is the calculations for the lifetime of ball bearings which are dealt with from the point of view of statistics and probability, but no sufficient basic ideas are given.

It is known that quality control (including reliability) is given insufficient consideration in design shops. Assurance of quality of products starts with design. However, designers often do not seem to make much effort to become familiar with the conditions of products and parts in production processes or in service.

This weak point seems to arise largely from training in designing. As described earlier, conventional designing (engineering) reviews machines in idealized conditions and recognizes realities to be away from an ideal state. Reliability designing takes up realities (which vary as time goes on) and tries to enable given functions to work satisfactorily under such conditions.

Now that I have given a rather long preliminary, in this article, I intend to explain approaches which are easy to carry out, by anyone who has been trained in the conventional methods of designing but wishes to attempt reliability designing.

1. What Is Reliability Designing?

The term "reliability" can to some extent be understood by using common sense. Here, those who wish to try reliability designing have to know the term reliability and related terms more correctly.

JIS explains that reliability is "the degree or characteristics which represent consistent stability of systems, equipment and parts".

To allow automatons to continue automatic operation properly without failures for long periods requires sufficient control including adjustments and repairs for wear, fatigue, plastic deformation and corrosion.

In order therefore to ensure reliability or maintain certainty, it is necessary in designing to take into account ease of maintenance. Maintenance designing aims at structures which facilitate detection, inspection and repair when machines and parts are faulty or in periodical control including lubrication.

In general, faults in machines show a pattern as illustrated in Fig.1. Faults appearing in initial periods include defects in materials, defects caused in the course of manufacture and in compatibility with environment. Once ironed out, defects will

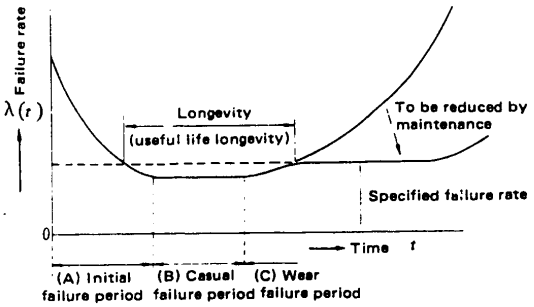


Fig. 1. Failure Rate Curve for Typical Equipment Failure

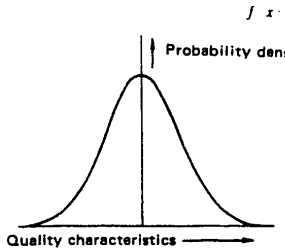


Fig. 2. Normal Distribution

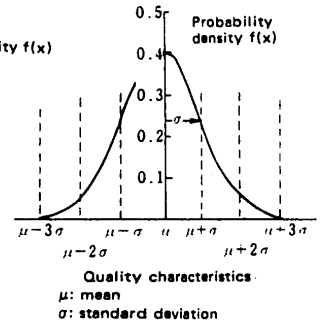


Fig. 3. Means and Standard Deviation of Normal Distribution

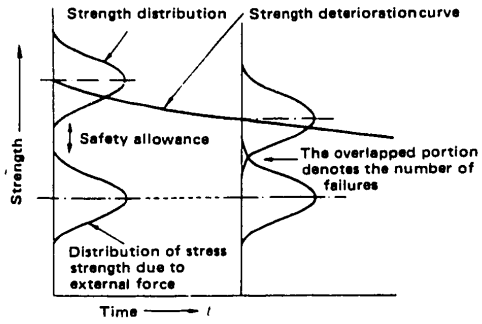


Fig. 4. Safety Model

rapidly decrease. Other trouble resulting from wear, indicates that machines and parts have reached a useful life and can be avoided only by replacing worn parts or taking other necessary measures. Hence, reliability designing has to find out how to extend durability periods.

Measures of reliability are the level of reliability, which is measured by probability. From a practical viewpoint, however, it is better to take them in terms of faults (defects) per unit of time.

In the period of casual trouble ((B) in Fig.1), faults except for those caused by external factors, originate in the quality of designing. Proper designing and proper handling will hardly result in any trouble.

In this period, however, data in maintenance shops shows that troubles occur in almost all mechanical components such as shafts and gears. They are to a considerable extent caused by improper designing.

There were designers who claimed that because they had done calculations of strength, they had made no errors in designing. They ignored the fact that in the conventional concept of safety factors, there are possibilities of different levels of reliability resulting from the same safety factors.

In general, values in design calculation should be taken as probability variables. In other words, quality characteristics of mechanical parts and loads delineate a curve (a proper distribution) as shown in Fig.2. In quality control, the curve is provided with graduations as shown in Fig.3 and is used as the 3α method and the basis for control charts. The probability of deviation from $\pm 3\delta$ is 0.0027=0.3%.

Relations between strength, safety factors and time are plotted on the basis of the above idea in Fig.4. The Figure indicates that although safety is ensured in mean values, it never is when dispersion is taken into account.

As explained briefly above, reliability designing includes statistical processing, which requires substantial data. For automatic machines for single-product production, however, data is hard to obtain in situations outside experiments.

2. Approaches to Reliability Designing in Automatic Machines

It has been common recognition that mechanical components from proper designing will be stable for considerable periods. However, this is not always true when automatic machines are required to be high-speed (or high-output) types, as proved by maintenance data described in the previous chapter.

It is imperative to earnestly and immediately tackle reliability from the angle of mechanical designing, though very few design shops seem to do it. However, system engineering (statistical) approaches given in study books for reliability designing seem to be somewhat unfamiliar to those who have been trained in conventional mechanical component designing and application of statistical designing in automatic machines requires much experiment because such machines are not products for mass production. So, let us review another approach.

An example of the procedures is given below.

(i) Classification and Clarification of Causes for Failures (All anticipated are to be picked up and classified.)

Causes for mechanical failures are mainly familiar ones such as wear, deflection, deformation, fatigue, corrosion and thermal deformation. The point is by what kind of energy and in what conditions such causes appear in the parts concerned. The lives of the parts depend on the causes for deterioration.

For direct causes for failures in shafts, for example, the maintenance data mentioned above lists the following: improper fitting, improper keying, use of shafts of bent materials (drawing specified toothbrush sticks – long ones may be bent), wrong materials, insufficient strength, insufficient rigidity, poor shapes and structures (such as stress concentration) and fatigue.

(ii) Calculations for Parts Concerned

Calculations of strength and rigidity are generally essential. Calculations of inertia and acceleration of moving parts have to be carried out in detail.

Practical calculations involve a number of misleading factors such as the selection of allowable stresses and determination of loads. For these, values for a few (usually 3) cases should be obtained instead of obtaining single values and final selection and determination should be made by reviewing interrelations between parts when dimensions are determined.

Assumed, selected and determined values should be all recorded.

(iii) Absorption of Maintenance Data

If maintenance data is to be collected, it is almost impossible to obtain data in relation between makers and users of automatic machines. However, that is not always impossible if it is considered in relation to services.

Minimum requirements for maintenance data are as follows:

a) Duration of decreased functions (e.g., dimensional accuracy

Table 1. Reliability Parts List

Drawing No.	Name	Sketch	Calculated value	Failure intervals (data)	Failure conditions	Remedy	Remarks

failed to meet specifications after so and so days and returned to normal by adjusting such and such), methods of processing and periods of maintenance, etc.

b) Intervals between failures, troubled points, phenomena, presumed as causes, remedies, maintenance time, service conditions, etc.

(iv) Preparation of Lists of Above 3 Items

The lists should be as shown in Table 1 and in it data at designing stages should be written each time it is obtained and maintenance data should be written when it has been collected.

Various initial troubles occur during test runs before acceptance. During this period, designers have a chance to attend and so they have to do their best to attend and obtain such data. Not only obtaining data but also recording it in lists will enable prompt measures to be taken for initial troubles.

(V) Criteria for Determining Values

When a number of check lists have been collected, data on similar parts should be reviewed for each item. This will reveal that standards determined for allowable stress or tolerances may be incorrect or too large (or too small) and this empirical review will enable standard values to be determined.

(vi) Operational Efficiency and Reliability of Automatic Machines

The mechanical sections of automatic machines often consist of a series system. Trouble at a point in it will stop the entire system. A review of operational efficiency replaced with reliability will find that reliability for the whole is very low because it is the product of multiplication of reliability factors for component sections. With a combination of a unit like a cam which has relatively high reliability and a unit like a parts feeder which has relatively low reliability (certainty), a technique of wait redundancy (switchover) is adopted on the side with low reliability (for a parts feeder, e.g., feeding via a work pool).

(vii) Carrying out Principles for Increasing Reliability

Principles here mean nothing but what anyone knows in his

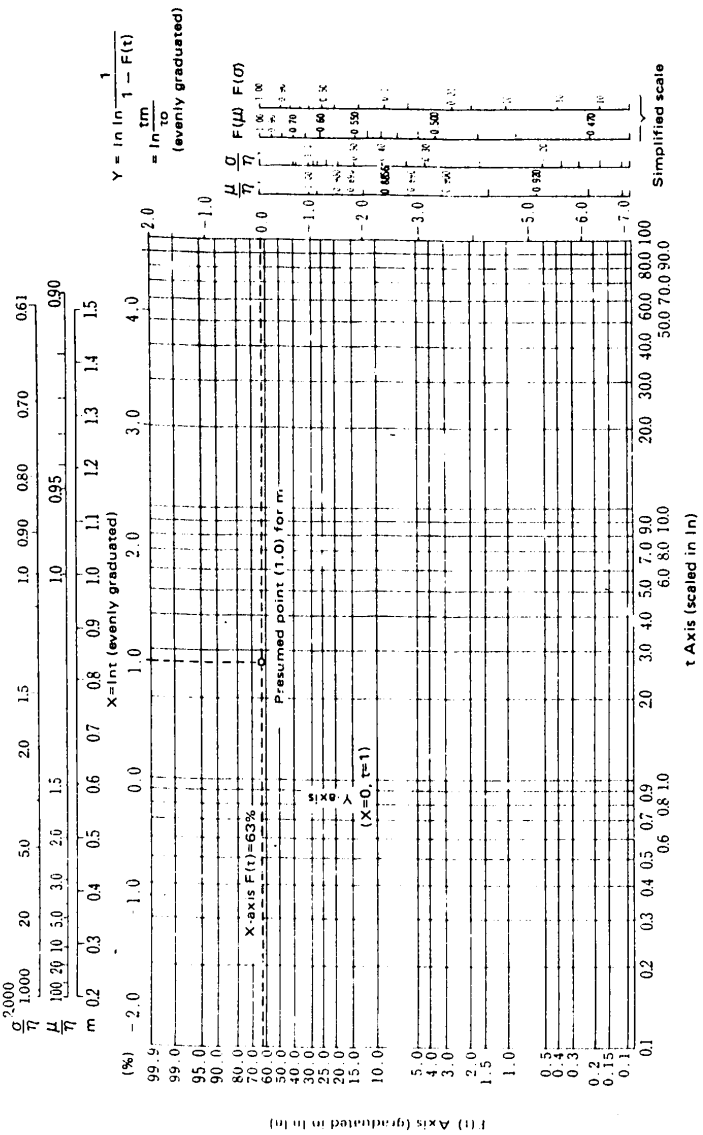


Fig. 5. Japan Technology Federation's Probability

common sense. The point is to carry them out without fail. They include: a) theoretical designing (selection of materials, calculations for estimation of loads, etc.), b) ease of manufacturing processes (failures often originate from poor machining and assembly resulting from infeasibility of designs), c) running in (to discover misses and collect data), d) protection from external disturbance, e) spares for low-reliability parts, f) if possible, automatic correction systems, and g) simplification of systems.

The above is a brief description of part of a little experience I had in several designing shops. A considerable advance can be made by carrying out the above items. However, it requires statistical methods to make further advance. For fatigue parts, because of breakages often involved, the S-N curves for lifetime calculations are in practice out of theory. With a considerable number of parts collected, lifetimes can be calculated by obtaining the time of operation before failures or, if the number of failure is known, can be calculated from the Japan Technology Federation's probability (see Fig.5). Use is found in most reference books.

Also, for units like parts feeders, estimates of makers can be found by work and reliability can be easily obtained by measurement.

Finally, I recommend designers to determine everything numerically or quantitatively by doing calculations, not to determine qualitatively.

CSO: 4120

SCIENCE AND TECHNOLOGY

EFFORTS TO INCREASE OPERATIONAL EFFICIENCY OF AUTOMATIC ASSEMBLERS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 pp 15-19

[Article by Masafumi Bito and Yoshikatsu Miyashita]

[Text]

1. Acceptable-Product Producting Operational Efficiency

Since it is the probability of enabling equipment to be properly operative when necessary, operational efficiency is represented by the ratio of operative time to service time of a machine. Therefore, operational efficiency can be increased by increasing the operative time in this ratio.

However, if efforts to increase efficiency by increasing operative time while reducing repairing time result in an increase in unacceptable products, it invites a counter-effect, involving increased manhours and waste of raw materials.

While defining the improvement of operational efficiency as the probability of enabling acceptable products to be produced when so desired, let us seek a way to increase acceptable-product producing operational efficiency (hereinafter called efficiency). This problem can be illustrated as shown in Fig. 1.

2. To Improve Efficiency

The improvement of efficiency cannot simply be determined by the quality of the equipment but largely depends on 3 factors: parts,

equipment and maintenance. From the point of view of designing and manufacturing automatic assemblers, discussions will be as follows:

2-1. Parts

(1) First, parts have to be designed suitably for automatic assembly. A variety of problems are taken up from such details as detection of heads and tails or fronts and backs, and standards for assemblers to variations in parts features and response to variations. So, it is necessary to avoid situations of reliability tests for parts having ended and restrictions by the lead time of product development starting by the time personnel for planning automatic assemblers meet parts for assembling.

(2) The point to be taken into account about parts at the time of designing automatic assemblers is similar but different parts. Aside from supplying parts to a nearby wrong line, it should be noted that parts are different in nature between makers who supply parts and that they are also slightly different due to difference between molds etc. Consideration of how to absorb such differences by preliminarily knowing them will play a large part in preventing assemblers from showing unexplainable decreases in operativity efficiency after they start operation.

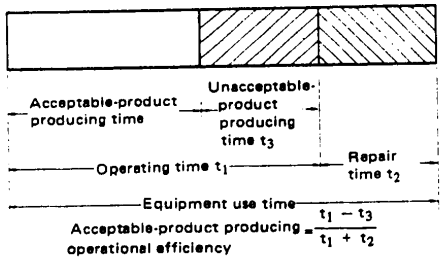


Fig. 1. Illustration of Operational Efficiency

2-2. When Equipment Is Planned and Designed

(1) A sequence of stopping the system upon occurrence of unacceptable products detected by checking assembly quality in individual processes should be included in basic plans. Some high-speed assemblers are designed to reject unacceptable products or continue operation while tagging such products. These systems should be applied to highly advanced assemblers with low probability of producing unacceptable products. In the initial planning, the system should be designed to stop upon any unusual occurrence of a defective product and resume operation after removing the causes for the trouble and taking measures to prevent its recurrence. This is expected to reduce sufficiently the duration in which defective products are produced to make up for initial downtime.

For this purpose, consideration should be given to listing troubles in as much detail as possible.

(2) The system should be designed to consist of easily detachable sections in the event of trouble. There will be no problem if an automatic assembler, upon trouble, is designed to have assembling continued manually. On the contrary, if an automatic assembler has stations which require large amounts of force, as in pressure fitting, beyond manual work, in addition to sections such as for parts feeding in which mechanical work can be replaced by manual work, failures in parts feeding only in such stations will inevitably bring the entire system to a halt.

The efficiency of the entire system can be maintained by separating parts feeders and their controls from the main system and supplementing workers.

(3) Simple mechanisms, highly reliable machine parts and accessibility for maintenance are necessary. Needless to say, it is important to make existing trouble clear to anyone and use mechanical parts which are unlikely to cause trouble. Also, parts easily available (such as those of simple structure, and parts purchased and held in stock) in the event of trouble, as well as mechanical structures which permit easy replacement indicate, in a sense, high reliability.

2-3. At the Time of Manufacturing

Adequate running tests and observations have to be made to try to reduce trouble arising after starting operation. Because of limitations to lead time and the quantity of test pieces, 1/100 of real operation is too much for test conditions to simulate. Thus, the best care should be taken in observation.

Experience thus far tells that unexplainable trouble which occurs even once in test runs will certainly occur again in practical operation. It is only a matter of course on the part of users that defects which were not detected at the time of manufacture should be discovered in the initial stages of operation

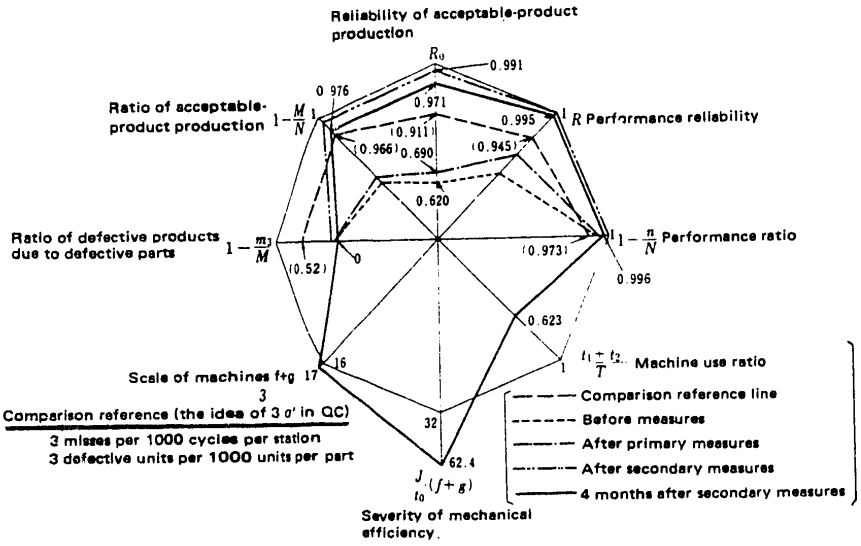


Fig. 2. Assessment Graph

with measures completed for it. This is also important from the point of view of efficiency on the part of manufacturers.

Also for equipment which was complete when it started operation, it is possible to maintain its high operativity efficiency by sufficiently conveying the philosophy of plans for and designs of the equipment to maintenance and service divisions.

The following is an example of improvement of efficiency of an automatic assembling through surveys and measures during initial running-in periods.

3. An Example of Efforts to Increase Operational Efficiency

3-1. Assessment of Operation

Efficient promotion of efforts at improvement requires correct survey of data and analysis. Also, data has to be analyzed to properly direct improvement, leading to the assessment of efficiency of the entire machine.

The assessment graph given in Fig.2 shows the mechanical power of the equipment outline described later and represents the process of increasing efficiency by the effects of the measures taken.

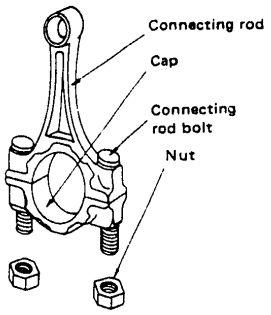
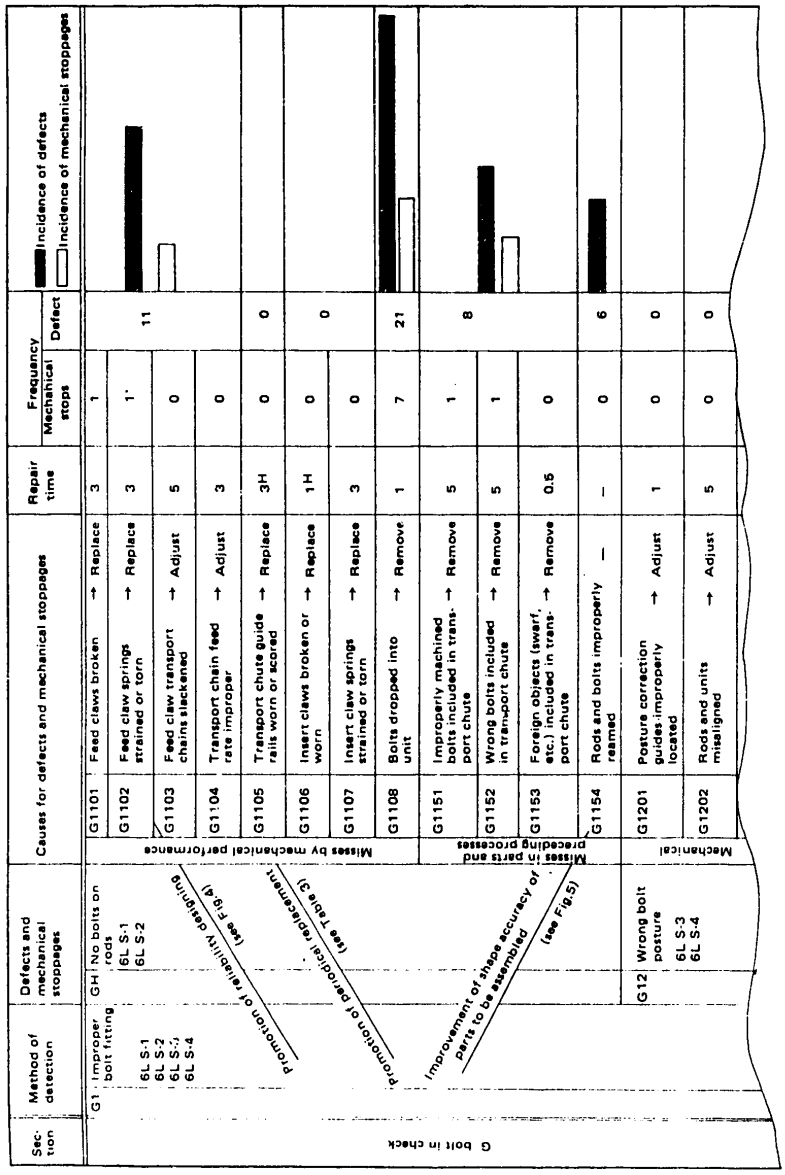


Fig. 3. Connecting Rod x Cap Products

Table 1. Analysis Sheet for Mechanical Stoppages and Defects



(Outline of Assembler)
Machine type: Full-automatic in-line Tr. machine
Work details: Connecting rod x cap x bolt fitting
Number of stations: 16
Number of parts to be assembled: 6 (see Fig. 3)

A review of reliability R_0 for acceptable-product production (=efficiency) indicates the necessity of measures because the primary measures before action are far below the reference line as a guide. An examination revealed that most of the problems in measures were about designing or unfamiliarity of maintenance personnel with the machine. So, in the secondary measures, including the intention of overcoming failures in the primary measures, efforts were made at the following 3:

(1) promotion of reliability designing
(2) improvement of accuracy of parts to be assembled.
(3) proper maintenance and use

Consequently, the secondary measures were very effective. The system has been operating very stably for 4 months after the measures showing high operational efficiency.

3-2. Details of Efforts

In order to carry out efforts at efficient improvement, it is necessary to know items of measures and their effects on efficiency. Table 1 and Fig.4 show techniques for this purpose.

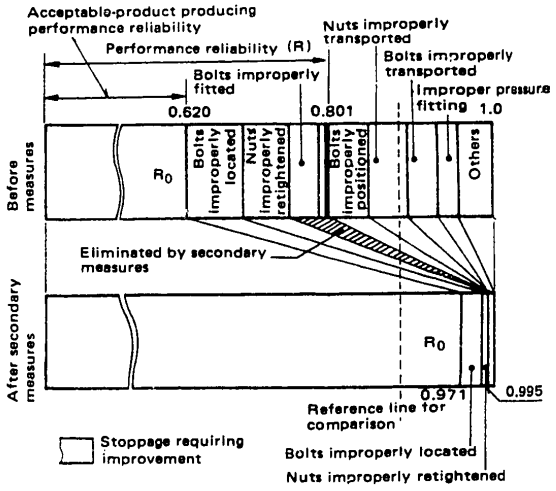


Fig. 4. Effect Level Analysis Pallet Chart

Table 2. Daily Check Sheet (for Different Machines)

Reference drawing	No.	Check point	Check item	Checking		Frequency	Method	Instrument	Criterion	Measures	Remarks	Personnel
				During operation	During downtime							
1 – 1	1	Transfer finger	Stop position		○	Daily	Visual	–	Acceptable if it stops at the station C	Adjust location of the coupling	–	M.
	2	Transfer bar	Irregularity (of motion)	○		Weekly	〃	–	Acceptable if not visually recognised	Replace the cam followers	–	I.
〃		〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃

Table 3. List of Periodical Replacement (Quarterly, Bi-Yearly and Monthly)

Parts for quarterly replacement							
No.	Name of parts / Part product No.	Quantity	Material	Location of use	Reference drawing	Remarks
1	Work infeed pin / D-36	2	S45C	St.1 Work feeder head pin	4-1	
2	Positioning socket / JH-125	2	SCr22	St.7 and 8 Bolt head positioning	4-3	

An analysis sheet as shown in Table 1 for types of mechanical stops and defective products was prepared by observation of mechanical actions and was summarized as an effect level analysis pallet diagram as shown in Fig.4. Using these, items of measures were determined from both aspects: costs and technical problems and promoted with emphasis laid on important items.

In promoting reliability designing, efforts are being made to review structures and functions of troubled sections, rigidity (including shapes, materials and thermal treatment) of parts and ease of maintenance and strongly promote improvements of existing machines under limited conditions while properly carrying out follow-ups for feedback to the subsequent machines.

Decrease in shape accuracy of parts to be assembled, which presented no problem in manual assembly, will greatly affect the efficiency of assembling systems in automatic assembly. Adequate consideration has to be given to frequent machine stops due to this. Thus, measures after adequate review of the preceding processes are essential.

Furthermore, efforts were also made to promote proper maintenance and use. Assembling systems in the initial periods of operation generally have relatively high efficiency. In order to keep this high consistent for long periods, it is necessary for the maintenance and operation divisions to familiarize themselves with the machines and promote proper maintenance and promote proper maintenance and operation. The efforts in this example were made to promote 3 items: daily inspection, periodical replacement and personnel training.

Table 2 shows a list of check items to promote daily inspection. Table 3 shows a list of periodical replacement to ensure operational st. bility of the machines by periodically replacing worn and troubled parts.

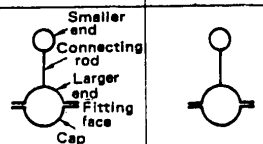
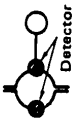
st. No.	St.1	St.2	St.3
Name	Work feed	Idler	Work in check
Illustration of operation			
Operation drawing	Transferring connecting rod and cap from transport conveyor to machine		Detection of connecting rod and cap
Related drawing	Section 325 45 work transferer		Section 325 39 Section 325 45
Remarks			

Fig. 5. Illustration of Operation for Stations

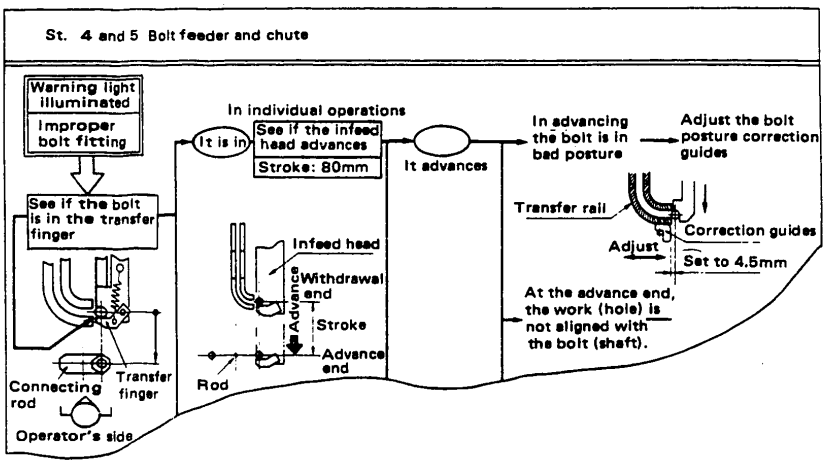


Fig. 6. Repair Sheet for Failures

Furthermore, in order to improve the skills of maintenance personnel and mechanics, and reduce repairs, improper assembly and wrong inspection, performance illustrations for different stations and repair guidance sheets for trouble types as shown in Figs.5 and 6 have been prepared to be used as materials for training.

Fig.7 shows the chart of the improvement effort system in this example. In this improvement effort, not only the planning, the designing and the manufacturing divisions but also the maintenance and the operational divisions cooperated to increase operational efficiency and finally successfully achieved a large increase in it.

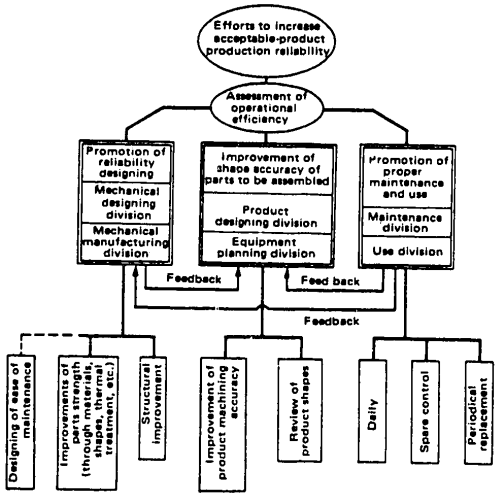


Fig. 7. Improvement Effort System

CSO: 4120

SCIENCE AND TECHNOLOGY

THERMAL SPRAYING TECHNOLOGY REPORTED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 pp 20-34

[Article by Motoji Seki, president, Tokyo Metalikon Co., Ltd., and Kazuo Ishikawa, general manager, Technical Div., technical engineer, Tokyo Metalikon Co., Ltd.]

[Text]

1. Introduction

Thermal metallic spraying, invented by Dr. M.U. Schoop in 1908, was first introduced into Japan in 1921. This implies that Japanese industries have a 60-year experience in its use. Its application started with industrial art works and architectural decorations, and continued for some decades, primarily, in the anticorrosion treatment of iron and steel articles. In the 1950's, such thermal spraying techniques as plasma spraying and explosion spraying appeared, enabling a variety of substrates to be coated with, not only metallic, but also ceramic and cermet, simple or compound substances, to produce new characteristics. Thus, thermal spraying has grown to be important in modern industry, widening its application to functional parts for single or compound purposes, such as prevention of corrosion and wear, thermal resistance and electrical insulation. We can cite as proof: thermal zinc spraying (JIS H8300, H9300), thermal aluminum spraying (JIS H8301, H9301), thermal rebuilding spraying (JIS H8302, H8664) and self-fluxing alloy spraying (JIS H8303, H8665) all of which are established JIS codes, and to these recently has been added thermal ceramic spraying (JIS H8304, H8666). This article outlines the developments and current trends of thermal spraying technology in Japan.

2. Developments

Thermal metallic spraying is a method of coating an object with metallic or non-metallic materials deposited in a molten or semi-molten state by thermally spraying these materials as atomized particles, onto the object. In Japan, thermal metallic spraying was formerly called metalikon, and this

is currently used in names of companies, for example. The term "metalikon" was established by Kenjiro Ezawa who combined the English word "metallic" with the Latin word "kon" (disguise). In early days, the spray systems used were mainly AC arc type for processing room ornaments, clock cases, ceramics and architectural ornaments. A typical example was thermal spraying applied to the silver, tin and bronze works of Fumio Asakura, a noted sculptor. The satin surfaces, as a result of spray coatings, were highly appreciated, as they provided new textures otherwise unobtainable. Other noted examples were sprayed articles exhibited at a Peace Memorial Fair in Tokyo and at an Invention Exhibition, winning grand prizes, and silver-sprayed vases, works of Kozan Miyakawa, which were bought by Her Majesty the Empress. Also, architectural ornaments made by bronze spraying, and coloring cast iron, were displayed at department stores such as Mitsukoshi and Matsuzakaya.[1)]

Thermal spraying for anticorrosion purposes, was first applied, around 1928, to water tanks for bath which were, zinc sprayed both inside and outside, for delivery to the Imperial Household Agency. Subsequently, army gasoline tank lorries and underground tanks were zinc sprayed internally or tin sprayed after an undercoat of sprayed zinc.

Until around 1937, there were only a few thermal spraying companies because "metalikon" was a process patented by its introducer Kenjiro Ezawa. Until the end of the war in 1945, in the business there were about 8 spray shops and 6 companies doing their own spray work. Following the war, as there were no articles to be sprayed, the spray shops decreased to about 4. Business gradually began to recover around 1948, when orders came for items requiring overall zinc spraying, parts for boats which the US Navy received under the agreement on repatriations. Subsequently, government and public organizations, such as the Japan National Railways and the Ministry of Construction, adopted zinc spraying as anticorrosion measures for water tanks, under the floors and on the roofs of railway coaches, tank lorries and sewage carriers. This established the application of zinc spraying in anticorrosion treatment and helped increase the number of spray shops to more than 10.

In 1963, a complex anticorrosion system, a combination of zinc spraying and painting for the purpose of long-term anticorrosion was first adopted in Japan, and used for the Double-Arch Bridge to the Imperial Palace (the front iron bridge). Also, the system has been applied to parts of the Kanmon Bridge linking Honshu and Kyushu, the world's 9th longest, completed in 1973. The bridge linking Honshu and Shikoku, also has been partially treated. Later, these applications will be described in detail.

Thermal spraying was then applied in the repair of mechanical parts around 1955, primarily in rebuilding worn automobile parts such as crankshafts. Subsequently, the value of sprayed

Table 1. Characteristics of Thermal Spraying Methods

Types of thermal spraying	Wire spraying	Powder spraying	Electric arc	Plasma spraying	Detonation	Wire explosion	Thermo spraying fused
Heat source	Oxygen: acetylene / Oxygen: propane (flame)	Oxygen: acetylene / Oxygen: hydrogen / Oxygen: propane (flame)	Arc	Nitrogen: hydrogen / Argon: helium / Argon: hydrogen (plasma flame)	Energy from explosion of oxygen: acetylene	Discharge	Oxygen: acetylene / Oxygen: hydrogen (flame)
Spray materials	Steels such as carbon steel and stainless steel, non-ferrous metals such as molybdenum, nickel and copper and their alloys	Most metallic and resin systems such as nylon and epoxy	Steels such as carbon steel and stainless steel, non-ferrous metals such as molybdenum, nickel and copper and their alloys	Most metal materials, high-melting-point oxides and carbides and a few organic materials	Most metallic materials and high-melting-point oxides and carbides	Most metallic materials	Self-fluxing alloys such as Ni-Cr-B-Si, Co-Ni-Cr-B-Si and Ni-B-Si
Shape of spray material	Wire, rod	Powder	Wire	Powder	Powder	Wire	Powder or cord
Spray material	Almost all metal materials, glass, ceramics, carbon and a few organic materials with some exceptions				Almost all metal materials	Almost all metal materials	
Substrate temperature during spraying	Controlled to below 200°C						Approx. 1,050°C
Adhesion kg/cm²	980N/Cm²	686N/cm²	980N/cm²	1,470N/cm²	1,666N/cm²	1,960N/cm²	34,300N/cm²
Porosity factor %	5~20	10~20	5~15	3~15	Below 3	0.1~1.0	0
Recommended thickness	0.3~1.0	0.2~1.0	0.1~3.0	0.05~0.5	0.05~0.1	Below 0.1	0.5~2.0
Features Features	In site application available	Suited to plastic spraying	Thicker coatings available	High-melting-point materials can be sprayed	Sprayed objects limited (ϕ5—700xabout 2,600)	Internal spraying allowed	Deformation caused by thermal stress

coatings, increasingly were better recognized, with application of coatings widening for protection against heat corrosion. At the same time, agencies of foreign spray equipment manufacturers opened in Japan, importing good spray systems and materials. Thus, thermal spray technology was founded for development. Meanwhile, the number of spray shops increased to about 80 and companies doing their own spray work numbered about 200 including most leading companies.

Studies on thermal spraying as the foundation for these developments were initiated in 1935 by Dr. Takeshi Takei, honorary professor at Keio University, the late Masayoshi Tagaya, honorary professor at Osaka University, who were succeeded by Dr. Hideo Nagasaka, professor at Ibaragi University (and a member of the standing committee of the International Thermal Spraying Conference), Dr. Yoshibumi Mima, professor at Osaka Industrial University and Dr. Shigeteru Isa, professor at Steel College. They included basic studies of the phenomena of thermal spraying, involving not only metals but also plastics, and valuable studies of application of sprayed coatings to parts of electronic equipment. For plasma spraying, Atsushi Hasui, professor at Keio University (formerly at the National Research Institute for Metals and Technology), Shigeru Kitahara, chief of staff at the National Research Institute for Metals, et al. have, since around 1958, conducted basic studies and application studies of various aspects, ranging from plasma sprays to the phenomena of spraying, and properties of sprayed coatings. Moreover a number of scientists, including Dr. Sosuke Uchida, professor at Tokai University, and numerous industrial researchers and engineers have pursued a variety of studies of thermal spraying.[2)-12)]

Meanwhile, the Japan Thermal Spraying Society was established in 1957 and has since been conducting regularly, biannual lectures and reports on various studies. In particular, the development in 1962, of a wire explosion spray,[13)] devised by Dr. Toshiro Suhara, professor at Kyushu University, et al. attracted worldwide attention. In 1976, Tateno et al. of the staff at the Plasma Physics Division of the Institute of Physical and Chemical Research, applied oxygen plasma systems to thermal spraying. These active studies were motivated by information from reports and discussions at international thermal spraying conferences held every 3 years.

Recently, thermal spraying is increasingly receiving more interest and is being studied actively by government and public organizations, and industrial laboratories, and efforts are being made to make use of emittance properties of sprayed coatings for energy saving. Better materials for spraying are already being produced domestically. Table 1 summarizes the types and properties of methods of thermal spraying being applied in Japan.

3. Application of Thermal Spraying to Anticorrosion and Rust Prevention

Although visited by four seasons, surrounded by the sea and blessed with untold scenic beauty, Japan has one of the hardest environments from the viewpoint of the prevention of steel structures from corrosion and rusting.

When applying to Japan, data from the British Ministry of Industries, that iron, equivalent to 3.5% of GNP is lost annually by corrosion, we find that losses by rusting for 1978 amount to approximately ¥7,000 billion. For example, in 1976, the national budget for painting and repairs of bridges alone was about ¥2.3 billion, about ¥5.0 billion in 1977, about ¥7.0 billion in 1978 and about ¥10.0 billion in 1979, really enormous sums. In order to reduce as much as possible these huge costs, efforts are being made to develop technologies for making maintenance-free bridges. One of them is related to steel materials such as weatherproof steel. Another is related to the improvement and development of suitable paints. On the other hand, one of the method of surface treatment which is attracting much attention, is a double anticorrosion system using complex coatings of a combination of thermal spraying and painting. A few weather exposure tests and practical applications will be described below.

3.1. Weathering Exposure Tests

3.1.1. Weathering Tests at the Japan Weathering Test Center[14]

Weathering tests were commissioned in 1972 by the Agency of Industrial Science and Technology to be conducted by a foundation, the Japan Weathering Test Center. Test items included metallic coatings, the results of which will be outlined below.

The weathering tests were conducted at the Japan Weathering Test Center located in the suburbs of Choshi, Chiba Pref. The period of exposure to weather was 3 years. Test samples consisted of SS41 steel (≒ AISI 1020) plates which were thoroughly steel grit blasted, sprayed with zinc, aluminum, zinc-aluminum alloy and then coated variously. Table 2 shows outlines of their preparation.

The tests used a weatherability test, a sunshine carbon arc method and a salt spray testing method. Scratched plates were included in the weatherability test samples. The items consisted mainly of appearance and adhesion between metal coatings and paint coatings.

Test results showed that samples undercoated by metallic thermal spraying had good appearance involving no rust or blisters. Most of the scratched samples also showed good weatherability. Table 3 shows an outline of the test results. It seems particularly noticeable that samples sprayed with a

zinc-aluminum alloy were stable without any defects, even when they are combined with various paint systems having room-temperature drying. For paint systems, phenol M10 was more stable than epoxy, chlorinated rubber and vinyl chloride systems, proving paint systems already in use in long seaside bridges at home and abroad.

3.1.2. Weathering Tests in the Kanto District[15]

Another weathering test has been maintained since 1968 by our laboratory, under the guidance of Prof. Hideo Nagesaka of Ibaraki University in four sections of the Kanto District: a rural atmosphere (Hiratsuka, Kanagawa), a sub-industrial atmosphere (Ota-ku, Tokyo), a coastal heavy industrial atmosphere (Kawasaki) and a marine atmosphere (Itsuura, Ibaraki). Test results over 9 years will be described below. The tests can be characterized by test samples consisting of large 2kg plates and channel plates, a single coat of a cheap wash primer (a zinc chromate system) for base coating and a single coat of a phthalic-acid resin system for top coating. Metals used for undercoating spraying were zinc, aluminum and a 70% zinc –30% aluminum alloy with coat thicknesses: 0.05, 0.1 and 0.15mm respectively. Test results are outlined below.

(1) Complex anticorrosion treatment consisting of metallic spraying and painting on steel objects is effective.

(2) Painting with a cheap phthalic-acid resin system will become effective with the use of metallic spraying as an undercoating.

(3) Samples undercoated with a zinc-aluminum alloy proved effective in coastal and coastal heavy industrial atmospheres.

Fig. 1 shows examples of the test results.

3.1.3. Weatherability Test of Complex Anticorrosion Coatings in Cold Areas[16]

A weatherability test has been maintained since 1975 by our laboratory (under the guidance of Dr. Yoshiharu Kitamura of Hokkaido Engineering University) in Sapporo, Hokkaido. A freezing-defrosting test and a low-temperature impact test, which have been reviewed together with the weathering test, will be outlined below.

(1) Weathering Test

Test samples consisted of 200X100X3.2(t) mm plates. Their types and numbers are given in Tables 4 and 5 together with the paint systems used. Exposure to weather took place at our company (Ota-ku, Tokyo) for comparison with Hokkaido Engineering University (Sapporo). Appearances after the test showed no signs of rusting but a trace of discoloring. We consider that there is little difference between the two districts but will continue to follow progress in the future.

(2) Freezing-Defrosting Test

Test samples consisted of 80X65X3.2mm(t) plates of the same types as in Section (1). The test method was as follows: Samples, placed in a steel plate case were immersed in the brine tank of the test system and a freezing-defrosting cycle between $-18^{\circ}C$ and $+5^{\circ}C$ was repeated 150 times. A room temperature test was also conducted using the same samples to inspect appearance and adhesion. Table 6 shows results of a grid adhesion test. These results indicate that paint system 1 results in extensive separation with any of the variously coated samples, while samples under coated with a zinc rich paint result in heavy separation with any of the paint systems.

(3) Low-Temperature Impact Test

Test samples were the same as in Section (2). The test method was as follows. Samples were kept at $-28^{\circ}C$ and then kept at room temperature. Then, they were subjected to impact test A of the standard painting test JIS K5400. Results were evaluated by appearance. No samples showed any cracks or separation.

The above are a few examples of weathering tests. In addition, weathering tests are also being conducted by government and public laboratories such as the Anticorrosion Division of the National Research Institute for Metals and companies such as Mitsui Mining and Smelting Co., Ltd.

3.2 Practical Applications of Double Anticorrosion Using Complex Coatings Formed by Thermal Spraying and Painting

3.2.1. Front Imperial Bridge

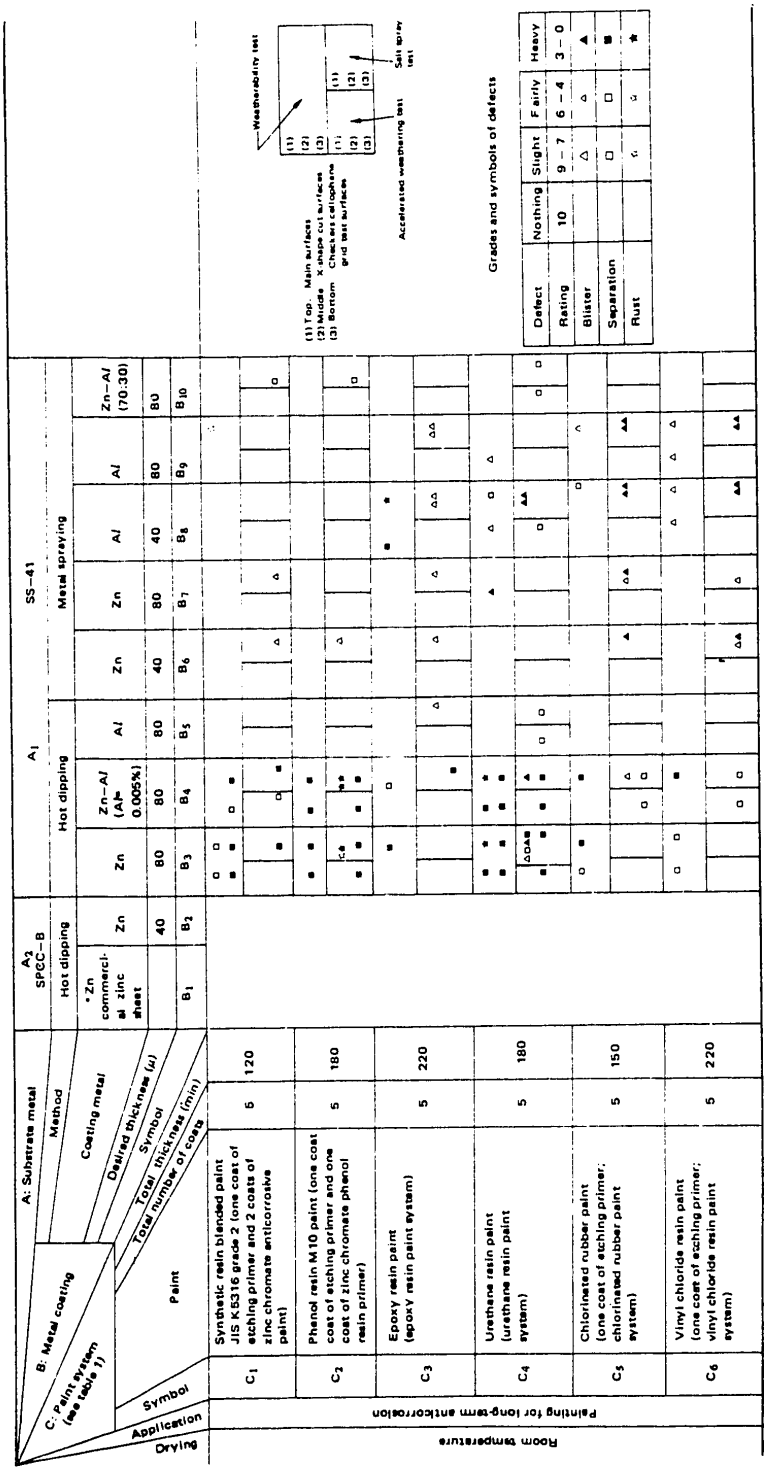
The front bridge to the Imperial Palace originated as a wooden arch bridge (31.7m long and 8.9m wide) having beautiful bronze ornamental tops of railing and, which was made in the Edo Period. This was replaced in 1888 by an iron bridge made by a German company, Harcourt Aktien Gesellschaft (Duisberg). Despite its 50 year guarantee, this bridge suffered increasingly from traffic loads and a corrosive environment. Thus, it was replaced by the present steel bridge in 1964. The steel bridge consists of 2-hinge arches 10m wide, 255m long and having a 24.44m span, and is located about 100m away from the stone bridge, seen from the imperial front plaza. It has a construction consisting of 5 parallel I-cross section main girder arches provided with horizontal girders. Although in appearance, it looks very like the former bridge, it was carefully designed on the basis of the latest theory. Particular attention was given to environmental, affects thus, to anticorrosion treatment, and an innovative method for a bridge of those days was adopted, i.e., zinc spraying was applied as an under coating. Table 7 shows the major specifications.

Table 2. Test Samples for Metal Coatings

A: Substrate metal	SS – 41					Coating specifications																Application
B Metal coating: Method of coating	Metal spraying					Primary			Secondary			Third			Fouth			Fifth			Total thickness (min)	
Coating metal	Zn	Zn	Al	Al	Zn I Al																	
Desired coat thickness	40	80	40	80	80	Paint	Thickness (μ)	Quantity (g/cm²)	Paing	Thickness (μ)	Quantity (g/cm²)	Paint	Thickness (μ)	Quantity (g/cm²)	Paint	Thickness (μ)	Quantity (g/cm²)	Paint	Thickness (μ)	Quantity (g/cm²)		
C Paint system / Drying: Symbol	B6	B7	B8	B9	B10																	
Room temperature drying: C1	○	○	○	○	○	JIS K5633 etching primer grade 1	10>	60 130	JIS K5627 zinc chromate anti-corrosive paint grads 2	35	140	JIS K5616 synthetic resin blended paint grade 2 for finish coating	35	140	JIS K5616 synthetic resin blended paint grade 2 for finish coating	30	120	JIS K5616 synthetic resin blended paint grade 2 for finish coating	25	110	120	Coating for long-term anticorrosion
C2	○	○	○	○	○	JIS K5633 etching primer grade 1	10>		Phenol resin zinc chromate primer	35	150	Phenol resin M10 paint	50 ~ 60	270	Phenol resin M10 paint	50 ~ 60	270	Phenol resin M10 paint	50 ~ 60	270	180	
C3	○	○	○	○	○	Epoxy resin primer mist coat	10>		Epoxy resin paint primer	60 ~ 80		Epoxy resin paint primer	60 ~ 80		Epoxy resin paint for intermediate coating	30 ~ 50		Epoxy resin paint for finish coating	30 ~ 50		220	
C4	○	○	○	○	○	Epoxy resin primer mist coat	10>		Urethane resin paint primer	50 ~ 70		Urethane resin paint primer	50 ~ 70		Urethane resin paint for intermediate coating	30		Urethane resin paint for finish coating	30		180	
C5	○	○	○	○	○	JIS K5633 etching primer grade 1	10>		Chlorinated rubber paint primer	40 ~ 60		Chlorinated rubber paint primer	40 ~ 60		Chlorinated rubber paint for intermediate coating	30		Chlorinated rubber paint for finish coating	25		150	
C6	○	○	○	○	○	JIS K5633 etching primer grade 1	10>		High-build coating vinyl resin paint primer	80 ~ 100		Hihg-build coating vinyl resin paint primer	80 ~ 100		Vinyl resin paint for intermediate coating	40		Vinyl resin paint for finish coating	20		220	

Note: From data from the Weathering Test Center

Table 3. Summarized Results of Metal Coating Tests



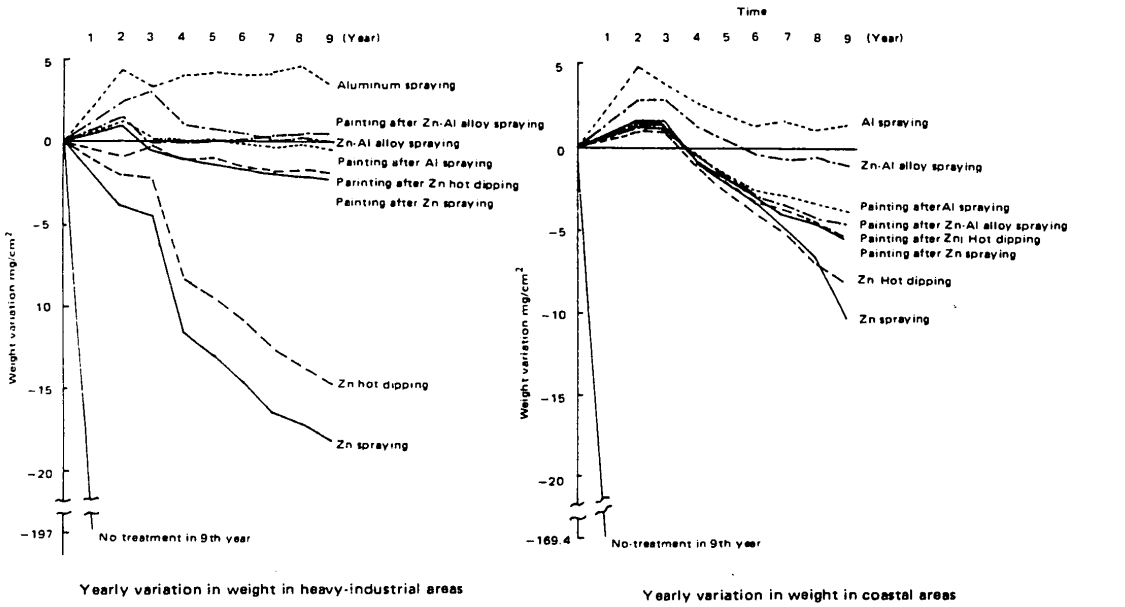


Fig. 1. Examples of Weathering Test Results

Table 4. Types and Quantities of Test Samples

Surface treatment / Base treatment	Blast only	Spray-ing only	Paint system 1	2	3	4	5
Blasting	3						
Zn spraying		3	3	3	3	3	3
Al spraying		3	3	3	3	3	3
70Zn–30Al spraying		3	3	3	3	3	3
85Zn-15Al spraying		3	3	3	3	3	3
Zinc rich paint coating			3	3	3	3	3
Subtotal	3	12	15	15	15	15	15
Total							90

Notes: (1) Figures in the table are those for roof weathering tests and defrosting tests at Hokkaido Engineering University
(2) For figures for roof weathering test at Tokyo Metalikon, two samples for each type given in the table were used.
(3) For low-temperatures impact tests, 5 samples were used for thermal spraying only and for zinc rich paint coating only
(4) Metal sprayed coatings are 100μ thick and dried zinc rich paint coatings 75μ thick.

Table 5. Types of Paint Systems and Requirements of Painting

		Type of paint	Number of coats	Quantity/coat (g/m^2)
Paint system	1	Etching primer (JIS K5633 Type 1)	1	100
		Zinc chromate primer	1	130
		Phthalic acid enamel	2	120
	2	Etching primer (JIS K5633 Type 1)	1	100
		Phenol zinc chromate primer	1	130
		Phenol M10	1	180
		Chlorinated rubber paint	2	160
	3	Etching primer (JIS K5633 Type 1)	1	100
		Epoxy base coat	2	230
		Polyurethane (MW)	2	180
	4	Etching primer (JIS K5633 Type 1)	1	100
		Vinyl chloride base coat	3	170
		Vinyl chloride enamel	2	150
	5	Etching primer (JIS K5633 Type 1)	1	100
		Chlorinated rubber paint (undercoat)	2	250
		Chlorinated rubber paint (finish coat)	2	150

Table 6. Results of Grid Adhesion Test

Sample coding	Number of remaining measures (mean)		Sample coding	Number of remaining measures (mean)	
	Room temperature	Defrosting		Room temperature	Defrosting
Z -1~3	○	○	ZAP2-1~3	○	○
A -1~3	○	○	ZAP3-1~3	○	○
ZA -1~3	○	○	ZAP4-1~3	○	○
ZL -1~3	○	○	ZAP5-1~3	24 24 25	○
ZP1 -1~3	16 17 16	13 21 25	ZLP1-1~3	21 19 21	21 23 23
ZP2 -1~3	○	○	ZLP2-1~3	○	○
ZP3 -1~3	○	○	ZLP3-1~3	○	○
ZP4 -1~3	○	○	ZLP4-1~3	○	○
ZP5 -1~3	○	25 24 25	ZLP5-1~3	○	25 25 18
AP1 -1~3	24 19 24	24 22 25	HP1 -3~3	10 6 6	3 9 18
AP2 -1~3	○	○	HP2 -1~3	24 25 25	○
AP3 -1~3	○	○	HP3 -1~3	24 16 13	4 6 5
AP4 -1~3	○	○	HP4 -1~3	22 23 19	24 18 24
AP5 -1~3	○	○	HP5 -1~3	25 24 25	22 21 25
ZAP1-1~3	18 19 17	22 10 17			

Notes: (1) The number of remaining measures (mean) denotes the mean of three measurements for each sample, 25 remaining measures indicates non-separation.
(2) ○ Mark denotes 25 25 25, indicating non-separation for individual samples.
(3) Sample coding means the following:

Code	Base treatment	Parinting
Z	Zn spraying	No painting
A	Al spraying	No painting
ZA	70Zn–30 Al spraying	No painting
ZL	85Zn–15 Al spraying	No painting
ZP1	Zn spraying	Paint system 1
AP2	Al spraying	Paint system 2
ZAP3	70Zn–30 Al spraying	Paint system 3
ZLP4	85Zn–15 Al spraying	Paint system 4
HP5	Zinc rich paint painting	Paint system 5

A survey was conducted of the bridge for resistance to corrosion, 12 years after erection. The following are the results.[17]

(1) Surveyor: Japan Association of Steel Bridge Painting Contractors, Yokogawa Bridge Works Ltd., Thermal Spraying Laboratory of Tokyo Metalikon Co.

(2) Survey Date: October, 1976

(3) Survey Methods: Visual (direct and using a telescope), for blisters, separations and rust.

Table 7. Specifications of Anticorrosion Treatment of Front Bridge

	Process	Treatment	Remarks
Shop processing	Substrate preparation	Steel grit blasting (#40 : #60 = 3 : 7)	
	Base treatment	Zinc spraying	100μ
	Pretreatment	Surfaces to be sprayed are cleaned with thinner and wiped with a clean cloth before ensuring processes.	
	Primer, single	Etching primer	0.08 ~ 0.10kg/m^2
	Base coating, single	Calcium plumbate anticorrosive paint	0.14 ~ 0.16kg/m^2
In situ processing	In site painting	After erection, bolts, scratches, etc., are cleaned carefully before entering into the subsequent process.	
	Base coating, single	Calcium plumbate anticorrosive paint	0.14 ~ 0.16kg/m^2
	Intermediate coating, single	Phthalic acid resin paint specified colour	0.11 ~ 0.13kg/m^2
	Finish coating, single	Phthalic acid rein paint specified colour	0.10 ~ 0.12kg/m^2

(4) Environment

The bridge is located in an urban area about 300m away from major roads and 4km away from the sea. Thus, it is subjected fairly extensively to exhaust gasses from automobiles (which also it is presumed, the reason for corrosion in the bronze lights sited on the sides of the bridge). It can also be subjected to salt particles from the sea with winds of particular direction and velocity. Also, it is subjected to humid conditions because it is over a moat. Thus, such corrosive factors can be cited as sunshine (ultraviolet rays), moisture, exhaust gasses (such as sulfur dioxide) and small quantities of marine salt.

(5) Results

Photo 1 shows the central section and under members of the front iron bridge surveyed.

Appearance of Coatings: Although top coatings are locally separated, primer is completely set, showing no signs of rusting. The plaza in front of the Palace is swarming with pigeons, for which the bridge proves a good resthouse because of its structure and location. Naturally, while vertical edges remain almost flawless, the horizontal edges which are easy for pigeons to roost are seen to be scaling and rusting. This is probably because their coatings have been damaged and contaminated by pigeons roosting on them over a long period.

The above is an outline of the survey's results. Although studies on paints on sprayed coatings were insufficient at the time of erection, and there arose the unexpected effects of contamination by pigeons, it has proved that double anticorrosion using zinc spraying as an under coating was sufficiently effective in view of long-term anticorrosion.

3.2.2. Kanmon Bridge

The Kanmon Bridge is located on the main trunk line connecting Shimonoseki of Japans' main island of Honshu to Moji of Kyushu, the southernmost island. The total length is about 1068m, with the central span about 712m, a side span about 178m and towers about 140m high. At the time of erection, it was the 9th largest suspension bridge in the world. Its construction cost the gigantic sum of about ¥30 billion. The most up-to-date Japanese technology for its construction was invested in its structure and construction systems. As the site is subjected to severe atmospheric conditions and environ-

Table 8. Part of Specifications for Anticorrosion of Kanmon Bridge

Process			Paint and treatment	Thickness (μ)	Painting interval
Shop painting	Iron works	1	Hot rolled steel sheet shot blast S15. Sa—2.5 or over	—	
		2	Inorganic zinc rich primer (Kanpe-ferrodor ZE No.2527 primer)	15 (mean)	
		3	Product grit blast S15. Sa—3	—	
		4	Zinc spraying	75 (min)	Less than 2 hours Less than 2 hours
		5	Etching primer (Kanpe-ferrodor eprimer)	10	Over 2 hours Less than 12 hours
		6	Phenol resin zinc chromate primer (Kanpe-ferrodor M-608 primer)	40	Over 12 hours Less than 3 days
		7	Phenol resin M10 paint (Kanpe-ferrodor F-29)	60	Over 16 hours
		8	Phenol resin M10 paint (Kanpe-ferrodor F-29)	60	
In site painting		9	Chlorinated rubber intermediate painting (rubber marine intermediate coat)		
		10	Chlorinated rubber funish coat (rubber marine top coat 5GY 7/1.5)		

mentally, to smoke from neighboring factory areas containing sulfur dioxide and salt particles from the sea, double anticorrosion, consisting of zinc spraying and painting, which had proved effective for the Forth Road Bridge and Sevan Bridge in England was adopted. It was applied mainly to the reinforcing girders covering about 110,000m^2.

The bridge was constructed under the following conditions: (1) All processes from preparation (including blast cleaning) of members to second and finish coatings were carried out consistently in shops. In particular, processes up to phenol zinc primer were dealt with indoors. (2) Thermal spraying was all performed with temperature over 10°C and humidity below 75%, as measured indoors. (3) Zinc spraying was completed within 2 hours of blasting and first primer within 2 hours of zinc spraying. Table 8 shows parts of the coating specifications.

A survey of corrosion of the bridge was conducted 5 years after erection by the Thermal Spraying Study Group of our company (under the guidance of Hideo Nagasaka, professor of Ibaragi University.

Its summary will be quoted below.[18]

(1) Date of Survey: July 20, 1978

(2) Methods of Survey: Visual appearance inspection, particularly of the "undersides of girders"

(3) Environment: It was reported that the bridge was contaminated by marine salt particles as anticipated from the results[19] of analysis of deposits on beam members and unexpected heavy sulfides, the levels of contamination being comparable with those in high-contamination areas along highways in factory zones.

Photo 2 shows a full view of the base structure of the Kanmon Bridge surveyed.

(4) Survey Results

The survey revealed that the double anticorrosion system generally remained in good conditions despite the corrosive

environment, except for some defective parts. The defects included blisters and separations of coatings, mostly found in overlapped parts of members at certain intervals. They may be caused by moisture permeability of coatings[20)21)] and harmful substances such as marine salt particles deposited between shop base coating and in situ top coating. The most prominent rusting was found at in situ painted heads of bolts and nuts, which is a problem to be solved.

Separately, on a different bridge, a double anticorrosion system consisting of zinc spraying and a non-bleed tar epoxy coating (330g/m^{2}N2) was applied to rails and fixtures for inspection cars on the upper structures of the OMISHIMA bridge linking Honshu and Shikoku, erected in 1978, and which is winning favorable reputation. Recently, steel structures with double anticorrosion specifications are increasing in government and public circles, such as the Ministry of Construction and Telegraph and Telephone Public Corporation.

Let us add a special material: aluminum coated steel[22)] made by aluminum spraying included in processes being marketed currently.

3.3. To resist high temperature corrosion.

In complex anticorrosion systems, consisting of thermal spraying and painting, sprayed coatings are composed of porous laminates of fine particles and follow their substrates in thermal expansion and contraction at relatively high temperatures. Thus, sprayed coatings can be applied for thermo-resistant oxidation and thermo-resistant anticorrosion treatments.

However, in fear that the porosity of sprayed coatings will allow corrosive gases to penetrate and corrode their substrates, thermal spraying has rarely been applied as thermoresistant anticorrosion.

As investment in chemical plant facilities were reduced following the first oil shock in 1968, thermal spraying which permits in site application attracted attention and has been increasing in application in thermoresistant anticorrosion including practical plant tests.[23)]

Sprayed metal coatings are usually inferior to natural electrode potential of materials before thermal spraying. Multilayer sprayed coatings consisting of single or complex materials, depending on conditions such as substrate and corrosive environment, have much effect on anticorrosion properties.

On the other hand, porosity can be improved by increasing the thickness of sprayed coatings to more than 150μ and selecting an appropriate sealer.

Sprayed coatings consisting of combinations of cermet and ceramics such as Ni-Al+ZrO_2MgO and ZrO_2MgO are also used in Japan, e.g., the combustion chambers of jet engines in

Table 9. Practical Applications of Thermoresistant Anti-corrosion Spraying (for Heat Exchanger)

Product	Service environment	Service temperature	Material	Spraying	Sealer
Fin heat exchanger casing	LPG combustion gas Sulfuric acid dew point (3% sulfuric acid) Intermitted use	180°C max. 120°C norm.	SS41	Aluminum	Silicon epoxy
Tube heat exchanger (shell, tube surfaces)	Crude oil refining exhaust gas Continuous; No dew point	200°C max. 150°C nol (on the heating side)	SS41	Aluminum	Silicon epoxy
Fin heat exchanger case (for gas coolers) (shell, tube surfaces)	LNG (SNG) combustion gas Continuouse use	120°C norm. (on the heating side)	SUS316	Nickel-radial alloy	Silicon + Al powder
Water supply heater cover (casing only)	Coal gas combustion exhaust gas Continuous use	150°C norm.	SS41	Nickel-radial alloy	Silicon + Al powder
Hairpin heat exchanger (external tube surfaces)	Garbage burning exhaust gas SOx=150, Hcl=1000ppm Intermittent use	220°C max. 120 ~ 180°C norm. (on the heating side)	STPG	Nickel-base alloy	Silicon
Tubing heat exchanger (shell, tube surfaces)	Heavy oil A combustion gas Continuous use	120°C max. (on the heating side)	SS41 (Tube=Cu)	Aluminum	Silicon
Hairpin heat exchanger (external tube surfaces)	Sea water splashes	180°C max 100 ~ 130°C (cooling side)	STPG	Nickel-base alloy	Special sealer

compliance with specifications of Pratt & Whitney Aircraft. Photo 3 shows a microscopic cross-sectional view of a ceramic coating.

Recently, ceramic sprayed coatings are being used in chemical plant equipment in highly corrosive environments, with good results.

Table 9 shows an application of thermoresistant anti-corrosion treatment. Photo 4 shows a sprayed panel of heat exchanger tube seats. Photo 5 shows sprayed tubing for hairpin type heat exchangers.

4. Application to Functional Parts

A lot of researchers have explained basic characteristics of thermal spraying and sprayed coatings, such as the adhesion between sprayed coatings and substrates, the structures of interfaces[4)5)], residual stress of sprayed coatings[8)9)], effects of blasting[11)], effects of preheating[25)],, angles of spraying[26)] and properties of sprayed coatings. Separately, high-power output – 80kW, 120kW and 200kW – plasma spray systems have been introduced and automatic systems developed, helping increase reliability while steadily widening application to functional parts.

4.1. Rebuilding and Wear Prevention

Thermal spraying is a non-strain by thermal stress surface. processing method and is often used to resotre worn or miscut parts. Sprayed coatings consist of laminates of particles and have porous characteristics. Photo 6 shows a microscopic cross section of a metallic sprayed coating. Adhesion of sprayed coatings to substrates is based on mechanical bonding or so-called anchoring effects. Photo 7 shows an example of adhesion (anchoring effects) of metallic sprayed coatings to their substrates.

When metals are thermally sprayed, the coatings produced are harder than the original metals because their particles involve oxides or are subjected to strain in processing. Thus, they will increase their resistance to wear. At the same time, their porosity, which is a drawback in anticorrosion applications, turns to be oil-retaining, ready to work effectively on lubricated sliding surfaces.

Table 10 shows an example of the hardnesses of sprayed metal and ceramic coatings.

Also, laminate coatings of particles work effectively against fretting abrasion caused at fittings.

Some actual applications will be described below.

4.1.1. Lubricating Antiabrasion and Rebuilding

(1) A burn due to an error in manufacture of oil ports occurred to the external surfaces of a low carbon steel sleeve, 120mm in outer diameter, 10Q in inner diameter and 120mm in length and internal surfaces were damaged when the sleeve was removed. So, the sleeve was repaired by using a wire spraying gun. Service conditions of this shaft sleeve are 4,000rpm and a surface pressure of 0.6kgf/cm^2 (5.9 N/cm^2). Thermal spraying consisted of Ni-Al 0.3mm thick on the inner surfaces and a bonding coat followed by white metal (WJ-2) 1.2mm thick on the outer surfaces. Proven durability was over 3 years.

(2) Rebuilding of an Armature Shaft.

Worn parts of an armature shaft were repaired by thermal spraying with 0.3mm thick Mo without removing the core. Proven endurance was over 5 years. Disassembly and assembly cost little. Repairs were thus low in cost and the job completed quickly.

(3) Rebuilding of Locally Worn Parts of Trolley Wires of the New Tokaido Line[27]

For the purpose of increasing the intervals of replacement of trolley wires, consideration was given to rebuilding using in site thermal spraying. Trolley wires are subjected to high-speed energization wear resulting from violent current arcs different from wear of machine parts in general. Thus, for them, sprayed coatings are required to withstand severe conditions such as current collection, conductivity, wear resistance abrasion and

Table 10. Example of Hardness of Sprayed Coating

Spray material	Type of spraying	Hardness (Hv200)
13Cr	Metallizing	420 ~ 500
Mo	Metallizing	450 ~ 677
Ni-Cr	Metallizing	250 ~ 360
SWR H42	Metallizing	400 ~ 460
SWR S80	Metallizing	450 ~ 550
Al_2O_3	Plasma	750 ~ 1,500
Al_2O_3--TiO_2	Plasma	740 ~ 1,180
Cr_2O_3	Plasma	900 ~ 1,600
TiO_2	Plasma	600 ~ 750
ZrO_2	Plasma	400 ~ 500

resistance to arcing. Particularly, adhesion is an important factor.

In order to select sprayed coatings which satisfy these requirements, basic experiments were conducted of spray materials, selection of spraying methods (spraying onto the sliding surfaces of trolley wires is from underneath), temperature rises of trolley wires during spraying, electric resistance, abrasion and adhesion. Test results determined that the spraying method was to be wire spraying and the spray material to be a self-fluxing alloy (flexible cord) of a Ni-Cr-B-Si system.

Table 11 shows an example of results of basic experiments.

The above tests were followed by in site tests to prove that except for a few difficulties thermal spraying can reduce wear of trolly wires. Sprayed coatings were found particularly effective in low-speed sections. Fig. 2 shows an example of results of in site tests. Practicalization involves problems about scheduling because spraying work is dependent on weather.

(4) Sealing Surfaces of Vacuum Equipment Parts

Sealing surfaces (mated with teflon) with a rotation of 2,500 rpm, a temperature of 100°C and a pressure of 10^{-2} torr were plasma sprayed with Cr_2O_3 0.2mm thick and have been in service for a durability period of over 5 years. Also, ceramic spraying is used on guide rolls and pump shaft sleeves for synthetic fiber machines.

In addition, one of the examples of coating for resistance to wear caused by dust is the impellers (substrate: cast steel) of blast furnace blowers sprayed with 13Cr steel, which are in use withstanding a wear of 800 m/s max. involving coke particles.

4.1.2. Resistance to Fretting Wear

(1) Jet Engine Air Sealing[28]

The mating inner surfaces of a titanium alloy ring about 500mm outside diameter, 580mm inside diameter and 40mm in thickness were worn over their full 5mm width. So, the ring was repaired by plasma spraying. It involved service require-

Table 11. Results of Spray Material Tests

Spray metal	Thickness (mm)	Pretreatment	Adhesion (kg/cm^2)			Bending test (degree)				Electric resistance ($\times 10^{-3}\Omega$)		
			Mean	Range	Dispersion	Mean	Range	Dispersion		Mean	Range	Dispersion
Cu	0.1	R.O G.B	166	–	–	78	70~80	5.18	△	2.57	1.87~3.27	0.12
	0.2	R.O G.B	169.5	148~192	6.22	40	25~55	11.2	○	3.25	1.88~4.62	5.54
	0.3	G.B	167.5	71~144	10.2	22	10~34	7.37	◎	3.54	24.4~46.8	1.23
	0.3	G.B	–	–	–	–	–	–	–	7.5	–	–
Sn+Cu	0.1	G.B	110	87~123	3.55	59	44~74	7.50	○	6.02	2.60~9.44	3.81
Ni+Al+Cu	0.1	G.B	169	(D)	65.8	60	54 ~64	4.12	△	1.30	1.0~1.6	0.27
Ni – Cr	0.3	G.B	222	191~253	–	26	21~31	3.9	○	96	70 ~122	57.8
Ni – Cr	0.3	G.B	–	–	–	–	–	–	–	58	–	–
Ni – Al + Ni – Cr	0.1	G.B	90	–	–	72	59~84	11.7	△	186	123~249	70.5
Brass	0.3	G.B	116	86~146	27.4	–	–	–	–	2.34	2.08~2.50	0.20
	0.3	R.O	–	–	–	–	–	–	–	1.6	–	–
	0.3	G.B	–	–	–	–	–	–	–	0.66	–	–
16C	0.3	G.B	(E)	–	–	17	12~22	–	○B	26	17~35	11
6C	0.1	G.B	(E)	–	–	35	33~37	1.4	○	54	45~62	14
Al	0.3	G.B	166	(C)	–	37	30~44	12.2	○	(A)	–	–
Al – Zn	0.3	G.B	32.5	16.7~48.3	4.43	46	29~63	11.5	○	4.0	2.39~5.61	2.1
MA – 1	0.1	G.B	212	176·249	(X)	45	–	–	○	12.1	11.9~12.2	1.3
	0.3	G.B	204	172~232	18.8	14	–	–	○B	(G)	–	–
MA – 2	0.1	G.B	262	260·264	(X)	42	–	–	○	21.9	20.7~23.1	1.3
	0.3	G.B	223	204~242	13.5	15	–	–	○B	16.0	9.5 ~22.4	7.2
FP 6B	0.3	G.B	262	–	–	2	–	–	○B	94.0	78.5~109	14.3
60C	0.3	G.B	217	195·239	(X)	10	–	–	○B	32.1	19.0~44.2	27.3
Ni – Al	0.3	G.B	136	125·148	(X)	30	–	–	△	83.0	81.4~90.5	6.7
Ni – Al+Mo	0.3	G.B	207	203·211	(X)	28	–	–	○	65.9	50.4~81.4	24.0
Colmonoy + WC	0.3	G.B	212	–	–	20	–	–	△	15.0	8.6~21.5	9.9

Remark G.B: Gritbast
R.O: Grooving

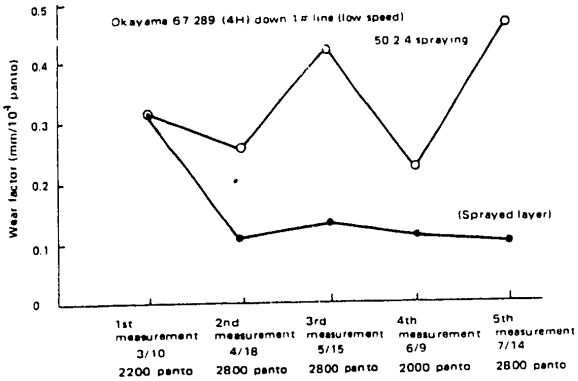


Fig. 2. Wear Measurement in In-site Test

ments: an engine speed of about 7,300 rpm (note: the ring was affixed to a rotor), amplitudes around 0.1 –0.127mm (as measured on the casing) and vibration from speed around 38 mm/s. Spraying consisted of 0.2 mm thick Mo. This repaired ring endured over 4,000 hours use. These rings are sprayed initially and repaired at a certain intervals.

Photo 8 shows a sprayed air seal.

(2) Crank Case Bearing Stand

The bearing stand cylinder, a half shape of a cylinder 120mm in diameter and 45 mm in width of a crank case of cast aluminum alloy, was worn inside. So, it was repaired by plasma spraying. Service requirements were unknown. It was sprayed with Ni-Al 0.2 mm thick as a bonding coat and Al 0.3 mm thick over this. No trouble in the repaired area has been reported for more than 3 years since.

(3) Parts Used at Low Temperatures

Consideration was given to application of a sprayed coating for resistance to fretting wear about 25 mm wide in an FC 25 (cast iron) external fitting parts about 1,000 mm in diameter and about 200 mm thick.

A special service requirement was a temperature of $-50^{\circ}C$. Tests were conducted of resistance to fracture, adhesion and resistance to impact of sprayed coatings at low temperatures. For low temperatures, a cycle of holding test samples in liquid nitrogen for 30 minutes and then restoring them to room temperature was repeated a maximum of 10 times before the samples were put to the test within 5 minutes of this processing. All samples met test requirements. Thus, actual fitting parts were sprayed and no trouble with them has since been reported.

4.1.3. Anticorrosion and Wear Resistance

A cast-iron pump cover 430 mm outside diameter and 230 mm inside diameter was corroded in several locations

by a water flow containing particles erosion. So, it was repaired by wire spraying. Service requirements were 150°C max. and flow rates of around 7.5 m/s. Spraying consisted of a bonding coat followed by 18Cr-5Ni stainless steel 1 mm thick and an overcoat of a phenol resin sealer. The repaired part endured service for over 2 years. Photo 9 shows a sprayed pump casing.

Another successful application for resistance to abrasion by particles erosion by plasma spraying, was to guide vanes (substrates of cast steel) important structural parts of hydraulic equipment, with a WC contained alloy.[29]

Generally, applications of sprayed plastics, taking advantage of the techniques features, are extending into a variety of fields from liquid tanks and turbo-fan casings in chemical plants, to functional parts requiring resistance to corrosion and abrasion such as feeder rolls and canvas rolls in paper manufacturing, textiles, steel manufacturing and food processing plants.

Photo 10 shows a steel mill roll sprayed with nylon.

Photo 11 shows a paper manufacturing roll sprayed with nylon.

Now, we have reviewed a small part of actual applications mainly of abrasion resistance and rebuilding repairs. Recent trends are the use of wear resistant coatings by thermal spraying on newly made parts, made on the basis of successful applications. In order to reduce weight, in particular, thermal spraying is being applied to functual parts, the substrates of which are aluminum.

4.2 Anticorrosion and Antiabrasion by Self-fluxing Alloy Spraying

Different from ordinary methods of thermal spraying, self-fluxing alloy spraying uses a fusing treatment after spraying, which heats sprayed coatings to over fusing temperatures (about 1,000°C). This fusing treatment eliminates pores in sprayed coatings and greatly increases bond strength between coatings and their substrates.

Spray materials are so-called self-fluxing alloys made by adding about 1–4% boron or silicon as a flux to alloys of a nickel, nickel-chrome or a cobalt derivative.

Although its applications are rather limited because substrates are thermally strained by fusing, this spraying is being successfully applied to those parts required to be resistant to wear by cavitation, errosion anda brasion by sand. Self-fluxing alloy spraying is finding its application in pump parts, crusher hammers, screws of centrifugal separators, valves and dies for glass molding as well as rolls for iron mills.

5. Special Applications and Future Trends

Applications of thermal spraying which are able to coat a variety of substrates with plastics, metals and ceramics, are

unexpectedly wide. As studies on thermal spraying and sprayed coatings produce results, special applications are developed successively. They include new types of thermocouples, resistance elements for artificial satellites, magnetic systems and sensors in the fields of electronics, capsule sleeves in nuclear-power equipment and solar parts making use of emittance characteristics of sprayed coatings useful in solar energy projects,not to mention the addition of conductivity and insulation. Thermal spraying is also used in the manufacture of barium titanate condensers[30], attracting attention of fields of surface processing for its parts manufacturing ability.

One recent study of particular note is a "photo-chemical reaction using titanium oxide sprayed electrodes".[31] This seems to be a development of air plasma spraying. At present, industrial laboratories and main plants are earnestly pursuing studies of thermal spraying, making efforts to establish methods of non-destructive testing including blasting, while using vacuum spraying to improve sprayed coatings in respect of porosity. The application of thermal spraying seems limitless.

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ELECTROLYTIC MULTI-COLORING OF ANODIZED COATINGS ON ALUMINUM

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[Text]

1. Introduction

The anodized coating of aluminum has been conventionally conducted in a sulfuric acid bath and the colors obtained on the coating in a succeeding nickel sulfate bath are blackish or brownish [1–5]. Coatings possessing primary colors can be developed by either changing the metal of the sulfate salt [1, 4–6] or applying rather lower voltage than that employed in the usual method [7–8], however, the colors developed are not multi-colors and control of the colors to be developed has been hardly made [9–10].

On the contrary, a coating formed in a sulfuric acid bath and/or that in an oxalic acid can be multi-colored by intermediate treatment, such as decreasing the voltage [11–12], the pore-widening [13], and reanodizing [7, 14].

Whereas, a coating formed in a phosphoric acid bath can be easily multi-colored by merely changing electrolyzing conditions in the absence of the above-mentioned intermediate treatment, giving rise to iridescent colors of red through violet [9, 15–16].

Fundamental study has been made a little on the relation between the colors developed and the conditions for both, anodizing and coloring steps [17–18]. Various explanations for the cause of the colors of anodized coatings, such as the geometrical form of the pore structure of the barrier layer [5, 19], dispersion of metal deposits in the pores [1–5, 8], particles size distribution of the metal [8, 20], and interference effects [9–10, 13–17, 21–22], have been known, however, still they have not been fully elucidated.

In the present paper, the relation between anodizing conditions, mainly the electrolytic condition in the phosphoric acid bath, and the colors developed on the aluminum are described. Also, the effect of additives to the coloring bath of nickel sulfate upon the multi-coloring of the coating is outlined and the possible cause of the multi-colors is discussed.

Table 1. Conditions of the Anodic Oxidation and the Colors Developed

System	Step	Electrolyte		Electrolysis			
		Formulation (g/1)		Wave form	Voltage (V)	Current density (A/m^2)	Duration (s)
Two-step coloring process	Anodizing		H_3PO_4 30	d.c.	25	8	600 ≀ 3600
	Coloring	A	$NiSO_4$ 30	a.c.	15	34	<160
		B	$NiSO_4$ 30, H_3BO_3 10				
Three-step coloring process	Anodizing		H_2SO_4 150	d.c.	15	100	1200
	Reanodizing		H_3PO_4 30	d.c.	20	6	300 ≀ 2400
	Coloring	A	$NiSO_4$ 30	a.c.	14	32	<160
		B	$NiSO_4$ 30, H_3BO_3 10				

2. Experimental Procedures

2-1. Aluminum and Its Pretreatment

Aluminum foils of 99.8% purity and thickness of more than 100μm were used for the experiments. Prior to anodizing, the foil was degreased by wiping with trichloroethylene in order to avoid losing the brightness of the original surface.

2-2. Anodic Oxidation and Electrolytic Coloring

Anodic oxidation was carried out as presented in Table 1; in the case where thin coating (< 1μm) was desirable, a single phosphoric acid bath was employed, while in the case for a thick coating, phosphoric acid was used for reanodizing the coating which had been anodized in the sulfuric acid bath. Anodizing in phosphoric acid in the former case and reanodizing in phosphoric acid in the latter were made by applying constant voltage which was lower than that employed by the usual method.

The process for the coloring of the thin anodized coatings will be tentatively called as the two-step coloring process and that for the thick coating as the three-step coloring process.

Coloring of the coating obtained in the three-step coloring process was conducted under the same electrolytic conditions applying alternating current (a.c.), as employed in the usual method using a nickel sulfate bath ($NiSO_4$ 30g/1) with or without addition of boric acid (H_3BO_3 10g/l). The kinds of additives to the bath were, besides boric acid, well-known complexes, such as ammonium compounds, amines, aqueous ammonium, and pH buffer reagent, such as sulfuric acid,

tartaric acid, aluminum sulfate, for the purpose to examine the effect of the dissolved aluminum in the bath upon the coloring of the coating.

In order to determine the effect of the duration of the electrolysis for the coloring upon the colors developed, a pair of electrodes, the aluminum foil anode and a carbon-plate cathode, was immersed in the bath initially and after conducting the electrolysis for a period of 20 s, the aluminum anode was raised ~20mm and again the electrolysis was carried out under the conditions identical to those in the previous run. This procedure was repeated more than ten times. When necessary, the colored coating was sprayed with clear lacquer and comparison was made by observing the colors before and after the spray.

Samples to check the metal deposits alone in the pores were prepared by dissolving only the coating which had been obtained in either the anodizing or the reanodizing step with a mixture of H_3PO_4 and H_2CrO_4 at ~99°C for ~5 min.

2-3. Color Measurements

Change of color of the coatings developed in the coloring step was evaluated using Hunter's color scale, L, a, and b, which had been measured by a Color Difference Meter (Suga Instrument Co., Ltd., AUD–CH2).

2-4. Observation of the Metal Deposits in the Pores

The electrolytic deposits in the pores were examined by observing a ultra-thin section prepared from the anodized colored coating by means of an ultramicrotome with a transmission method using a high resolution electron-microscope (Hitachi, Ltd., 1250KV).

3. Results and Discussion

3-1. Two-Step Coloring Process

Hunter's diagrams for the colors of the anodized coatings obtained at various durations of anodizing in the phosphoric acid bath are given in Fig.1. Visually observed color of the coating at 10 min was a pale-yellowish and the color became darker with a lapse of the duration. This trend is recognized in Fig.1-A and the diagram indicates that multi-coloring is not complete yet. After 40 min, multi-coloring progressed with increasing the duration and at 60 min, multi-coloring was almost completed, as can be seen in Fig.1-D. At this stage, variation of the visually observed colors of the coating was:

dark brown → blue → yellow → orange → red →
dark reddish green → green → dark reddish purple

and finally ending in black.

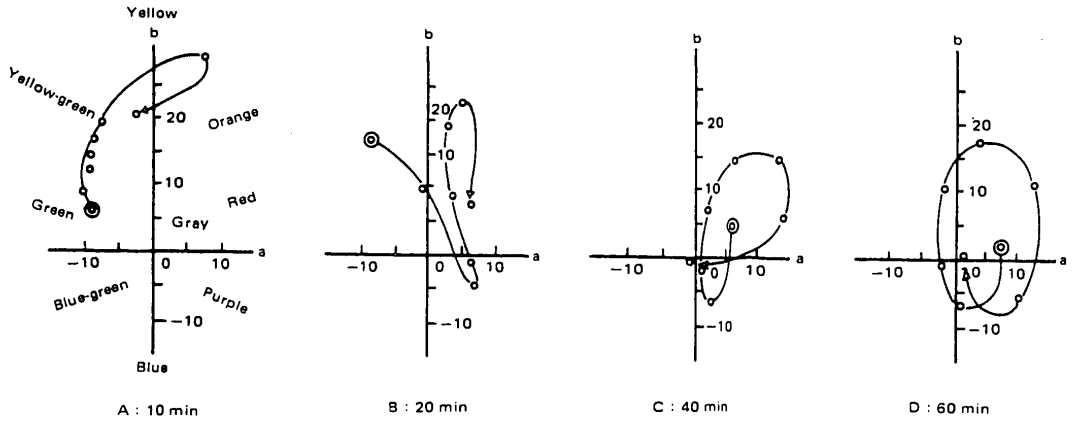

Fig. 1. Hunter's Diagram for the Colors Developed with a Function of the Anodizing Duration in the Two-Step Process

3-2. Three-Step Coloring Process

Anodized coatings obtained by the usual method using a sulfuric acid bath have generally been colored with a duration of more than 20 min in a metal salt solution, in which some addition, e.g. H_3BO_3, is made. However, the coating reanodized in a phosphoric acid bath for 5 min with applying lower voltage than that in the usual method can be colored quickly to dark brown in the subsequent coloring step, and further coloring gives bright multi-colors on the coating. This fact indicates that the three-step coloring process shortens the coloring period, though an additional reanodizing step is required.

Relation between L-value of the colors of the coating obtained by the three-step process and the duration of a.c. electrolysis for the third step, with a function of reanodizing duration in the phosphoric acid bath (L-T curves) is shown in Fig.2. Curve for 0 min means the L-T curve for the colors of the coating obtained with absence of the reanodizing step, i.e. the colors obtained by the usual method using a sulfuric acid bath. The color developed in the coloring step for 20s which had been obtained by reanodizing for 10 min was dark brown and further continuation of the coloring made the colors brownish, through reddish, to bluish grey, however, multi-colors were not produced. This is also recognized as the characteristic wavy curve for 20 min anodizing in Fig.2. In general, a longer reanodizing period seems to promote satisfactory multi-colors on the coating.

Owing to the observation made above, coloring of the coating in the three-step process can be controlled, similar

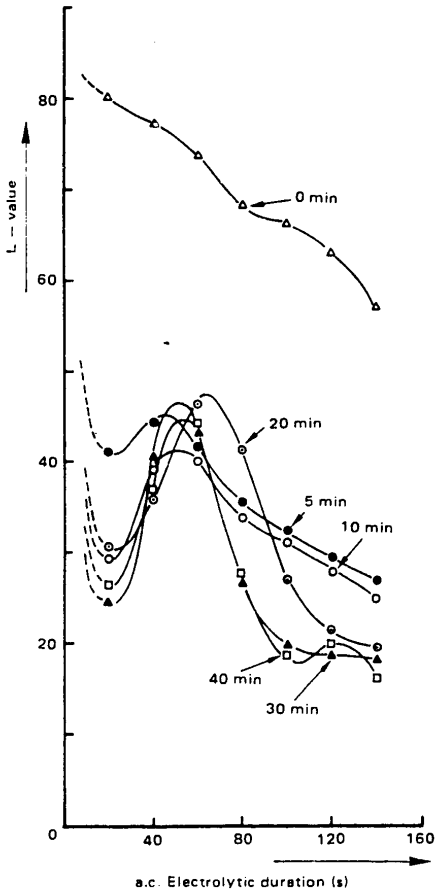

Fig. 2. Relation between L-value of the Colored Coating and the Duration of a.c. Electrolysis, with a Function of the Anodizing Duration in H_3PO_4 Bath in the Three-Step Process

Table 2. Kinds and Amounts of Additives, and pH of the Electrolytes for Multi-coloring

Electroyte			
Base electrolyte	Additive		pH
	Kind	Amount	
$NiSO_4$ (30 g/l)	H_3BO_3	0 (g/l)	6.9
		1	6.2
		3*	5.6
		5*	5.5
	$(NH_4)_2SO_4$	0 (g/l)	6.4
		1	5.8
		3	5.4
		5*	5.2
	$(HOCH_2CH_2)_3N$	0 (ml/l)	6.9
		1	7.3
		3	7.9
		5	8.2
		8	8.3
		10	8.6
		13	8.8
		15*	8.9
		20*	9.0
	NH_4OH (25%)	0 (ml/l)	5.3
		1	7.7
		5	8.0
		10	8.2
		20	8.6
		30*	9.2
		40*	9.5
		50*	9.7

* Multi-coloring

to the two-step process, with the durations of both for reanodizing in the phosphoric acid bath and for coloring in the nickel sulfate bath with or without addition of boric acid.

3-3. Effect of Additives to the Coloring Bath for Three-Step Process

3-3-1. Additives to Promote Coloring

Experiments to examine the effect of additives on the final colors were conducted on the samples which had been reanodized thoroughly in the single phosphoric acid bath. Thoroughness of this reanodizing can be affirmed by the indication of a brown color on the coating in the succeeding coloring step using a bath of nickel sulfate only. The anodized coating was able to promote multi-coloring in the nickel sulfate bath into which boric acid had been added. As present in Fig.3, addition of 1 g/l H_3BO_3 develops colors of brownish, through bluish, to yellowish brown. Increasing the amount of boric acid to 3 g/l almost completes multi-coloring, and further addition up to 5 g/l does not give any significant change.

Besides boric acid, other additives which promoted multi-coloring were ammonium compounds, amines, and aqueous ammonium. The kind and the amount of the additive into the nickel sulfate bath are reported in Table 2. As seen Table 2, multi-coloring was obtained with the presence of 5g/l, 15ml/l, and 30ml/l of ammonium sulfate, triethanolamine, and 25% aqueous ammonium, respectively. The effectiveness of the additive to control the multi-coloring is in the order:

$$H_3BO_3 > (NH_4)_2SO_4 > (HOCH_2CH_2)_3N$$

3-3-2. Additives to Promote Single-coloring

The effect of additives to the coloring bath upon the promoting of the single coloring was investigated for re-anodized coating which was able to develop multi-colors in the standard nickel sulfate bath with addition of boric acid (5 g/l). These results are tabulated in Table 3.

L-T curves and Hunter's diagrams of the colors developed with a function of the amount of tartaric acid added into $NiSO_4$-H_3BO_3 bath are delineated in Fig.4 and Fig.5, respectively. It is apparent from the figures that the addition of tartaric acid of 5g/l gave, instead of multi-colors, a light and shady brown color, similar to that obtainable by the usual method, and, from Fig.4, the coloring without any addition is retarded by 20 s with addition of 1g/l boric acid.

Addition of sulfuric acid seems to affect identically as does tartaric acid. Sulfuric acid of 0.5ml/l developed a light and shady brown, but not multi-colors. As indicated in Table 3, aluminum sulfate of 3g/l yields the single color of brown.

In contrast to the kinds of the additive, pH value of the nickel sulfate bath in which aluminum sulfate had been added was higher than that in which either sulfate acid or tartaric acid had been added.

From these observations, final colors of the coating appear to be attributed not only to the duration of the electrolysis, both in the anodizing step using phosphoric acid bath and in the coloring using nickel sulfate bath, but also to both the amount and the kind of the additive in the coloring step.

Table 3. Kinds and Amounts of Additives, and pH of the Electrolytes for Single-coloring

Electrolyte			
Base electrolyte	Additive		pH
	Kind	Amount	
$NiSO_4$ (20 g/l) + H_3BO_3 (5 g/l)	H_2SO_4	0 (ml/l)	4.9
		0.25	2>
		0.50*	2>
	[CH(OH) COOH]$_2$	0 (ml/l)	4.8
		0.50	–
		1	2.5
		3	2.2
		5*	2.0
	$Al_2(SO_4)_3$	0 (g/l)	4.9
		0.50	4.3
		1	4.1
		2	4.0
		3*	3.8
		5*	3.7

* Single-coloring

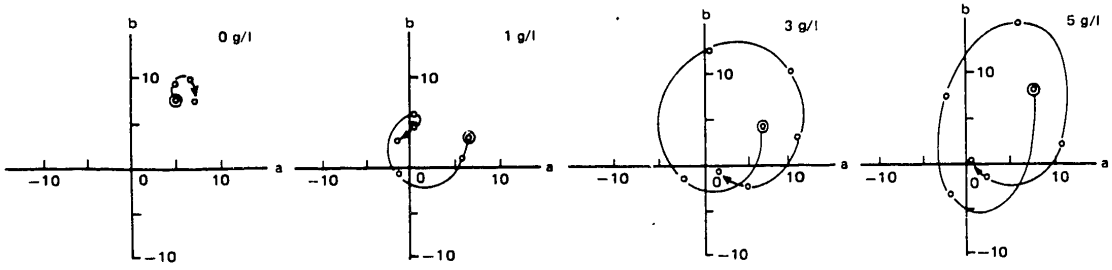

Fig. 3. Hunter's Diagram for the Colors Developed with a Function of the Amount of H_3BO_3 Addition to $NiSO_4$ Coloring Bath in the Three-Step Process

4. Observation of the Deposits in the Pores and of the Coloring Mechanism

4-1. Microstructure

Photographs 1 and 2 reproduce the surface and the sectional views of the colored sample. The sample was prepared by the two-step coloring process, conditions of which were: Anodizing in 30g/l H_3PO_4 bath at 21°C with applying direct current (d.c.) [current density (c.d.); 0.054A/dm^2, 20V, 22

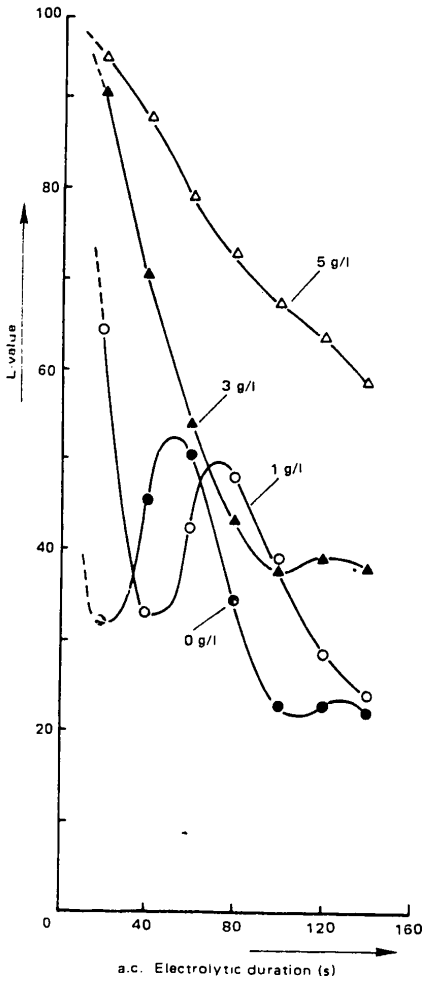

Fig. 4. Relation between L-value of the Colored Coating and the Duration of a.c. Electrolysis, with a Function of the Amount of Tartaric Acid Addition to $NiSO_4 + H_3BO_3$ Bath in the Three-Step Process

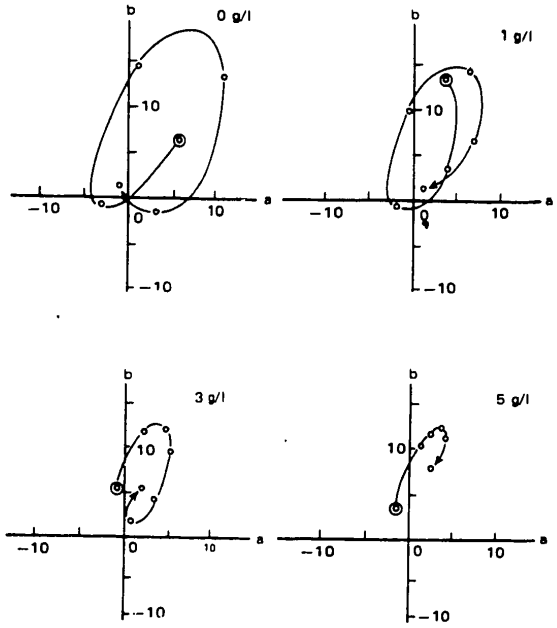

Fig. 5. Hunter's Diagram for the Colors Developed with a Function of the Amount of Tartaric Acid Addition to $NiSO_4 + H_3BO_3$ Bath in the Three-Step Process

min]; Coloring in 30g/l $NiSO_4$ + 10g/l H_3BO_3, at room temperature, a.c. (c.d.; 0.32A/dm^2, 15V, 60 s). These photographs indicate that the pores' size distributes over a wide range and the electrodeposits are composed of fine nickel particles which have grown from the bottom of the pores.

4-2. Coloring Mechanism

Final colored coating shows different colors depending on the thickness of the coating prepared in the anodizing or reanodizing step and the kind of the bath employed in the coloring step. Variation of the colors of the coating with increasing the electrolytic duration in the coloring step is summarized in Table 4, which is arranged with the thickness of the coating that is controllable with or without the reanodizing step, i.e. two-step process or three-step process. Coloring was made in the nickel sulfate bath (30g/l) and in the bath composed with nickel sulfate (30g/l) and boric acid (10g/l). In order to identify the interference effect caused at the porous layer, variations of the colors of the coating post-treated with clear lacquer are also shown in the Table. In Test 1 in Table 4, a coating thinner than 1μm formed in the sulfuric acid bath developed bright primary colors in the consecutive coloring step using the nickel sulfate bath. The thick coating (~6.5μm) obtained in Test 2 consisted of a porous layer formed in the anodizing step using sulfuric acid bath and that in the reanodizing step using phosphoric acid. It yielded a light and shady brown, but not dark, in the subsequent coloring step. In Test 3, similar to Test 1, a thin coating was obtained first and the succeeding coloring step gave bright primary colors with employing a nickel sulfate bath containing boric acid. In Test 4, unlike Test 2, dull primary colors developed on the thick coating using the mixed bath.

4-2-1. Cause of Colors in the Two-Step Process (thin coating with H_3BO_3 addition)

The colors developed in Test 3 were visually observed to be bright primary colors, identical to that in Test 1. However, post-treatment of the colors with clear lacquer lost the brightness of the original colors and resulted in different dull colors. On the basis of the observation, the colors of the coating appear to be caused preferentially with the interference between the top surface of the coating and that of the electrodeposits in the pores, rather than that between the top of the electrodeposits and the surface of the base aluminum.

L-T diagrams and Hunter's diagrams for the colors developed on the thin coating, for the colors of the lacquer treated coating, and for the colors of the deposits alone prepared by dissolving only the coating are shown in Fig.6 and Fig.7, respectively. As seen in Fig.6, the colors developed with the coloring duration up to 80s are controlled by the colors

Table 4. Electrolytic Conditions for the Coloring Systems and the Colors Developed

Test No.	System	Thickness (μm)	Coloring bath	After treatment	a.c. Electrolytic duration (s)	Color developed with increasing electrolytic duration								
						20	40	60	80	100	120	140	160	180
1	Two-step coloring process	About 0.6	30 g/l $NiSO_4$	None *		Light purple	Blue	Green	Yellow-ish green	Greenish yellow	Yellow	Orange	Reddish purple	Green
				Lacquer** coating		Brown-ish silver	Light brown	Brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown
2	Three-step coloring process	About 6.5		None *		Light brown	Brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown
				Lacquer** coating		Brown-ish silver	Light brown	Brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown	Dark brown
3	Two-step coloring process	About 0.6	30 g/l $NiSO_4$ + 10 g/l H_3BO_3	None *		Light green	Green	Brown-ish green	Yellow-ish gray	Light yellow	Yellow	Orange	Reddish purple	Dark reddish purple
				Lacquer** coating		Brown-ish silver	Light brown	Brown	Dark brown	Bluish gray	Yellow-ish gray	Light orange	Orange	Dark green
4	Three-step coloring process	About 6.5		None *		Brown	Bluish gray	Yellow-ish blue	Yellow	Yellow-ish orange	Orange	Indigo	Green	Yellow-ish brown
				Lacquer** coating		Brown	Dark reddish purple	Yellow-ish blue	Yellow	Yellow-ish orange	Orange	Reddish indigo	Green	Yellowish brown

* Anodized coating only
** Coated with clear lacquer on the anodized coating

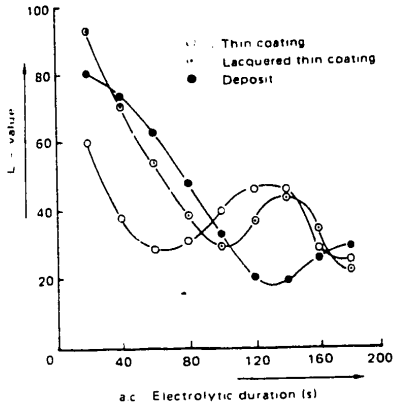

Fig. 6. Plots of the a.c. Electrolytic Duration in $NiSO_4 + H_3BO_3$ Bath Against the L-value of the Thin Coating, of the Lacquered Thin Coating, and of the Deposit

of the deposits which were a light and shady brown. Between 80 and 160 s, L-T curve for the lacquered finish looks like a mirror image of that for the deposits alone across the horizontal line. It exemplifies that the colors of the coating and that of the deposits are complementary to each other. From the results of visual observation, colors of the coating developed with further prolonged duration seems to be controlled by other factors which will be discussed in the next section.

4-2-2. Cause of Colors in the Three-Step Process (thick coating, with additive)

Colors of the coating developed in Test 4 resemble closely those with lacquer treatment in Test 3. It is consistent with the following interpretation: variation of color of the coating by increasing the duration in the coloring step in Test 4 seems to indicate different primary colors which appear when the interference colors of the coating obtained in Test 3 disappear by being sprayed with lacquer. In fact, colors of the coating obtained in Test 4 did not change their own colors even after treating with lacquer.

L-T diagram and Hunter's diagram for the colors developed on the thick coating, for the colors of lacquer treated coatings, and for the deposits alone are indicated in Fig.8 and Fig.9, respectively. With comparing a pair of Fig.6 and Fig.7, and that of Fig.8 and Fig.9, a different trend can be noticed in the diagrams for the colors of the coating. Contrary to this, the colors of the coating and those of the lacquer coated appear almost same except for a slight change in color at the duration of 40–60s and that of 120–140s as seen in Table 4. Examina-

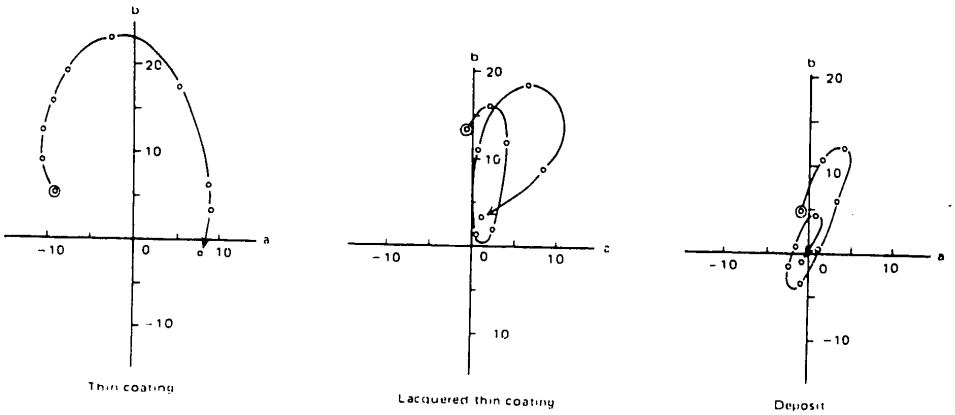

Fig. 7. Hunter's Diagrams of the Thin Coating, of the Lacquered Thin Coating, and of the Deposit Obtained from $NiSO_4 + H_3BO_3$ Bath in the Two-Step Process

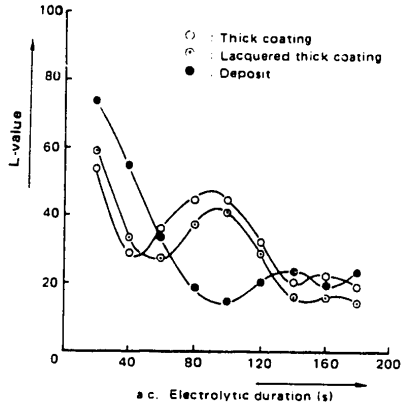

Fig. 8. Plots of the a.c. Electrolytic Duration in $NiSO_4 + H_3BO_3$ Bath Against the L-value of the Thick Coating, of the Lacquered Thick Coating, and of the Deposit

tion of each curve in Fig.8 suggests that the colors developed with the duration between 0 and 40s seem to be caused by the brownish color of the deposits and also the color of the lacquered thick coating and that of the deposits developed in the duration range 60–120s, are complementary to each other. Moreover, the primary colors developed with the duration between 140 and 180s are likely due to the interference caused by reflections at the surface of the base aluminum and at the top surface of the deposits. When the height of

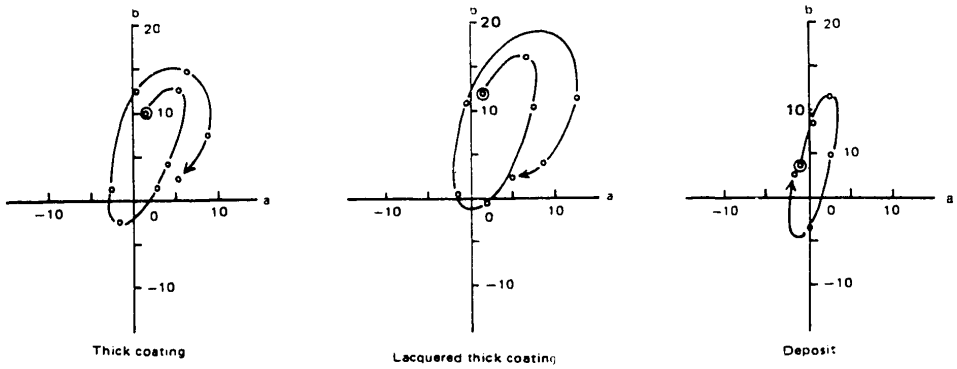

Fig. 9. Hunter's Diagrams of the Thick Coating, of the Lacquered Thick Coating, and of the Deposit Obtained from $NiSO_4 + H_3BO_3$ Bath in the Three-Step Process

the deposit is nearly equal to one quarter of the light wave length, cause of the color can be obviously explained by the interference, however, the colors developed in these durations were less brighter than those caused by the interference between the surface of the coating and the top surface of the deposits.

Among the colors developed on the coating, the colors obtained with the duration between 40 and 60s are possibly due to overlapping the colors of the deposits themselves and the colors complementary to that of the deposits. Likewise, the colors obtained between 120 and 140s are also considered to be dependent on overlapping the colors complementary to those of the deposits and the interference colors.

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Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 46

[Text]

* Osaka Gas Co. and British Gas Corp. (BGC) has agreed to basic terms for the joint development of synthesized natural gas (SNG). SNG, an alternative to natural gas, is synthesized from materials such as light oil, heavy oil, asphalt and coal. Among SNG production processes, those using light compositions of petroleum such as naphtha and liquefied oil gas, are already close to practical application. On the other hand, the object of the joint development is to produce natural gas from heavy petroleum oil. Conversion is called the FBH process and has been investigated by BGC. Gasification is conducted by direct addition of hydrogen to heavy oil using a fluidized bed. They claim as merits of the method, fast gasification and economical costs. They have decided on a joint development program since diverse materials are required to promote the natural gas conversion programme.

CSO: 4120

SCIENCE AND TECHNOLOGY

METHACOAL PLANT COMPLETED IN 1980

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 46

[Text]

* Mitsui's Coal Liquidification Research Association, with Mitsui Mining Co. and Mitsui Toatsu Chemicals, Inc. as main members, has a plan to construct a process plant with 1.2t/day capacity within this year in order to promote the research and development of "methacoal" which is a mixture of methanol and powdered coal. A more realistic pilot plant will follow after a 2 year long experimental operation starting from next year.

Subjects of the experiments include the methanol and coal mixture ratio, environmental problems associated with combustion, calory, coal type selection and transportation methods. At present, they will use subbituminous coal with low percentage water content. Mitsui Toatsu Chemicals, Inc. is in charge of methanol production which is produced using coal changed into gas phase. Mitsui Mining Co. is in charge of selection of coal type and methanol transportation.

CSO: 1980 Fuji Marketing Research Co., Ltd.

CSO: 4120

SCIENCE AND TECHNOLOGY

FORMATION OF NEW GENERAL ENERGY DEVELOPMENT ORGANIZATION

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 46

[Text]

• The New General Energy Development Organization was formed, which serves as the kernel to oil alternative energy development promotion. Both the government and private companies are involved in the organization. In order to promote oversea activities, it is soon going to open oversea offices in Washington and Sydney. Further, a Paris office will be established in fiscal 1981. The establishment of the organization is based on a law concerning oil alternative energy development and introduction promotion. The organization takes over part of the work of the Coal Mining Industry Rationalization Corporation which has been abolished. However, its main functions consist of: (1) new energy technology development (coal liquefication, hot water utilizing power generation, deep-layer hot water supply systems, solar heat power generation and solar systems for industrial applications. (2) Geothermal resources development (the guarantee of obligation for geothermal resources development and inquiries for distribution situation of geothermal resources). (3) Oversea coal development (the guarantee of obligation for oversea coal development and financing for exploration.

CSO: 4120

SCIENCE AND TECHNOLOGY

HEAT RECOVERY OF STACK GAS DESULFURIZATION FACILITY

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 46

[Text]

* The Furukawa Electric Co. has developed exhaust gas heat recovery equipment for stack gas of a desulfurization facility and delivered the first set of equipment to the Kurosaki plant of Mitsubishi Chemical Industries Ltd. The equipment will be used for boilers of a thermal power plant.

As an energy saving measure, many kinds of heat recovery industrial systems from exhaust gas have been introduced. Among them, this is the world's first practical use of dirty gas such as from the stacks of desulfurization systems. The system attracts much of the industry's attention because it is a breakthrough for dirty gas heat recovery utilization. In such, durability is a problem due to heat exchanger corrosion making heat recovery very difficult. The newly developed system recovers heat from the exhaust gas and uses it to heat desulfurized gas which is used for the "reheat process". The equipment delivered to the Kurosaki plant has actually recovered 2.11 million Kcal/hr heat from 250.3 thousand Nm^3/hr exhaust gas. The Furukawa Electric Co. developed a practical heat pipe for heat recovery equipment in 1976 and has been increasing its sales as energy saving equipment in various industries. This is the first time corrosion and durability problems have been solved by adopting a special heat pipe with a main pipe made of copper coated with a new alloy which having excellent corrosion-resident properties.

CSO: 4120

SCIENCE AND TECHNOLOGY

LARGEST LNG COLD HEAT POWER GENERATION PLANT UNDER CONSTRUCTION

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 46

[Text]

* Chubu Electric Power Co. has disclosed a construction program for the world's largest LNG cold heat power generation plant. The plant with 10,000kW output is to be located at the Chita LNG base in Chita city, Aichi Prefecture and operation is planned to start in March, 1983. Designing and building the plant with two 5,000kW generators has been done by Chubu Electric Power Co. in co-operation with Hitachi Ltd. The investment will approximately reach ¥2 billion.

Principles of the system are as follows: By indirect contact with natural gas which is cooled and liquefied at −160°C, Freon gas absorbs evaporation heat of LNG. The liquefied Freon gas vaporizes through a heat exchanger, drives turbines of the generators and then recirculates for repeated use. The company expects that about 40% of the cold heat will be recovered at least.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW FLEXIBLE AMORPHOUS SOLAR CELL DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 47

[Text]

Teijin Ltd., with the assistance of Prof. Hamakawa, Faculty of Engineering Science, Osaka University has developed a flexible amorphous silicon solar cell, a world first, which can be bent freely. The cell is formed of a thin amorphous silicon film grown on a base made of thin heat resistant high polymer film. The cell, which is still in the experimental stage with a small size of only 3mmx3mm, has achieved 3.6% photo-electric conversion efficiency which is close to that of other amorphous silicon solar cells on the market. Much easier to handle than other of cells, it promises an extensive range of applications, such as on the roofs and walls of buildings, on tops of cars and trains, and as portable power source in the form of a sheet. Moreover, significant cost reduction is feasible.

The new cell consists of several layers formed on a 0.1mm thick polyimide film having a 300°C heat resistance. These layers are, from the bottom, 400 to 1,000Å thick stainless steel film by spattering, n, i, p-type amorphous silicon film with 1μ total thickness, ITO (indium trioxide) film, a collection electrode, protection film and reflection prevention film. The cell is called a "Hetero face junction type". Under 92.5mw/cm² simulated solar light, the cell showed 3.6% photo-electric conversion efficiency. Another remarkable feature of the solar cell is that it does not need a frame for installation normally required by conventional solar cells and can be simply fitted to a curved surface. This fact will significantly expand its applications to cars, trains, and even a portable power source for hikers as it can be easily stowed.

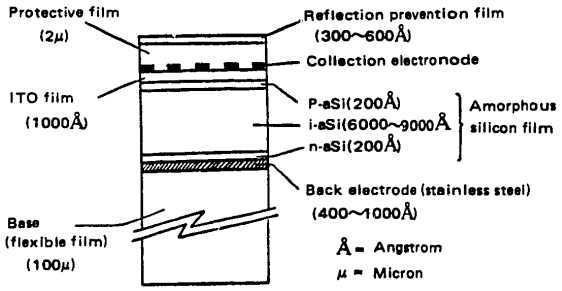


Fig. 1. Flexible Amorphous Silicon Solar Cell Developed by Teijin

CSO: 4120

SCIENCE AND TECHNOLOGY

SOLAR CELL DRIVEN CIRCULATION PUMP FOR SOLAR HEAT COLLECTORS DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 47

[Text]

Kawamoto Seisakusho Co., a medium class pump maker, has developed a circulation pump system driven by solar cells, for solar heat collectors. The system which drives the pump efficiently, even with variations in solar energy, is of an energy saving type since it does not require any external power. The company is accelerating development to complete the system by the end of this year and hopes to put the system on the market next year.

In recent years improvement of the performance of solar heat collectors has become a social need and the Ministry of International Trade and Industry is promoting research and development for their improvement. Especially the development of forced circulation type collectors has been advanced, so as to achieve higher efficiency of heat absorption by circulating the water between the heat collector and storage tank. However, until now the rather complicated system layout has largely cancelled benefits.

The newly developed system eliminates the need for water circulation speed control by syncronizing the solar cells with the solar heat collector. The solar cell power output varies with the solar energy available and allows automatic and efficient water circulation. The unique combination of the circulation pump and the motor was devised by the company.

They plan to complete the system by the end of this year, based on the analysis of experimental data, and to put the system on the market next year. They will provide 3 to 4 standard models for household consumers while larger systems for industries will be produced to order.

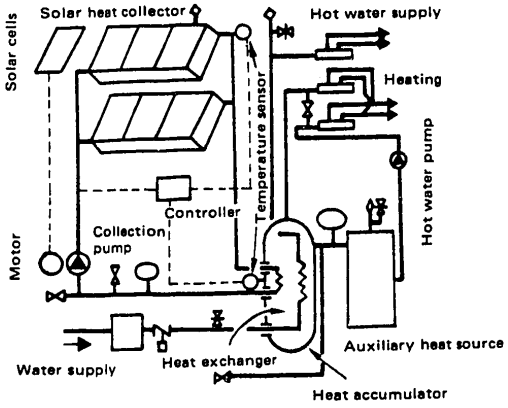


Fig. 1. Schematic Diagram of the Solar Heat Collector System

SCIENCE AND TECHNOLOGY

SEA WATER EFFECTS ON CRACKS IN HIGH STRENGTH STEELS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 50

[Text]

• Fatigue crack growth rates were obtained in air at 16.7Hz, (da/dN) air, and in sea water at 0.167Hz, (da/dN)cor, for HT80, HY140, HY 180, HY240, HP9-4-20, PH13-8Mo, and 18Ni (200) maraging steels. Stress ratios, R of 0.10 and 0.50 were used. The ratio of (da/dN)cor/ (da/dN)air, $\gamma_{0.167Hz}$, were used as the degree of the effect of sea water on fatigue crack growth. The following results are obtained. (1) The value of $\gamma_{0.167Hz}$ was lower in HY140 tempered at 615°C and HP9-4-20 steels. (2) The maximum value of $\gamma_{0.167Hz}$ was obtained at ΔK=50 to 100kg/mm$^{3/2}$ for R=0.10 in all steels used. At $\Delta K < 20 \sim 40$kg/mm$^{3/2}$ and $\Delta K >$ 250kg/mm$^{3/2}$, no effect of sea water on fatigue crack growth rate was obtained. (3) The value of $\gamma_{0.167Hz}$ depended on K_{max} and ΔK at lower and depended on ΔK at a higher crack growth rate. The maximum value of $\gamma_{0.167\,Hz}$ depended on K_{max}. (4) A positive interrelation was obtained between $\gamma_{0.167Hz}$ and area fraction of brittle fracture in 18Ni(200) maraging steel.
[M. Sumita, et al.: *Tetsu-To-Hagane*, 66(1980). 1669]

CSO: 4120

SCIENCE AND TECHNOLOGY

EFFECT OF SUBCRITICAL QUENCHING TEMPERATURES ON CAR AXLES

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 50

[Text]

* In order to apply a sub-critical quenching method for the improvement of fatigue strength of pressfitted parts of car axles, the effect of sub-critical quenching temperature (500 ~ 700°C) on the microstructure, hardness, residual stress distribution and fatigue strength was investigated using 12mmφ notched specimens (0.35%C steel) and press-fitted specimens (0.4%C steel) of 50mmφ. (1) The maximum surface hardness, about 1.2 times higher than the normalized state, was obtained by 650°C sub-critical quenched specimens. The cause is attributable to the solution hardening effect of carbon into ferrite. And it can be considered that the hardness increase in the surface would have a beneficial effect to improve the fatigue limit for the crack initiation, σ_{W1}, of notched or press-fitted parts. (2) The maximum value of the compressive residual stresses in the surface was generated by 650°C sub-critical quenching, but depths of the compressive residual stress zone were almost independent on the sub-critical quenching temperatures. (3) The maximum value of the fatigue limit for falure, σ_{W2}, was obtained by 650°C sub-critical quenching. Moreover, a linear relationship between σ_{W2} and the values of the compressive residual stress in the surface was clarified by the sub-critical quenched specimens and the normalized ones. (4) It is concluded from the above results that the optimum sub-critical quenching temperature is about 650°C.
[R.Takahashi, et al.: *Tetsu-To-Hagane*, 66 (1980), 1679]

CSO: 4120

SCIENCE AND TECHNOLOGY

LOWERING BLAST FURNACE FUEL REQUIREMENTS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 50

[Text]

* To further decrease fuel consumption of a blast furnace, which was already very close to the lower limit under present operating conditions, the following two studies in addition to traditional improvements to fuel consumption have been carried out; (1) An advanced control technique for burden distribution at the furnace throat to achieve stable furnace conditions and ideal gas utilization, and (2) an operational technique to decrease Si-content and temperature of hot metal without any troublesome using of sinter with high MgO content. These techniques were applied to Fukuyama No.3 BF(inner volume: 3,223m^3) in order to approach to minimum fuel consumption under practical operating conditions. A 428.2kg/t-hot metal monthly fuel ratio was recorded in January 1979. Not only an increase of gas utilization but also the decrease of heat output in the melting zone contributed to achieve this low fuel ratio. A 405kg/t-hot metal ratio was estimated as the lower limitation, which might be achieved in the near future in actual opcrating conditions in Nippon Kokan, from the above results.
[M.Iizuka, et al.: *Tetsu-To-Hagane*, 66(1980), 1968]

CSO: 4120

SCIENCE AND TECHNOLOGY

RECOVERY OF IRON AND PHOSPHORUS FROM BOF SLAG USING FE-SI ALLOYS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 50

[Text]

* The recovery of iron from BOF slag by reduction is one of the most effective ways of its utilization. However, phosphorus which is simultaneously reduced dissolves in liquid iron almost completely. The present work was undertaken to seek a possibility for separate recovery of iron and phosphorus from BOF slag. The experiments were carried out using a plasma furnace under conditions by which BOF slag was reduced by powdered carbon in the presence of an Fe-Si alloy bath where silicon presumably enahnces the activity of the phosphorus. More than 95% iron and phosphorus were removed from the slag. While iron was recovered by Fe-Si alloy, a substantial amount of the reduced phosphorus was removed to the gas phase as P_2 gas. It is likely to be CO gas explosively generated on the reduction of iron oxide in slag and which has great effect on gaseous dephosphorization.
[H.Takeuchi, et al.: *Tetsu-To-Hagane*, 66(1980), 2051]

CSO: 4120

SCIENCE AND TECHNOLOGY

EFFECTS OF STRAIN-AGING, WELDING COLD-WORKED STRUCTURAL STEEL PLATES

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 50

[Text]

* COD tests were conducted on JIS-SM41B, -SM50B and -SM58Q steel plates in order to examine the effect of strain-aging on embrittlement of these steels. The hot straining embrittlement phenomenon on weld joints of cold worked steel plates was also studied. Finally the allowable bending radius in cold working of structural steels was examined on the basis of COD test results. The main results obtained are as follows. (1) Strain-aging strongly affects brittle fracture behaviour and shifts the COD transition curve toward the higher temperature range. Fibrous crack initiation at the crack tip and its slow growth, on the other hand, are not strongly affected by strain-aging if the prestrain is limited up to 10%. (2) The amount of the shift of COD transition curve toward the higher temperature range due to strain-aging is in good accordance with predictions based on Tetelman's critical fracture stress theory. (3) The COD value in the hot straining embrittled zone near the weld joint of cold worked steel plate is nearly equal to that of steel plate which is strained and then aged at 250°C for one hour. (4) The critical bending radius allowable in cold working can be calculated using the COD test results, and it is 4.5~7.3 times as large as the plate thickness.
[J.Kudo, et al.: *Tetsu-To-Hagane*, 66(1980), 2058]

CSO: 4120

SCIENCE AND TECHNOLOGY

STEEL CONTAINING MOLYBDENUM PRODUCES INDUSTRIAL SAVING

Tokyo TECHNOCRAT in English Vol 13 No 1-, Dec 80 p 51

[Text]

Steel containing molybdenum has been widely used as materials for machine structures. However, the price of Mo has increased and supplies have been difficult. In addition, successive rises in the price of crude oil have rsised the manufacturing costs. To cope with such, there is a strong desire to develop new kinds of steels and at lower prices.

Under such circumstances, Kobe Steel Ltd. has developed wire rods saving Mo and steel bars (Mo saving steel) which, while complying with users' demands for cost-reduction, provide characteristics required for machine parts.

Table 1 shows examples of chemical composition of the Mo saving steel which the company recommends and which are taken out from each high toughness steel and case-hardening steel.

Main composition of Mo saving steel of the high toughness steel is Mn-Cr-B. This kind of steel has been studied and developed before, and some of it has already been placed on the market as a practical steel, gaining a good reputation.

Fig.1 shows a comparison of characteristic values between the existing Mo containing steel and Mo saving steel when the tensile strength is set to 120kgf/cm^2. When the tensile strength is set to the same, there is almost no difference between the two. There is also a case where Mo saving steel is supeior.

The company has established a system by which it advises the optimum kinds of steel to be selected by users from steels of various compositions in compliance with characteristics required for machine parts, and that products can be manufactured under working conditions most suitable for the kinds of steel selected.

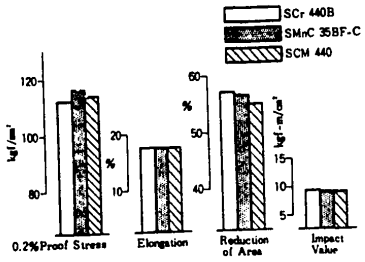


Fig. 1. Mechanical Properties Tempered to Similar Tensile Strength (120kgf/mm^2)

Table 1. Examples of Molybdenum Saving Steels

Items	Designation	Chemical Compositions %						Ideal Diameter
		C	Si	Mn	Cr	Mo	B	mm
To Replace SCM 440	SCr 440B (Cr-B Steel)	0.40	0.25	0.73	0.90	—	0.0008 Min.	120
	SMn C35B (Mn-Cr-B Steel)	0.35	0.10	1.10	0.75	—	0.0008 Min.	155
	SCr 440M (Cr-0.1 Mo Steel)	0.40	0.25	0.73	1.05	0.10	—	115
	SCr 440BM (Cr-0.1 Mo-B Steel)	0.40	0.25	0.73	1.05	0.10	0.0008 Min.	180
To Replace SCM 420	SCr 420M (Cr-0.1 Mo Steel)	0.20	0.25	0.80	1.10	0.10	—	65
	SMnC 20 (Mn-Cr Steel)	0.20	0.25	0.90	1.10	—	—	60
	SCr 420BM (Cr-0.1 Mo-B Steel)	0.20	0.25	0.73	1.05	0.10	0.0008 Min.	100
	SCr 420B (Cr-B Steel)	0.20	0.25	0.80	0.80	—	0.0008 Min.	75

CSO: 4120

SCIENCE AND TECHNOLOGY

BEHAVIOR OF NITROGEN, TIN-TYPE INCLUSIONS IN GRAY CAST IRON

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 52

[Text]

* The present investigation has been carried out in order to obtain more information on the behaviour of nitrogen in gray cast iron by analyzing the hydrochloric acid-soluble nitrogen (Ns) and acid-insoluble nitrogen (NI) determined by means of the JIS G1228 method. Nitrogen in gray cast iron combines with titanium present in or added to the molten iron, and forms TiN, which tends to float to the upper part of the specimen due to the difference in density of TiN and molten iron. When the mold temperature is high, the floating of TiN is pronounced, because solidification time is longer. When nitrogen content is increased, with titanium content held constant, a large quantity of TiN is formed and floats in a pronounced way.
[S. Idetsu, et al.: *Imono*, 52(1980), 623]

CSO: 4120

SCIENCE AND TECHNOLOGY

INFLUENCE OF NITROGEN ON GRAPHITE STRUCTURE OF CAST IRON CONTAINING TITANIUM

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 52

[Text]

* Nitrogen gas was introduced into molten grey cast iron containing 0.028% Ti.A nitrogen analyzer Thermatic "O-N" was used for nitrogen analysis. The graphite structure was analyzed using an image analyzing computer QTM720. Fine graphite precipitates during solidification in the cast iron being nitrogen treated. Non-metallic inclusions such as TiN, MnS, SiO_2, TiS and (Ti, Mn) S are found by microscopy and EPMA analysis. Nitrogen less than 100ppm reduces the number of eutectic cells in hypoeutectic cast iron. Nitrogen, however, does not have any influence on the primary graphite in hypoeutectic cast iron.
[N. Tsutsumi, et al.: *Imono*, 52(1980), 579]

CSO: 4120

SCIENCE AND TECHNOLOGY

EFFECT OF COVERING FLUX ON HYDROGEN CONTENT IN MOLTEN ALUMINUM ALLOYS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 52

[Text]

* Al-Si-Mg alloys were melted under a commercial covering flux containing NaCl, KCl, Na_2SiF_6 and NaF in an open-type, heavy oil-fired or natural gas-fired furnace. During this melting process, hydrogen content in the melt rapidly increased. Such rapid hydrogen absorption is prevented by the flux covering; however, humid atmosphere, prolonged holding and elevated temperatures cause an increase in hydrogen content in the melt even under the flux covering. Use of more flux effectively controls hydrogen absorption. Although the covering flux can itself dehydrogenize but the ability to do so gradually weakness with prolonged holding. The flux layer on the melt is gradually transformed from a liquid to a dense solid and subsequently to a porous solid as holding is prolonged. This leads to increase of hydrogen content in the melt.
[K. Sato, et al.: *Imono*, 52 (1980), 548]

CSO: 4120

SCIENCE AND TECHNOLOGY

CAST IRON POWDER SINTERING USING FE-SI-C MIXED POWDERS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 52

[Text]

• Recently sintered products from cast iron swarf powder have promised superior strength to parent cast iron. This strengthening mechanism has been studied using Fe-Si-C mixed powders with reference to the effects of C content, density and graphite morphology on tensile strength.

Reduced iron, atomized ferrosilicon (17% Si) and graphite powders were blended to contain 2.5%Si and various C contents in the range of 0~2.6%, and compacted at 600MPa. The preforms were sintered or powder-forged at 1423K in a dry H_2 atmosphere for various times up to 43.2ks, followed by air cooling (1K/s). The products containing about 1%C, sintered for a long time or powder-forged, showed high strength (900~1,200MPa), since graphite was spheroidized. But, it was not the case for the products containing more than 2%C. In the former, sintering proceeds in the state of all C being dissolved in the γ-phase, therefore, during the long sintering time, pores between powder particles are spheroidized. Powder-forging accelerates this spheroidization. In the latter, however, all C cannot be dissolved in the γ-phase, consequently, graphite remains along the boundaries of powder particles. In any case, during cooling, the supersaturating C precipitates as graphite to pores (from pore/γ-phase interface to the center) or to the residual graphite. This suggests that the precipitated graphite morphology is determined by the pore or residual graphite morphology.

[K. Hanawa, et al.: *Nihon Kinzoku Gakkaishi*, **44** (1980), 943]

CSO: 4120

SCIENCE AND TECHNOLOGY

STUDIES ON DENDRITE ARM SPACING, MICROSEGREGATION IN FE-CR-C ALLOYS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 52

[Text]

* Hypoeutectic irons with 5%, 10%, 15% and 30% chromium and with 0.5 to 3.8% carbon were quenched during solidification, and the dendrite arm spacings were measured to clarify the growth process of primary dendrite in Fe-Cr-C alloys. The distribution of chromium in the dendrites was analyzed with an electron probe micro-analyzer to investigate the solute redistribution during dendrite growth. The secondary arm spacing (D_2) during solidification was expressed by the empirical equation as follows: $D_2=A_2\theta_f^{0.30}$ where θ_f was solidification time. A_2 decreased with increasing chromium content, carbon content and cooling rate. The equation $D_2/D_2=0.3\theta_f^{-1}$ indicates that coarsening and coalescence of the secondary arms occur more frequently in the earlier stages of solidification than later. The distribution coefficient (K_{cr}) of chromium in the primary dendrite decreased almost linearly with increasing carbon content. In the specimens with chromium ranging from 5 to 15%, K_{cr} was little affected by the chromium content and was expressed by the following equation: $K_{cr}=-0.11(\%C)+0.99$. K_{cr} of the 30%Cr iron was appreciably larger than that given by the above equation. The segregation ratio of chromium in the dendrite is quantitatively expressed by the ratio of the chromium content in the boundary of the dendrite (C^B_{cr}) to that in the core (C^O_{cr}). The ratio C^B_{cr}/C^O_{cr} decreased gradually from 1.8 and 1.5 to 1.0 with increasing carbon content in the 5% and 10% chromium irons. On the other hand, C^B_{cr}/C^O_{cr} of the 30% chromium irons was less than 1.1. The results could be explained by the dependence of C^B_{cr}/C^O_{cr} in both K_{cr} and the fraction of the primary solid.
[K. Ogi, et al.: *Imono*, 52(1980), 629]

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF TECHNIQUE FOR OBTAINING POROUS METALS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 53

[Text]

Hitachi Ltd. has developed a new technique for forming a number of spongy pores in metals such as aluminum, or in effect producing porous metals. Porosity has already been realized in light-weight structural materials such as porous concrete and it has also been tried for metals for many years. Methods generally used at present include sintering, by which metal particles are sintered to form a porous body. However, sufficient porosity cannot be obtained readily by the sintering method. Further, it has been difficult to produce porous aluminum or its alloys.

With such difficulties in mind, the company has tackled making porous aluminum and other metals, having relatively low melting points, and has developed a unique casting method as shown in Fig.1, in which a spongy foamed resin plays the part of a metallic mold, so that porous metals have successfully been obtained.

Air occupies 98% of the porous metal obtained and it has a surface area about 400 times greater than normal. It is available about 50mm in thickness and can be cast in any shape.

Various uses can be considered – for example, for heat exchangers, solar heat collectors, heat resistant filters, and light-weight structural materials.

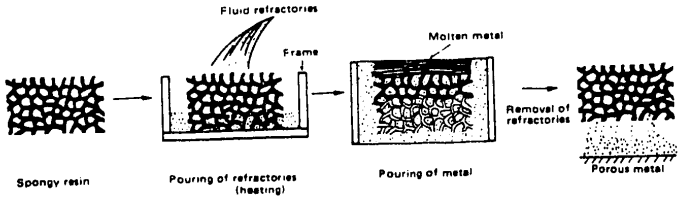


Fig. 1. Manufacturing Method

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW BUILD-UP WELDING METHOD DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 53

[Text]

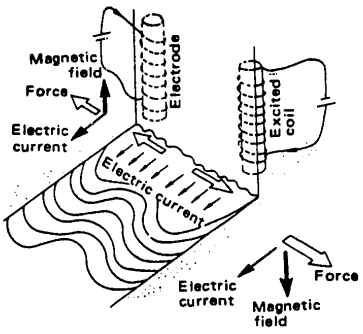


Fig.1. Principle of the Maglay Method

Kawasaki Steel Corp. has developed a new technique, the "Maglay Method" which is suited for build-up welding of stainless steel used for the inner walls of nuclear furnaces and chemical reaction vessels in order to raise their strength.

A long and narrow strip of stainless is used for the build-up welding method. The new technique permits the use of a wide stainless steel sections of over 150mm, three times that used previously. This considerably reduces welding time as compared with the conventional method.

The conventional welding method is called a submerged arc welding method by which flux is built up on a base metal and a electrode is inserted in it. Welding is there carried out by the heat of an arc generated between the electrode and base metal. In contrast, the Maglay method scatters flux on the base metal and generates a arc at the start so as to melt the flux. Then, as it is solidifies and is capable of passing electricity, the Joule's heat formed melts the stainless.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW SEAMING METHOD FOR ALUMINUM DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 53

[Text]

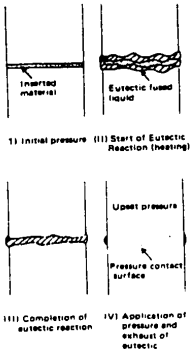


Fig. 1. Seaming Process of Aluminum to Aluminum

Hitachi Ltd. has developed an extremely new eutectic pressure welding method for seaming aluminum and which does not use conventional welding or soldering. It has successfully been put to practical use in the seaming of aluminum into aluminum pipes and aluminum to copper pipes.

Conventionally, aluminum is seamed by welding or soldering. However, the surface of the aluminum is liable to be oxidized. The rigid oxide film requires pre-treatment for its removal, and prevention of the oxide film during welding requires the welding to be carried out in an inert gas.

The method recently developed by the company is to use eutectic pressure welding by which an eutectic reaction of the metal is utilized for pressure welding. This technique omits pre-treatment and permits seaming in the air and shortens the seaming time to a great extent.

CSO: 4120

SCIENCE AND TECHNOLOGY

AUTOMATIC DRAINAGE DISCHARGER FOR AIR COMPRESSORS DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 54

[Text]

* Meiji Kikai Seisakusho Co. has recently developed and marketed an automatic drainage discharger for air compressors, which efficiently and automatically discharges drainage collected in air compressor tanks.

Conventionally, the discharge of drainage from air compressors is made by periodical manual methods, or automatic systems using electrical control or differential pressure. However, these systems involve heavy air losses and often malfunction.

This automatic drainage discharger is designed to open the valve when drainage is necessary, and close it when not needed. This unique structure causes no air loss. The discharger has the following features: 1) it requires no power supply. An air signal cycle enables all drainage, even high viscosity, to be discharged from the tanks. 2) it incorporates a large-capacity cartridge, permitting easy maintenance without clogging. 3) it is provided with a cock which can be manually operated for regular cleaning. 4) its operation is simple, requiring only the connection of the pressure switch or the unloader pilot valve of the compressor to the drainage outlet. 5) it has a compact design (110mm long, 80mm deep and 70mm high) and weighs only 2.5kg. It can be fitted to any reciprocating compressor.

CSO: 4120

SCIENCE AND TECHNOLOGY

CLASS 100 OR LESS INDUSTRIAL CLEAN ROOMS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 54

[Text]

* Takasago Netsugaku Kogyo Co. has produced a practical industrial clean room able to provide LSI and ultra-LSI manufacturing processes high-accuracy dust-free conditions, by removing micro dust particles, 0.1μ or less in size.

The new system is based on a high-accuracy thermohygrostat clean room unit which guarantees an air cleanliness below class 100 (209 base, U.S. Federal Standards) with temperature variations within $\pm 0.1^{\circ}C$ and humidity variations within 3%, and able to reduce dust (fine particles) with particle sizes below 0.1μ to less than 20 particles per ft^3.

The system consists of a mechanical unit incorporating a refrigerator, a heater, an automatic control, a high-performance filter (HEPA filter) and a circulation fan and work area. Conventional clean rooms completely clear only a certain portion of the area of dust, and control temperature and humidity. The new clean unit is designed to clean, with a high accuracy, a series of LSI and ultra-LSI manufacture exposure processes. This requires a high-accuracy removal of fine particles and control of temperature and humidity, in addition to cleaning the entire work area. In other words, the characteristic of the system is that it is designed to be integrated with an LSI manufacturing unit.

CSO: 4120

SCIENCE AND TECHNOLOGY

FIRST 'AUTOMATIC TIRE EQUIPPING SYSTEM' DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 55

[Text]

Hitachi Ltd. has recently developed a "automatic tyre equipping system" which realizes full automation from their receipt through to setting them to a car body to final tightening of the bolts.

The system consists of a Y-shape tyre feeder feeding tyres to the side of the front and rear wheels, a nut supplying device, tyre delivering devices disposed respectively at front and rear wheels, a bolt location detecting device, a tyre angle regulating device, and a machine hand reciprocating between the front and rear wheels for fitting and bolt fastening.

The system is a so-called "equipping robot" which detects the location of hub-bolts for each car body and functions the machine hand on the basis of the information so as to carry out the tyre equipping operation. In view of the fact that such an operation relies entirely on a man's hands at present, the success in full automation by the system is epock-making for the first time in the world. Although the equipping process is lagging most in automation out of the production processes of automobiles, the development of the system has made it possible to approach realization of an entirely unmanned factory a step further.

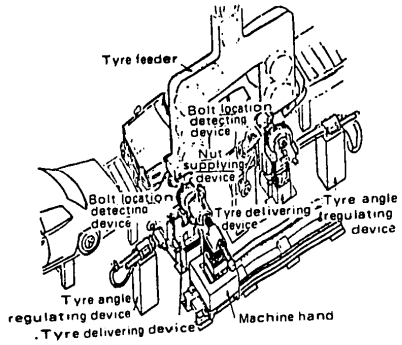


Fig. 1. Conceptual Diagram of Automatic Tyre Equipping System

CSO: 4120

SCIENCE AND TECHNOLOGY

DIAPHRAGM TYPE PULSE PUMP USING CRYSTAL OSCILLATION DIGITAL CIRCUIT

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 55

[Text]

Nippon Feeder Kogyo Co. has recently developed an electro-magnetic type diaphragm quantitative pulse pump "PD series" using crystal oscillation digital circuits and has started sales.

The mechanism of the pulse pump is as follows: a power circuit incorporated in the electronic circuits furnishes an electric current to a solenoid coil. This generates an electromagnetic force and the attractive force causes reciprocating movements, which push out a diaphragm attached to its end. Turning off of the electric source extinguishes the attractive force and the action of a spring returns the diaphragm back to its former position. Switching on and off for providing such reciprocal movements is carried out with high precision by a pulse oscillating circuit employing crystal oscillation elements.

The pulse pump has the following characteristics: Minute quantity and high pressure impregnation down to 0.067cc is possible although conventional motor reduction driving systems require 1cc per pulse (driving). The size becomes smaller by 20 to 30% and the electric power consumed is less by 30% than with conventional pumps.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF LARGE OUTPUT CARBON DIOXIDE LASER

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 55

[Text]

With the development of large output carbon dioxide lasers for use in machinework being promoted, the Electrotechnical Laboratory of the Agency of Industrial Science and Technology has recently succeeded in producing a laser of the highest level available in Japan, with an output of 4.3kW. They have used a carbon dioxide laser oscillator manufactured on an experimental basis.

The carbon dioxide laser manufactured by the Laboratory is called a double-axis-crossing type in which the direction in which mixed gas (a mixture of carbon dioxide, nitrogen and helium) flows is the same a the direction of discharge, with the direction of the laser oscillates at right angles to it.

The size of the laser oscillator is 1.3m long, 13cm high and 5.4cm wide. It houses a total of 200 bottle-shaped cathodes, 2 copper anodes and a zink-selenium reflector. This oscillator is subjected to a mixed gas with a speed of 120m/sec so as to discharge between the cathodes and anodes, and as a result, a large output laser beam of 4.3kW maximum, could be produced continuously. The size of the beam spot is about 4.2cm in radius and its power shown is as strong as to easily melt refractory brick.

Outside Japan, Abco Inc., the U.S. has already developed carbon dioxide laser equipment of 15kW output, while in Japan the level is still low, and the Ministry of International Trade and Industry aims at developing equipment of 20kW output by 1983. The first step is to produce equipment of 5kW output by 1980, and the recent success with the high output oscillation has almost attained this goal.

CSO: 4120

SCIENCE AND TECHNOLOGY

H-I ROCKET—SATELLITE LAUNCHING ENTERS NEW PHASE OF DEVELOPMENT

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 58

[Text] * Space development in Japan will enter a new stage in fiscal 1981 in order to develop H-I rockets, later to be used for launching satellites after fiscal 1985. H-I rockets are capable of launching satellites with weights of about 500kg, into geostationary orbits (altitude is approximately 36,000km). The rockets will be developed utilizing domestic technology with the National Space Development Agency of Japan as the main coordinating body.

N-rockets developed by the agency are Improved N-rockets are capable of launching into orbits, of weights up to about 130kg. Improved N rockets are capable of launching satellites with weights of only about 350kg.

H-I rockets are three stage rockets, with a diameter of 2.44m, total length of about 40m and weight at launch of some 140 tons. nine strapped-on boosters will be installed on the first stage. The first stage is a liquid rocket using kerosene similar to the first stage of N-rockets. The second stage is a newly developed liquid oxygen/liquid hydrogen rocket ahd the third stage a solid fuel rocket. An onboard inertial navigation system conducts trajectory correction so as to fly along a programmed trajectory.

The mort important technical subject is the development of the liquid oxygen/liquid hydrogen rocket. Liquid oxygen and liquid hydrogen are supplied by means of pumps from tanks in the rocket to a combustion chamber to obtain thrust. Handling liquid hydrogen is very difficult since it has an extremely low temperature of 20°K. Part of the fuel is burnt in a gas generator to drive turbines and pumps. This is also the first attempt for the agency.

Development of the inertial navigation technology is also an important subject. The inertial navigation system conducts real time computation of position, speed and attitude of the rocket by means of onboard computer-processing sensor measurements. It provides a control system with commands to correct deviations from a target trajectory and to project a satellite into the desired orbit. It is said that the progress of autopilot systems for airplanes permits the development of the inertial navigation system using domestic technology.

CSO: 4120

SCIENCE AND TECHNOLOGY

GRAB BUCKET WITH DIESEL ENGINE DRIVE DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 58

[Text]

* Fukushima Seisakusho Co., a major marine equipment maker, has developed a grab bucket with a diesel engine drive and with remote opening and closing operations. This is the first of its kind both in Japan and the world.

Conventional grab buckets, with exception of those installed on bulk carriers and tankers, are manually operated since they are not equipped with power. Thus, a skilled operator is required. Othe demerits are lower efficiency and safety problems. The newly developed bucket eliminates all those difficulties.

The grab bucket is operated as follows. The engine mounted on the bucket suspended from a crane is started by simply turning a key as in a car. When the bucket approaches the cargo with the crane's movement, an opening and shutting command is sent to a hydraulic pump from a remote control box. The signal extends and retracts a cylinder connected to the pump to automatically open and close the bucket.

CSO: 4120

SCIENCE AND TECHNOLOGY

FORKLIFT FOR 40-TON CONTAINER DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 58

[Text]

• Mitsubishi Heavy Industries Co., has developed a forklift truck which can handle containers up to 40 tons regardless of a container's size. The first unit has been exported to Taiwan.

The forklift truck using a spreader system can handle a variety of containers in current use. It can also stack containers up to 3 rows high.

Specifications are as follows:

Load capacity	40,000kg
Maximum lift	9,300mm
Minimum turning radius	7,300mm
(loaded with a 20ft container)	
Total length	10,500mm
Total width	12,190mm
(loaded with a 40ft container)	
Total height	10,950mm
Vehicle weight	60,000kg

CSO: 4120

SCIENCE AND TECHNOLOGY

POLLUTION FREE COAL SUPPLY SYSTEM PROMOTED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 58

[Text] * Development of a pollution free coal supply system (Coal Cartridge System, CCS), promoted by the Japan Society of Industrial Machinery Manufacturers, will soon be on a full-scale basis.

The object of CCS is to supply safely and without causing pollution, pulverized coal of stabilized quality, to medium and samller customers rather than large customers like electric power companies and cement manufacturing plants. At coal centers, pulverized coal is charged into large cartridges together with inert gas after controlling moisture composition and particle size (radii of below 5mm). The cartridges are then transported to remote relay stations (more than 150km) by rail and ship. Refilled to medium and small cartridges, the coal is then delivered by truck to customers in a service area. Empty cartridges are returned containing ash. Thus, CCS is significantly beneficial to customers with respect to the expense of coal transportation and storage, and safety and pollution protection measures.

Major technical developments remaining are: filling technology for placing pulverized coal into tanks and cartridges, pulverized coal supply equipment for combustion at constant rates, and inert gas filling technology and equipment.

Since technology developed by "airborne transportation of pulverized coal" by the Coal Technology Laboratory and "Advanced Coal Chain (ACC)" by the Electric Power Development Company can be applicable to the above problems, it was concluded that development of the necessary hardware system was feasible.

The CCS committee of the society is going to conduct up to the spring of 1981 (1) detailed design of the necessary equipment and circulation systems (2) selection of a circulation model area with a coal center (3) dispatch of a group to investigate coal delivery systems in Europe.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF NEW SUPEREXPRESS TRAIN

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 59

[Text]

Japan National Railways (JNR) has recently completed a new concept for a new Shinkansen (superexpress train) largely, by remodelling the current Shinkansen. European countries like, England and France, have developed their own high speed trains in endeavours to catch up with Japan's Shinkansen. These trends have threatened the premier stand of the Shinkansen in the area of overseas technical assistance. The new Shinkansen is aimed to regain the past reputation in Japan and overseas, and to counter efforts of the European countries.

One of the features of the new Shinkansen concept is to use a double deck vehicle (Fig. 1). According to a design by JNR's vehicle design section, motors and equipment under the floor are relocated to a trailer type vehicle, enabling the floor between wheels is to be lowered considerably. The vehicles are 4.5m high from the track. Heights of the first and second floors are 1.9m and 2m, respectively.

Maximum speed of the new Shinkansen will be 260km/h, the same as the "TGV" of France. Current vehicle width of 3.4m is reduced by about 50cm. Height from the floor to the ceiling is also lowered from the current 2.1m to below 2m. This slim vehicle permits reduction of weight from 60 tons to 55 tons. Changing of seats from rows of 5 to 4 is also being considered for further weight reduction.

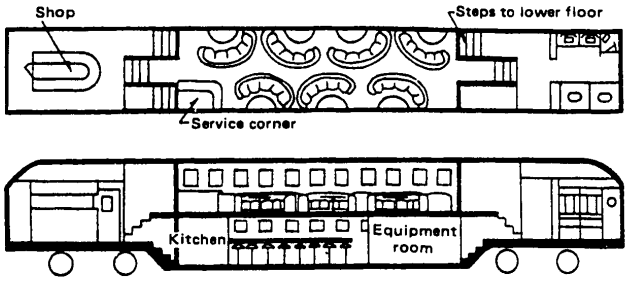


Fig. 1. Double Deck Lounge Car Planned for JNR's New Shinkansen

CSO: 4120

SCIENCE AND TECHNOLOGY

ALL-DAY HIGH-INTENSITY AERONAUTICAL OBSTRUCTION LIGHT SYSTEM

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 59

[Text]

Sanken Electric Co. has developed and introduced to the market a new type all-day aeronautical obstruction light system. Having high luminous intensity, the system is based on the technology for aeronautical obstruction lights using Xenon flash lamps introduced from the Solar Basic Co. in the U.S.

The system consists of high-intensity aeronautical obstruction lamps (Type FX-7-200K and Type FX-7-20K) a controller with a high voltage transformer, environmental illuminance sensors and relays. Features of the system are as follows: (1) White light radiation of 2,000 thousand candelas covers the entire visible radiation range to work effectively as an obstruction light even in daytime and in foggy conditions. (2) One of three intensities of light is selected, corresponding to environmental illuminance to use as an all-day long obstruction light. (3) Lamp exchange rate is one tenth of current light bulbs. (4) Higher radiation efficiency of Xenon flash lamps results in lower power consumption and higher reliability.

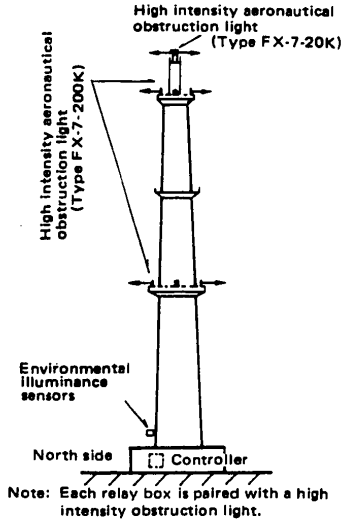


Fig. 1. System Implementation

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH-TEMPERATURE THERMISTOR DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 60

[Text] * Hitachi, Ltd. has developed a bead type high-temperature thermistor "GK32C1" which shows stable characteristics in the temperature range from 350°C to 500°C. The company has succeeded in the mass production of this thermistor by developing a special material for thermistors (a fine crystal sintered system of manganese-cobalt oxide) and technology for hermetic sealing.

The thermistor has the following features: 1) it uses thermally highly resistant palladium leads to make their life semipermanent. 2) It has higher sensitivity than platinum resistors. 3) It has a small time constant (or it is sensitive to temperature variation).

The thermistor's main specifications are as follows:

Resistance (at 400°C): 2kΩ
Thermistor constant: 6300 Kelvin (at 200–400°C)
Max. working temperature: 500°C
Temperature coefficient: −1.4%/°C
Thermal dissipation constant: 0.9mW/°C
Thermal time constant: 9 sec

Also it shows as small a resistance variation as ±3% at 500°C in 1,000 hours of operation. It is priced at ¥600 for lots of 10,000 units.

CSO: 4120

SCIENCE AND TECHNOLOGY

1M BIT MAGNETIC BUBBLE MEMORY DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 60

[Text]

* Fujitsu has developed a 1M bit magnetic bubble memory "FBM54DA". It has a total memory capacity of 1.2318M bits and uses a swap gate system which enables old data to be instantaneously replaced with new data.

Other than equipped with an instantaneous-power cut, means the new memory has the following features: 1) Its power consumption has been reduced to limit rises in temperature during operation and to increase reliability. 2) The minor loop group is divided into two to allow data to be read alternately. The use of a side-by-side system with a detector arranged adjacently has enabled the signal-noise ratio in the detector to be increased. 3) Technology for fine bubbles 1.9μm in diameter is used to make the body small and thin.

Main Specifications:

Total memory capacity: 1.231.800 bits (600 loopsx2053bits/loop)
Operating frequency: 100kHz
Transfer speed: 100k bits/sec. (max.)
Mean access time: 11.2ms
Pin arrangement: 24 pins DIP
Dimensions: 31.50x36.07x8.51mm

CSO: 4120

SCIENCE AND TECHNOLOGY

LARGE-CAPACITY LIQUID CRYSTAL DISPLAYS DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 60

[Text]

• The Suwa Seikosha Group has developed several large-capacity liquid crystal display units as computer terminal equipment. They are as follows:

1) dual liquid crystal display unit with 40 characters x 8 lines.
2) dual electrode liquid crystal display unit for picture display with 240 x 48 dots.
3) high-duty liquid crystal display unit with 20 characters (1 character: 5x7 dots)x8 lines.
4) multi-figure liquid crystal display unit.

For the high-duty liquid crystal display unit, the conventional limit duty range of 1/16 to 1/18 has been raised widely to 1/28 to achieve large-capacity display. For liquid crystal material, a twist nematic (TN) type has been improved to adequately increase response characteristics for display at high duty levels.

The dual-frequency liquid crystal display unit is driven by 2 frequencies: 50kHz and 10-15kHz for the large-capacity display. For materials, a biphenyl system is used to attain high contrast and a wide range of vision.

The dual electrode display unit has a dual electrode structure to double the resolving power of the conventional TNFE type (at a duty of 1/12).

The multi-figure liquid crystal display unit has been developed for computer terminals including word processors. The company intends to achieve a display capacity of 80 charactersx8 lines and ultimately replacing CRT's.

CSO: 4120

SCIENCE AND TECHNOLOGY

RETICLE DEFECT INSPECTION SYSTEM DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 60

[Text]

* Japan Automatic Control has developed an instrument "IRT-1" which automatically inspects reticles which correspond to original drawings, in the manufacture of IC's and LSI units.

The instrument is designed to compare reticle patterns with data in the magnetic tape of a pattern generator by using television to detect defects. It inspects more efficiently than can be performed using conventional microscopes.

The instrument consists of a video signal converter, a control unit with 3 television sets and an X-Y stage. Inspection is performed as follows: The video signal converter converts data in the magnetic tape into video signals to display a pattern on one of screens in the control. Meanwhile, a reticle is mounted on the X-Y stage for inspection and its pattern is displayed on another screen. If any of both patterns displayed disagree, the parts differing will be displayed on a third screen.

The instrument provides an inspection accuracy of 2-3μm and has an inspection speed of 12.6 sec per 1cm^2, which is about 10 times as fast as direct visual inspection. It is also able to detect omissions in patterns. Gang reticles with the same pattern repeatedly printed can be inspected by the photo-mask defect inspection system "5MD-24/25" marketed by the company.

The new instrument is priced at ¥100 million.

CSO: 4120

SCIENCE AND TECHNOLOGY

AUTOMATIC ULTRA LSI DESIGNING SYSTEM

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 61

[Text]

In its development of automatic systems for designing ultra-LSI units which are increasingly becoming larger and more complicated by using computers, NTT's Electrical Communications Laboratory has recently completed a new automatic designing system which is able to reduce the conventional number of man-hours for ultra-LSI designing to 1/10 to 1/100 that of conventional designing.

The new automatic ultra-LSI designing system has the following features:

1) It uses a newly developed "language" HSL (hierachical specification language) common to all stages of designing.

2) Designing data required at each stage is written in common HSL and stored in a data base, ready to be available for various purposes, such as designing and checking of operations and errors.

3) It is amply provided with newly developed programs for logic simulation, circuit simulation and automatic layout required for computer designing of ultra-LSI units.

Designing of LSI units includes a number of stages, such as logic designing, circuit designing, and layout designing. In this designing, it is necessary for a number of specialists including users and designers of equipment and systems, and personnel for LSI manufacture to participate from the stage of planning. Conventioally it was very difficult to communicate necessary data correctly between these people in different organizations and with different specialities.

To resolve these difficulties, HSL was developed. It is able to describe all data including logic specifications and circuit specifications necessary for LSI designing. It, for example, enables designers of equipment and systems to describe necessary LSI specifications, and communicate them correctly to the personnel of LSI designing and manufacture. Also, it has proved the possibility of reducing the number of man-hours for preparing computer input data at different stages, which conventionally required much labor and time, to 1/4 to 1/10.

Also, the new LSI designing system is provided with a designing data base storing various types of data written in HSL to enable data assets to be called out for various purposes at any stage of designing. This has permitted very efficient LSI designing throughout from logic designing to layout.

Programs provided for LSI designing at different stages cover 36 types including checking of logic operations, analysis of circuits and transistors, automatic layout and test pattern generation to deal with LSI designing for various purposes.

An example of LSI designing including 8,000 transistors, with the new automatic designing system, achieved a reduction of the number of manhours to about 1/20 with integration into a smaller area than in manual designing (see the Table). Another example including 70,000 transistors completed designing normally taking 3 man-months.

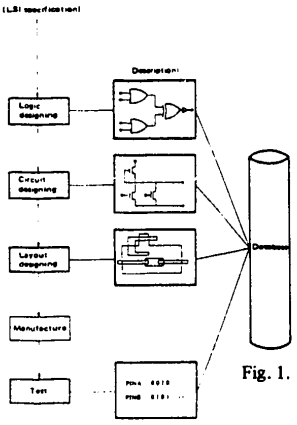


Fig. 1. Automatic Ultra-LSI Designing System (Descriptions are all written in HSL)

```
                IDENT   :PROCESSOR;
                VERSION :VR01.00 ;
                DATE    :80/10/03;
                AUTHOR  :DENDEN TARO ;
                PROJECT :VLSI03 ;
                COLLECTION :VLSI;
                COMMENT :  MICRO MPOCESSOR ;
                NAME    :BUS3W ;
                PURPOSE : LOGSIM , ROUTER ;
                PROCESS :EDM0S2U ;
                LEVEL   :BLOCK    ;
                EXT     :A.B.E.D.VDD.VSS;
                DEFAULT :1.1.1.A          ;
                INPUTS  :.B..E;
                OUTPUTS :.A.;
                POWERS  :.VDD,.VSS ;
                BUS     :.D;
                TYPES   :INV.TRINAND ;
                INV     :G1 ;
                TRINAND :G2.G3 ;
                MPOSITION (.A(1.1)..B(1.30)..E(1.50);
                  .D(100.50).G1(50.10).G2(50.20).G3(50.30);
                NETA    =FROM(G2.3)       TO(.A);
                NETB    =FROM(.B)         TO(G3.2);
                NETE    =FROM(.E)         TO(61.1.G3.1) ;
                NETD    =.D. G2.2, G3.3 ;
                MDELAYS :DEL035 :NETA .NETD ...;
                DELAYS  :DEL035,35.32,37.33,32.37 ;
                END     ;

                CEND ;
```

Fig. 2. Example of Description in HSL

Table 1. Example of Efficient Automatic Designing (for 8000 Transistor LSI Unit)

	Manual designing	Automatic designing
Area index	1	0.8
Number of man-days	225	10

CSO: 4120

SCIENCE AND TECHNOLOGY

PHOTO RESIST FOR MASS PRODUCTION OF ULTRA LSI

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 61

[Text]

Hitachi, Ltd. has developed an ultra-violet ray photo resist for the mass production of ultra-LSI units. It enables fine patterns, with a line width of 1μm, to be formed by one-to-one projection exposure, which previously had been considered not possible.

The new material developed by Hitachi is a negative-type ultra-violet ray photo resist mainly composed of a phenolic high-molecular compound and a photo-sensitive azide compound. Conventional negative-type photo resists make use of the phenomenon of molecules, when exposed to ultra-violet rays, swelling and becoming insoluble in a developer. In contrast, the newly announced photo resist makes use of the phenomenon of a resist material, when exposed to ultra-violet rays, changing chemically and the molecules becoming insoluble. This process does not cause the resist to swell during development and thus prevents the resolving power from decreasing. Also, with conventional negative-type photo-resists, the cross-section of resist images obtained by proximity or one-to-one projection exposure is trapezoidal, which makes it difficult to form fine patterns. With the newly disclosed resist, the cross-section of the photo-resist images can be controlled freely, making it possible to obtain rectangular cross sections most favorable to form fine patterns.

Furthermore, the phenolic high-molecular compound as one main component of the new material has resistance to heat, and is also highly resistant to radiation. Thus, the resist has the merit of withstanding severe plasma processing such as dry etching. On the other hand, the azide compound, as another main component, has high efficiency in photo-chemical reaction and thus has the merit of being highly sensitive. The new ultraviolet photo-resist material has been made practical by skillfully combining the advantageous properties of these substances. Their advantages have been made fully effective for the mass production of ultra LSI units including dry etching.

Features:

1) By using a one-to-one projection exposure system, its cross section of the resist can be freely controlled into rectangular and inversely trapezoidal shapes, with a line width of 1μ.

2) With a typical one-to-one projection exposure system, it enables 4-inch wafers to be exposed in 30 sec. (as measured by the company).

3) Like conventional resists, it allows such processes as application and development.

4) It has high resistance to dry etching.

5) It provides stable characteristics like conventional negative-type rubber photo resists.

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH SPEED ONE MEGABIT DATA COMMUNICATION

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 62

[Text]

* Nissei Electrical Institute has developed an "Optical Space Transmission Communication System" which provides high speed data communication of 1 megabit/second by sending infrared rays of 0.9μ direct without any cable. The system adopts a GaAs (gallium arsenide) LED (light emitting diode) as the light emitting device of the transmitter, a silicon photodiode (APD) as the light receiving device of the receiver, and provides data communication by sending 0.9μ infrared rays in space over a maximum communication distance of 600m. The system has the following features:

(1) It is low priced at ¥1,800,000.
(2) It is simple and quick to install requiring merely adjusting sights.
(3) It is easily connected to a computer using TTL (transister transister logic).
(4) Transmitter-receiver combinations can be connected in line with each other up to 4 or so combinations, in order to extend the distance.
(5) Since the system is small and light, it is easily portable.

CSO: 4120

SCIENCE AND TECHNOLOGY

MUTUAL COMMUNICATION SERVICE BETWEEN DRESS, DEMOS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 62

[Text]

* NTT will start a public data communication service between their DRESS center (which stands for stock management service center and DEMOS center (which stands for science technology computation service center) around next fall. Due to this service, users can use not only the transmission service of DRESS's file to DEMOS (or DEMOS's file to DRESS) but both DRESS and DEMOS services by one terminal equipment now in service. The mutual communication between the centers means greatly improved and easier access to the system for users who can only use one service (DRESS or DEMOS) at present. Aiming at the scheduled introduction of mutual communication between centers, NTT is planning to expand the intercenter communication ability between each DRESS center in order to attain file transmission ability which is already available at DEMOS service centers. Moreover, NTT will start a kanji output service at three centers (DRESS Tokyo III, Osaka IV and DEMOS of Tokyo V Science Technology-E batch center) by introducing their high speed kanji printer of 15,000 lines per minute.

CSO: 4120

SCIENCE AND TECHNOLOGY

SURVEY EFFECTS OF RAIN ON QUASI-MILLIMETER ELECTRIC WAVE COMMUNICATIONS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 62

[Text]

* KDD (Kokusai Denshin Denwa Co., Ltd.) has announced its experimental plan, and according to KDD's statement, they will start communications experiments based on the site diversity method, and which will use from late 1981 the Yamaguchi Satellite Communication Station and Hamada International Relay Station. This experiment aims to ensure good transmission of the 14/11GHz range (quasi-millimeter) electric waves used in communications making use of the Intelsat V satellite. The satellite is expected to be launched into space above the Indian Ocean in 1981.

The experiments aim to establish countermeasures for rain, since quasi-millimeter waves are easily affected by rain and this wave characteristic makes communications by one earth station difficult, especially in an area having a heavy rainfall such as Japan. Since a real satellite will be used in the experiment. KDD is expecting to obtain fruitful results concerning electric propagation or communication methods in the quasi-millimeter wave range.

CSO: 4120

SCIENCE AND TECHNOLOGY

OVERALL EVALUATION TEST STARTED FOR SUBMARINE PHOTOFIBER CABLE

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 63

[Text]

A cable with optical fibers used as the transmission medium has the following advantages over the conventional copper cable: it can be made to have a large-capacity and it is expected to be more economical because of low transmission losses and the necessity of fewer repeaters. Also, it is lightweight, flexible and easy to handle. Thus, it is expected to serve for submarine speech transmission lines which require difficult maintenance work to be performed within a limited space in installation ships. Various circles are promoting studies to put the cable into practical use.

Nippon Telegraph and Telephone Public Corporation has already sought cable structures sufficiently strong enough to endure the submarine environment and external pressures during installation and has established the basic technology for making them practical. In order to establish the technology for submarine photofiber cable and equipment for submarine terminal stations and to conduct overall assessment, the corporation has recently provided coastal test stations at Inatori and Kawazu on Izu Peninsula and has installed a transmission line consisting of a submarine photofiber cable, 10.2km long and 240m (max.) deep in the sea between the stations.

The cable installed is made from a collection of optical fibers covered with pressure-resistant copper tubing and further covered with PE, and an alternate double stranded sheath. The core system consists of 5 single-mode and 5 graded multimode optical fibers. These core wires were connected in folds to make a cable which was available for transmission tests, with a cable length of 50km and the cable was provided on the way with two junctions to obtain data on cable properties at these points.

Mean optical losses after installation, with an optical wavelength of 1.3μm, are 0.79dB/km for the single-mode optical fibers and 0.81dB/km for graded multimode optical fibers. These values are the smallest in the world for long-wavelength band optical transmission lines installed in the sea in any previous test.

CSO: 4120

SCIENCE AND TECHNOLOGY

RELIABILITY SURVEY OF MECHANICAL FILTER FOR CHANNEL TRANSLATING EQUIPMENT

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 63

[Text]

For new carrier channel translating equipment (VR-2(HTR)), it has been decided that mechanical filters which are better than conventional LC filters in respect of size and economy will be used for channel and signal filters, which are essential parts of the equipment.

Channel filters are characteristic in that they are used in large quantities and are required to comply with severe electrical standards. Thus, before adopting mechanical filters, it is necessary to definitely check their reliability.

The Musashino Electrical Communications Laboratory has for 2 years been conducting a series of tests to examine the reliability of mechanical filters.

Resonators used in these filters are made of an iron-nickel alloy which have excellent mechanical properties, including elastic coefficients. The properties of the filters depend on the resonance frequency of the torsional vibration of cylinders made of this alloy. So the laboratory has checked machine rooms for temperatures and assumed stresses during transportation to see if they can withstand such stresses.

The cut-off frequency, for example, as one of the most important properties of a mechanical filter, varied by only 46ppm (1ppm= 10^{-4}%) during a 13,000 hour high-temperature (55°C) storage test. From this data, variation over 20 years is calculated to be about 85ppm. This value is sufficiently small as compared with a variation allowed for a filter. Also in any tests concerning vibration, shock and temperature cycles (−10°C to + 55°C), it was proved that there was little variation in electrical properties.

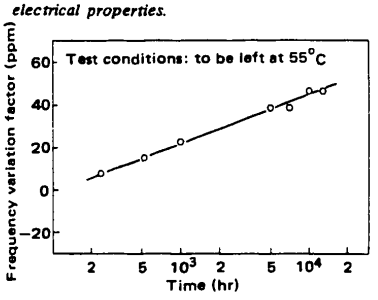


Fig. 2. Hourly Changes of Shut-off Frequency of Mechanical Filter

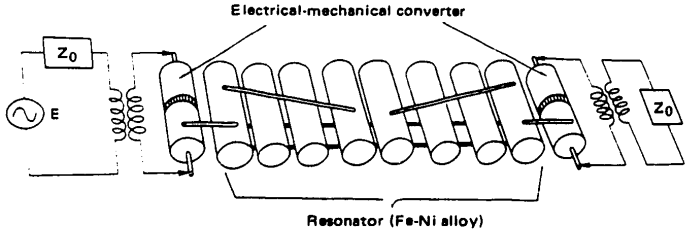


Fig. 1. Conceptual Sketch of Mechanical Filter

SCIENCE AND TECHNOLOGY

NEW MODEL HANDWRITTEN CHARACTER INPUT EQUIPMENT

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 65

[Text]

The Nagoya City Industrial Laboratory has developed handwritten character input equipment employing an on-line recognition system, in which a minicomputer is used. Up to the present time, the methods for conveying character information to a computer have been classified into the following four systems of inputting:

1. Keyboard system – inputting information by operating a teletypewriter keyboard.

2. Pen touch system – inputting information by indicating character position on a character panel by an indicator pen.

3. OCR system – inputting information by a direct character reader so that they can be recognized by the character recognition technique.

4. On-line recognition system – inputting handwritten information on a sheet of paper through the process of handwriting characters and then recognizing them based on time series data.

This equipment has been developed to meet strong requirements for a method to replace the keyboard-type, so as to be able to input characters to a computer easily by anyone with the simplicity of merely using a pen or ballpoint pen.

This equipment, though of the above-mentioned fourth type, employs an optical fiber instead of traditional sensors. The operational principle is such that handwritten information by characters being written by a pen or ballpoint pen on an ordinary sheet of paper are received by the optical fiber in the shape of reflected light of light reflected from the paper.

The differences between black and white from the paper corresponding to variations in light intensity, are converted into electrical signals and inputted into the computer, and their character configurations, such as the number of strokes and writing order etc., are analyzed in real-time processing (i.e., for each character) based on previously inputted handwriting information, and then they are collated with the previously-stored dictionary and recognised. This equipment employs a microcomputer which is very small and cheap, and has the optical fiber connected to it.

It has been tested and confirmed that this equipment can recognize all the common handwritten katakana characters, numerals, and letters of the alphabet which are inputted.

CSO: 4120

SCIENCE AND TECHNOLOGY

HIGH-PERFORMANCE 16-BIT MICROCOMPUTER DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 65

[Text]

Toshiba has developed the world's highest-performance 16-bit microcomputer "T88000" based on the SOS (silicon-on-sapphire) LSI. The company desired also to use the LSI as the CPU of the minicomputer and at the same time to develop and apply it to the computer peripheral terminals, and various control units for clerical and industrial use.

The SOS comprises an integrated-circuit substrate in which about a 0.6-micron thick silicon film is formed on a sapphire crystal. It gives about two or three times improvement in operational speed and power dissipation, and also enables about a 30% improvement in terms of the integration density as compared with the conventional I/C's using the silicon substrate (bulk silicon).

This established technology has implemented the highest performances as a complicated architectural logical circuit device: 2.8-micron effective gate length, 0.7 nanosecond/gate propagation delay time, about 1200-gate integrations per chip, and 700-milliwatt power dissipation per chip. The "T8800", with these high integrations and speeds being reflected on its performances and functions, has accomplished the world's highest performance as a microcomputer in terms of arithmetic-operational speed and processing functions, in implementing 400 nanosecond operational speed for addition and subtraction, 1.6M-bite capacity of the main storage area, built-in floating-point and decimal operational instructions, and improved internal registers and buses.

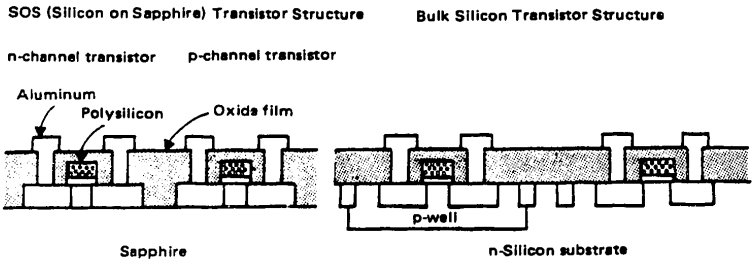


Fig. 1. Comparison of SOS Transistor Structure and Bulk Silicon Transistor Structure

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF HYDROXY APATITE REPORTED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 68

[Text] * Hydroxy apatite, an apatite derivative has been developed jointly by Junsei Kagaku Co. and Dental Kagaku Co.

Apatite has a general formula of $M_{10}(ZO_4)_6X_2$ and is used for various purposes, such as sintered ceramics, artificial bone, laser materials, catalysts and as an emulsifing agent. Hydroxy apatite is one derivative like chloro and fluoro apatites.

Although Dental Kagaku Co. has been dealing with chemicals for dentists, such as for false teeth, the development of hydroxy apatite has been continued jointly with the Junsei Kagaku Co. The dry synthetic method from among four techniques, dry synthesis, fusion method, wet method and hydrothermal synthesis, was adopted for manufacturing. According to the plan, the compound will be produced by Dental Kagaku Co. and Junsei Kagaku Co. will handle sales. Two grades of porous material (purity 99% up, granule) and high purity (purity 99.5% up, powder) will be sold. The porous grade has excellent bioaffinity, and the demand is expected as a bed for chromatography to isolate proteins, nucleic acid, enzymes and viruses. The company is planning to develop the market of chromatography for porous hydroxy apatite.

The company also is expecting demand for the high purity grade. Since hydroxy apatite is the main inorganic component of bone and teeth, the demand in the field of artificial bone and false teeth is expected. In addition to these uses, there are applications as a fluorescent substance, catalyst and electric materials being developed.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF NEW TECHNIQUE FOR MEASURING FORMIC ACID

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 68

[Text] * Tokyo Institute of Technology has developed a new technique for measuring formic acid using a bioorganism sensor. Although the compound is included in food and fermentation solutions, quantitative analysis is very difficult because it is easily decomposed. According to the new technique, the concentration of formic acid can be measured exactly and continuously, by converting a reaction between the formic acid and a microbe into an electric current.

The microbe for the sensor is *clostridium butyricum* and was cultivated at 37°C for 9 hours. The resulting fungi were collected and washed with a buffer solution of phosphoric acid. A 0.1ml of a suspension of the fungi, including 25mg of wet fungi, was added to 0.9ml of a gelatine solution (Japanese) and a filter film of acetyl cellulose was immersed in the mixture for 20 seconds and then chilled immediately to 5°C. The film of fixed microbes was obtained in this way.

The film was then bonded to a fluorocarbon polymer of the hydrogen electrode of a fuel cell (Pt anode, silver peroxide cathode) and then the surface was covered with a porous fluorocarbon polymer film. In this way the sensor for formic acid was constructed.

The mechanism of the sensor is explained as follows. Formic acid passing through the porous film contacts the *clostridium butyricum* and to produce hydrogen gas that is converted into a current signal at the Pt anode composing the hydrogen electrode of the fuel cell. An increase in formic acid concentration causes an increased output of hydrogen gas and therefore the current signal becomes greater. There is a linear relation between the concentration of formic acid and the current signal in the 10–1,000mg/l range. This corresponds well to results measured by gas chromatography. Acetic acid, propionic acid, butyric acid, methyl alcohol, ethyl alcohol and others do not produce hydrogen gas even if they come in contact with microbes. On the other hand, pyruvic acid and glucose produce hydrogen gas, but they cannot pass through the protective film. Therefore, the sensor is very selective toward formic acid.

CSO: 4120

SCIENCE AND TECHNOLOGY

SUPER SHORT CRACKING TECHNIQUE FOR CHEMICALS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 68

[Text] * Idemitsu Petroleum Chemical Co. has a plan to construct an ethylene plant with an annual output of 300,000 tons using their own new cracking technique.

With this technique, called the "super short cracking technique", the time of a raw material in a cracking equipment is only one second. This makes it possible to increase the cracking temperature up to approximately 1,000°C, but the improvement of tube material with heat resistance is very important for use of the technique. The company decided to construct the plant because it was found possible to use the method commercially as a result of tests using a test pilot plant for some time.

By adopting the super short cracking technique, the basic unit of naphtha in an ethylene plant becomes 4.1 (4,100kl of naphtha is used for 1 ton of ethylene production) and the ethylene yield is improved considerably with compared conventional methods, and reaches 36%. Heavy oil (except asphalt fraction) in addition to LPG, naphtha, kerosene and light oil, can be used as the raw material. Thus the technique is considered to be the best at present and is receiving attention from all parts of the world.

The cracking technique so far, is used mainly for naphtha, in Japan. Cracking equipment has been remodelled not only for naphtha but also for LPG and NGL, because the use of a greater variety of raw materials has been considered desirable after the first and second oil crises. Previously, only kerosene and light oil were available among various raw materials even when the latest equipment was used. On the other hand, this new technique, can use a variety of raw materials and this is the reason for it receiving so much attention.

CSO: 4120

SCIENCE AND TECHNOLOGY

INDUSTRIALIZATION OF HUMIC ACID SODIUM SALT

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 68

[Text]

* Japan Metals & Chemicals Co. has started to produce on an industrial scale, humic acid sodium salt, a derivative of nitro humic acid.

At present, the annual demand in Japan for this material is estimated to be 2,000-3,000 tons and two or three companies are producing it. However, the demand is expanding because humic acid sodium slat has various uses such as a mud material for public works and drilling bores, as a rust-proofing agent for tubing, a cement additive, an ingredient for surface-active agents, adsorbent for heavy metals and a deodorant. The company, the largest maker in Japan, decided to produce it commercially since there were possibilities for cultivating markets and the development of a varied range of uses.

The company has a nitro humic acid plant with an annual production of 50,000 tons at their Hanamaki factory, and 35,000 tons are used as a magnesia fertilizer of nitro humic acid and medicines for animals. The remaining 15,000 tons are converted to humic acid sodium salt.

CSO: 4120

SCIENCE AND TECHNOLOGY

POLYETHYLENE AS REGENERATIVE MATERIAL TO PRODUCE ENERGY SAVINGS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 69

[Text]

The development of safe regenerator to accumulate heat energy and release it according to needs as required is recently expected from the point of view of saving energy. When such used in the general home, for air-conditioning and heating, and for supplying hot water, its highly safety in addition to the high efficiency and the low cost is required.

A regenerative material of a latent heat type using crystalline polyethylene has been developed by the Government Industrial Research Institute, Nagoya, of the Agency of Industrial Science and Technology, where the study of regenerative materials has been continued as a part of the "sunshine programme".

Polyethylene is produced commercially in large quantities and its price is relatively cheap. In addition, it is non corrosive towards iron, and super-cooling and phase isolation are different from inorganic hydrate salts. Polyethylene becomes a viscous liquid beyond its melting point; and the efficiency of heat exchange becomes lower by the accumulating of welded particles which close the flow path of a heat medium at temperature lower than its melting point. These reasons are making its practical use difficult.

The regenerative material developed by the Institute is crystalline polyethylene cross-linked by a radiation treatment and the heat-resistant properties are improved as the result. Further, welding between particles has been prevented by coating the surface of the pellets (diameter 3mm) with powdered inorganic compounds, heat-resistant polymer, and metals.

The regenerative materials shown in the photography are pellets coated with powdered alumina(A) and nickel(B). They have shown good results with repeated regenerative operations over a long time without welding and deformation. A regenerator, easily reaching the 110–140°C can be made if such materials are packed in an insulated vessel.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW MANUFACTURING TECHNIQUE FOR SUPER FINE POWDER DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 69

[Text]

The Government Industrial Research Institute, Nagoya, of the Agency of Industrial Science and Technology has developed a new manufacturing method to make easily, super fine powder (particle size is below 1μ) of various oxides that are important raw materials for producing fine ceramics.

The method uses metallic hydroxides obtained from reactions between aqueous ammonia and metallic salts. The hydroxides turn to super fine powdered oxides through a colloidal chemical reaction.

The high purity, super fine powders with high uniformity are required as raw materials for producing fine ceramics. Their use is becoming popular especially for the manufacture of thin ceramic films and various other ceramics for electronics; thus the manufacturing method of super fine powder is becoming important.

Conventional methods for obtaining super fine powder are:

(1) alkoxide method by hydrolysis of metal alkoxides.
(2) thermal cracking, by cracking of metallic salts.
(3) pyrolysis in the gas phase by heating metallic compounds following their gasification.

In the first method, the alkoxides are expensive and the operation of hydrolysis is difficult. In the second method, the particle size is large and crushing is needed. In the third method, the process is difficult because only raw materials that can be gasified are used.

The new method developed by the Institute is as follows: Hydroxides produced by adding aqueous ammonia to metallic salts are treated by colloidal chemical process in an organic solvent such as a higher alcohol and ester. The oxides obtained as super fine powder are dried, calcined and powdered. Depending on the method, many kinds of oxides are obtainable, and they have already succeeded to make super fine powders of solids of complicated composition such as alumina, yttria, tin oxide, iron oxide, zirconia-yttria system, yttria-thoria system and so on.

The photograph by an electron microscope shows the powder of $(Y_2O_3)_{0.05}$ $(ZrO_2)_{0.95}$. The sintering properties of the powder were excellent and the sintered material with theoretical density was obtained by calcination at 1,500°C for two hours. Toyo Soda Manufacturing Co. and Nippon Kagaku Tokyo Co. are doing researching under the leadership of the Institute to make the method commercially practical.

CSO: 4120

SCIENCE AND TECHNOLOGY

APPLE ROT CONTROL CHEMICAL BECOMES TOP PESTICIDE

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 72

[Text] * It has been disclosed that "guazatine", an apple rot control chemical developed by Dainippon Ink and Chemicals, Inc., will be the product No.1 for hard-to-control pests, under the "New Agricultural Chemicals Development Promotion Project" by the Ministry of Agriculture, Forestry and Fisheries.

Few companies are interested in the development of new agricultural chemicals, for hard-to-control pests, because of the increasing gigantic funds and time it requires for such development. This has triggered the government to plan and promote new policies. The Ministry of Agriculture, Forestry and Fisheries started the "New Agricultural Chemicals Development Promotion Project" in 1978.

Dainippon Ink and Chemicals' "guazatine" has been developed as one of the apple rot control chemicals and was the starting theme of the project. It was shown to be effective in 1978 and was brought to toxicity tests in February, 1979. "Guazatine" is a new guanidine compound and can be used, not only as a coating agent, but also as a spray agent suited for heavy use.

Also, the new chemical has been shown to be comparable to Topzin, an agent already developed. If everything goes well, it will be put on the market in 1982.

"Guazatine" is expected to play roles of a pioneer product, and the Ministry of Agriculture, Forestry and Fisheries hopes that manufacturers of agricultural chemicals and of their starting materials will be more interested in developing new agricultural chemicals for hard-to-control pests and it is also considering enlarging the project to cover herbicides for field products.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF NEW ANTAGONIZER DISCLOSED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 72

[Text] Tobo Chemical Co. has recently developed a novel antagonizer called "aza-lactam".

This aza-lactam is usually called N-alkyl aza-alkene lactam, denoting the existence of another nitrogen atom, as a cyclic amide in the lactam ring. Also, under the universal nomenclature of heterocycles, it is "diazepin", a two-nitrogen containing heterocycle as a 7-element ring for n=2 and "diazosin", a two-nitrogen containing heterocycle as an 8-element ring for n=3.

Azalactam has the following features:

(1) Although it is a nonionic substance, it has a strong antagonizing activity.
(2) It is antagonistic to a wide range of bacteria.
(3) It has much lower toxicity than ionic antagonizers.
(4) It scarcely loses antagonizing power in the presence of proteins.
(5) It has a high affinity for solvents regardless of polarity.

As described above, it is recognized that azalactam has many advantages such as low-toxicity and low-irritation over conventional ionic substances used as antimicrophytes and disinfectants. The company expects it to be a versatile product for it can be mixed with plastics to make germicidal packing materials which can then be used to protect trees, vegetables and fruits against bacterial contamination. Its biocidal effects can be useful in the extermination of the sulfuric-acid reducing bacteria leading to the corrosion of the equipment used for oil drilling. Or it can be turned into an acetic acid to synthesize a lactam betaine type zwitter-ion interfacial active agent which can be used as a base for detergents and shampoos.

Again, penicillin, of the β-lactam system, has been well known as an antibiotic. Its structure contains an ion-base. In contrast, aza-lactam is completely a nonionic type. Thus, it is expected to attract the attention of pharmaceutical companies.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW DECOMPOSING REAGENT DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 73

[Text]

For the purpose of assisting solubility of compounds, several decomposing reagents have been used in many fields. Jado Co., Ltd. has developed a new decomposing reagent made from natural products. The products consist of cellulose powder and poly saccarides, the trade name is "JAF-Z". The main properties are shown in the table.

Table 1. JAF-Z

Appearance	White powder	
Composition	Natural products (cellulose powder) Polysaccarides	
Product analysis	PH	6.3
	AS	Not detective
	Heavy metal	1.3ppm
	Ash	0.1%
	Weight loss by drying	2%
	Particle size	100 mesh
	Living organism	$<10^3$/g
	E. coli	(–)
Main properties	(1) Easy to disperse (A) At any temperature 5°C ~ 100°C (B) At any PH	

CSO: 4120

SCIENCE AND TECHNOLOGY

COMPETITION HEAVY TO DEVELOP WATER ABSORPTION MATERIALS

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 74

[Text] * At present, textile makers are competing to develop water absorption materials. Kurabo Industries Ltd. and Toyobo Co. are both cultivating the market for processed cotton, and also, Toyobo Co. and Kura-ray Co. have completed the development of a water absorbing polyester fiber. In the field of acryl materials, sales of Kanebo's material are growing rapidly. The companies are concentrating their energies on the development of "distinguished materials", for example, cotton of which the water absorbency has been improved etc.

Originally, cotton is a material which has excellent water absorbency. The makers apply special processing methods for improvement of cotton's properties. Those methods though kept secret by the makers, are said to be similar to those for processing cotton wool. In the case of cotton processed by the special method of Kurabo Industries Ltd., the speed of water absorption is only 0.3 second (usual one requires 4 minutes). And, the processed cotton indicates a speed nine times faster than usual in the test of water permeation speed.

On the other hand, it is the largest defect of synthetic fibers that they can not absorb water. Therefore, the development of water absorbing synthetic fibers is the greatest theme for chemical fibermakers. Almost all the water absorbing synthetic fibers, acquire the properties by processing the fiber itself. Toyobo Co. has developed polyester wool for bedding, which is provided with water absorbency by means of chemical modification in the stage of polymerization. Kuraray Co. has started sales of polyester material of which the surface is modified to be hydrophilic. Also, Kanebo Ltd. has developed a water absorbing acryl fiber which absorbs water in microscopic holes in the filament making use of a capillaraction.

However, all the water absorbing fibers above have no moisture absorbency. A moisture absorbing fiber is indeed the synthetic fiber makers' final target of all their researches.

CSO: 4120

SCIENCE AND TECHNOLOGY

MANUFACTURING METHOD FOR POTASSIUM TITANATE FIBER ANNOUNCED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 74

[Text] * Ohtsuka Kagaku Yakuhin Co. has announced that they have established a manufacturing method for potassium titanate fiber, "Tismo" (trade name), and they have already started commercial production with a monthly output of 30 tons from spring of '80. The company's new fiber is a potassium titanate crystal whisker of 20–30μ diameter. And, it is extremely strong against tension and bending. The company expects uses of potassium titanate fiber as reinforcement of plastics, filter, friction material, etc. In the beginning, they plan to cultivate the market of reinforcement for plastics. Once, potassium titanate fiber was produced by the Du Pont, but today they have ceased production. Therefore, Ohtsuka Kagaku Yakuhin is the only maker in the world that is producing potassium titanate fiber.

The existence of this fiber has been known for some time, though there were several difficulties in its actual manufacture because of technological reasons. A few years ago, the National Institute for Research in Inorganic Materials of Science and Technology Agency developed a practical manufacturing method for the fiber. The company has been proceeding with the research on an industrial scale, and also they have received the rights for manufacturing the fiber. In March of '79, they completed a pilot plant, and in spring of '80, they achieved practical production at the pilot plant with a 30 ton monthly output.

There are several methods for manufacturing potassium titanate fiber, i.e. burning method, melting method, flux method, etc. Though the flux method is the most practical method, manufacturing conditions (equipment and cost) vary according to the type of flux used. The company solved the questions in manufacturing by means of the recovery and the reutilization of flux materials, such as, molybdenum and tungsten compounds.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW URANIUM ADSORBENT BEING DEVELOPED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 78

[Text] * The Government Industrial Research Institute, Shikoku has engaged in the research and development of adsorbents for collecting uranium from sea water, and has recently developed a flock type titanium-activated charcoal composite adsorbent and an amidoxim type chelate resin adsorbent.

1) Flock Type Adsorbent

The Institute has already developed a powdered titanium-activated charcoal composite adsorbent and has succeeded in collecting uranium, in the form of yellow cakes, from natural sea water. However, the drawback to this method was the collection efficiency. This was greatly decreased if the adsorbent was used in grain form, which is easy to use, instead of powder.

The Institute has solved this problem by turning the powdered adsorbent into flock, using polyacrylic acid hydrazide (PAH). Adding 0.5% PAH to the composite adsorbent causes more than 70% of the adsorbent to turn into flock with a grain size of over 0.1mmϕ. The speed of the flock adsorbent adsorbing uranium is 0.16mg g^{-1}-Ad, comparable to that of the powdered adsorbent. The adsorption performance of the flock adsorbent usually depends on that of the powdered adsorbent used as the flock adsorbent material. Thus, the flock adsorbents can be improved by using higher performance material. The flock adsorbent has a settling speed of over 12m per hour and can be applied to sedimentation separation type and fluidized bed type uranium collection systems.

2) Amidoxim Chelate Resin Adsorbent

Recently, a new chelate resin capable of selective adsorption of heavy metallic ions has been developed by Prof. Egawa, et al. of Kumamoto University. The resin was synthesized by allowing hydroxy amine to react with a copolymer of acrylonitril and divinyl benzen. The Institute attempted to apply this resin in collecting uranium.

The resin, however, had the disadvantage of a low affinity with water, making it difficult to increase the uranium adsorption speed. The Institute has now, succeeded in synthesizing a resin using tetraethylene glycol dimethacrylate (TEGDM) as a hydrophilic cross-linking agent. This resin has a higher uranium adsorption speed and larger uranium adsorption capacity, than conventional titanium adsorbents, 0.5mg g^{-1}-Ad per 10 days and 3mg g^{-1} per 150 days, respectively. Uranium adsorbed by the resin was separated by nearly 100%, at room temperature for 30 minutes, with IN acid. In addition, the resin, after repeated service, showed scarcely any decrease in adsorbing capacity. The resin is applicable to column adsorption through a fluidized bed system. Further research and development is being carried out at the Tokyo University Production Technology Laboratory and the Mitsubishi Kasei Industries Central Laboratory.

3) Amidoxim Type Fibrous Adsorbent

The Government Industrial Research Institute, Shikoku, has also developed a fibrous adsorbent by introducing an amidoxim base into acrylic fibers. Fibrous adsorbents can be manufactured into various products, including nets and belts. Thus, it is expected that the new uranium collection systems, which move adsorbents without moving the seawater, will be established.

The newly synthesized amidoxim fiber has a very high uranium adsorbing speed, around 10–20 times that of conventional titanium adsorbents. Tests using natural seawater proved that the fiber adsorbed uranium at a rate of 1.8mg-g^{-1} for 10 days or 4.6mg-g^{-1} for 50 days. The fiber still requires some improvement in its strength and endurance, though it is readily stripped of uranium.

CSO: 4120

SCIENCE AND TECHNOLOGY

SEMISUBMERGED CATAMARAN TYPE MARINE SURVEYOR CONSTRUCTION REPORTED

Tokyo TECHNOCAT in English Vol 13 No 12, Dec 80 p 79

[Text]

A semisubmerged catamaran (SSC) type marine surveyor, the "Kotozaki", has been constructed by the Mitsui Engineering & Shipbuilding Co., at the request of the Ports and Harbors Bureau No.4 of the Ministry of Transport, and has recently been launched.

The research and development of the SSC has been conducted by the Mitsui Engineering & Shipbuilding Co., in cooperation with the Japan Ship Machinery Development Association, since 1970. An SSC is a twin-hull ship of a special shape consisting of a submerged lower hull (a submerged body) and an upper structure connected with straps having a cross-section contour steamlined to the lower hull.

The special shape has provided the SSC with the following advantages over conventional ships: 1) high stability resulting from diminished hull rolling in rough seas, 2) small loss in speed in rough seas, and 3) a large deck area.

Mitsui Engineering & Shipbuilding Co., completed the "Meisa 80", in the fall of 1979. This is an SSC type practical passenger ship and is at presently undergoing a series of tests.

SSC Surveyor Specifications:

Overall length	*approx. 27.0m*
Length (between vertical lines)	*24.0m*
Width	*12.5m*
Depth	*4.6m*
Planned full-load draft	*approx. 3.35m*
Total tonnage	*approx. 240t*
Main Engines	*V-type independent 4-cycle fuel injection diesel engine (2)*
Continuous output, max.	*1900SP x 1400/1500rpm x 2*
Propulsion system	*Variable-pitch propeller (2)*
Speed (max.)	*19 knots*
Area of navigation	*Coastal seas*

Surveying Instruments:

1) *Ship locating system*
2) *Sludge collector*
3) *Sea depth meter observation*
4) *Meteorological observation instruments*
5) *Maritime meteorological observation instruments*
6) *Data collection and recording system*
7) *Other units such as sea water analyzers and sea water collectors*

CSO: 4120

SCIENCE AND TECHNOLOGY

EARTHQUAKE ALERT, COUNTERMEASURES OUTLINED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 pp 80-81

[Text]

* The consensus of many geologists is that if there were to be an eruption in Japan or its vicinity, it would trigger the "Tokai Earthquake". To cope with such a contingency, the government has beefed up a day for earthquake observation, aimed at coping with the expected Tokai earthquake. Once it is forecast that a great earthquake is imminent, the government will issue an alarm and put into force disaster-prevention structures in areas likely to be hit by the quake.

Last September 1st (in memory of the September 1, 1923 great earthquake that hit the Kanto area, taking the lives of 150,000 people, the day has been designated as the Day for Disaster-Prevention), a large-scale training for an earthquake was conducted under the assumption that the Tokai Earthquake had hit the Kanto area. The following are the countermeasures to be taken when an earthquake alarm is issued.

(1) Procedures until Issuing of an Earthquake Alert

Of all parts of the land, the Tokai area in particular is the target of intense monitoring by the Meteorological Agency, to begin with, and by other institutes. The networks of observation maintained by these institutes monitor earthquakes, strain bending and stress of the crust of the earth, expansion and contraction, tidal waves, changes in the level of underground water, etc. Data thus obtained are immediately piped to the Meteorological Agency for any unusual signs under a 24-hour-a-day structure.

If the Tokai area is to be hit by more than 10 rumblings in an hour and if this state continues for more than 2 hours – an unusual phenomenon surpassing certain standards – the director of the Meteorological Agency shall request the chairman of his private advisory council, the "Judgmen: Council", to convene. The Judgment Council chairman, upon receiving the request, will summon the council members to a judgment session. The session to last about 30 minutes, when the abnormal data will be studied. If it is judged at the meeting that all signs point to an imminent earthquake, the director of the Meteorological Agency will report to the prime minister "earthquake forecast information". The prime minister convenes a cabinet meeting and issues "a declaration of alarm".

The time required from monitoring of unusual data to the issuing of an alarm is supposed to take 130 minutes to 145 minutes. The news will be broadcast 30 minutes after convening of the judgment council. Police and fire departments will go into a full alert and begin to call up their members as soon as the judgment council is called into session.

The text of the declaration of alarm is scheduled to contain the following: *"Based on the special law concerning large-scale earthquake countermeasures, I hereby issue an alarm against possible earthquake disasters: Today, I have received a report from the director of the Meteorological Agency informing me that the earthquake observation networks in the Tokai area have detected abnormal signs and that there is a possibility of the area being hit within 2 to 3 days by a great quake with its epicenter either in the Bay of Suruga (off the coast of Shizuoka Prefecture) or further off in the more southern waters.*

If the earthquake really occurs, the prediction is that it will hit the area designated as the target requiring reinforced countermeasures against the Tokai earthquake with a force of 6 or more on the Richter scale and in neigh-

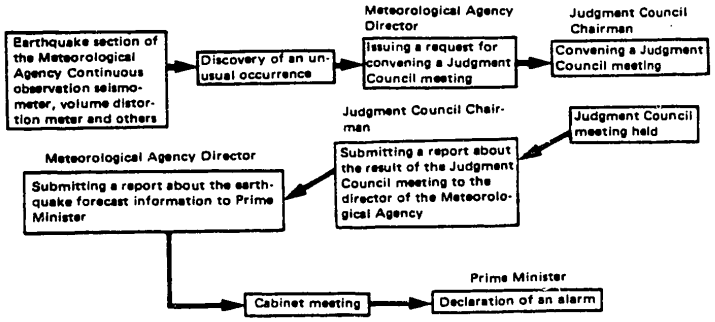


Fig. 1. Discovery of an Unusual Occurrence to Issuing of an Alarm

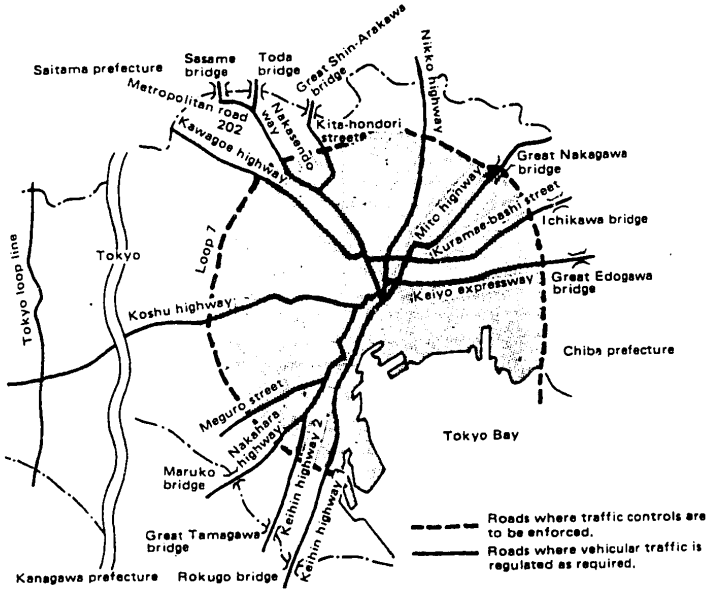


Fig. 2. A Map of Roads Where Vehicular Traffic is to Be Controlled After an Earthquake Warning has Been Issued

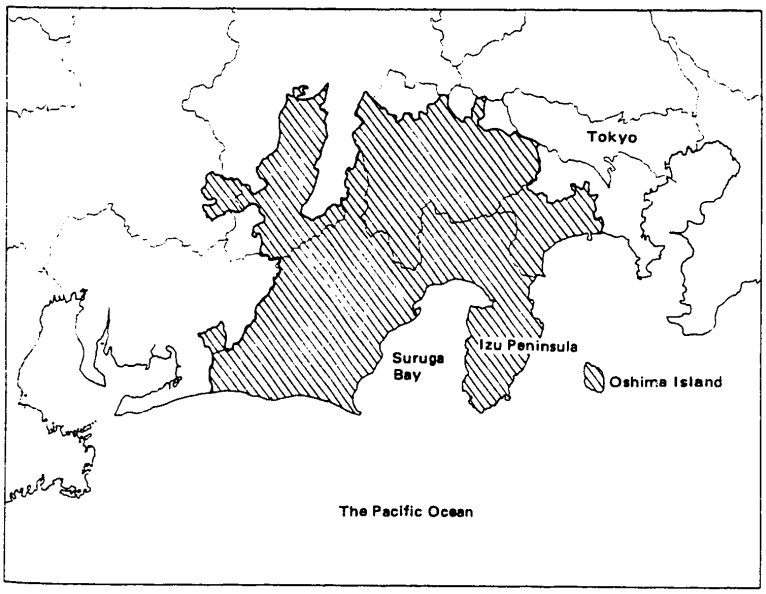


Fig. 3. Reinforced Countermeasures Area Which Covers a Part of the Tokai District, Middle Part of Japan Facing the Pacific Ocean

bouring areas with an intensity of about 5. The area stretching from the southern part of the Izu Peninsula along the Bay of Suruga is feared will be washed by great tidal waves. The public agencies within the reinforced countermeasures area are requested to put into force emergency measures against earthquake disaster prevention immediately. Residents of the reinforced countermeasures area and sojourns there are advised to stay fully alert and act following the instructions of disaster-prevention agencies.

Also, people are advised to refrain from making trips to or placing calls to the reinforced countermeasures area. For detailed earthquake forecast information, the director of the Meteorological Agency shall speak for me. Please, remain tuned to radio or TV. (full text)"

(2) After Issuing an Alert

[Railways]

All trains (including the Shinkansen trains) of the Japanese National Railways in the reinforced countermeasures area will be stopped at nearby stations. On the tracks running close to the area (including the Metropolitan area), trains will continue to be operated at reduced speeds of 30 to 50km/h and on reduced operation schedules.

Upon issuing of a declaration of alert, private railways serving the metropolitan area will be operated on special schedules already in place, that call for reduced running speeds and thinned-out operation.

[Roads]

Once an alert is issued, as the Police Agency plans it, all vehicles in the reinforced countermeasures area and the metropolitan area are required to slow down to a maximum speed of 20km/h. Access to the reinforced countermeasures area by vehicle will also be restricted.

Again, in the metropolitan area where traffic is heavy, vehicular traffic will be regulated. Clampdowns on vehicular traffic will be enforced inside and outside Loop 7 highway that runs skirting the central parts of Tokyo.

Vehicles entering from outside of Loop 7 into its inside (the central area of the Metropolis) will be restricted. Vehicles heading from the heart of the Metropolis toward Kanagawa and Yamanashi Prefectures, the reinforced disaster-prevention area, will be regulated at

prefectural borders. However, vehicles entering from the above two prefectures into Central Tokyo will not become targets for traffic control. Against this, traffic from Chiba and Saitama Prefectures, located opposite to the reinforced disaster-prevention area, into Tokyo will be restrained.

[High-rise building area]

In the Shinjuku area of Tokyo bustling with skyscrapers, the problem is how to discourage commuters at the time of the earthquake warning, from converging on the Shinjuku Train Station, which is the terminal station for several railways.

Nomura Building, one of the high-rise buildings, is the home of about 110 firms with some 5,600 employees, and the number of people who enter or leave the building in a day is said to reach as many as some 20,000 at the highest, when shoppers visiting the underground shopping mall are included. The emergency evacuation plan drawn up by the firm charged with maintenance of the building for an earthquake warning calls for first escorting the crowds visiting the building out of the building, then to let the employees of the tenant firms out and finally to show the way out to the responsible persons of the tenants. On this occasion, the building maintenance firm will dispatch its employees to the police, fire stations and nearby train stations to gather necessary information so that people will be diverted to the right stations.

[Supermarkets]

It is expected supermarkets will be open even after issuing of an earthquake warning to meet the demands of people for food and household merchandise. A large chain-store has a plan to sell merchandise centered on foods and household goods on the first floor at ground level at all its stores (business hours however will be shortened) when such a warning is issued. The supermarket also has enough stocks of about 60 items centered on foods and household goods with high turn-over rates that will enable the store to meet customer demands for them for 7 to 10 days.

[Civic organizations]

Each region or community has its own "residents' organization for disaster-prevention" and it has been engaged in activities aimed at enlightening the residents about disaster-prevention as well as has been giving training on disaster-prevention. The organizations are expected to play an important role in relaying information to residents when an earthquake alert is issued. According to a survey by the Fire Defense Agency under the jurisdiction of the Ministry of Home Affairs, in Tokyo 2.5 million households have joined such organizations, which means that 59% of households are associated with the organizations.

CSO: 4120

SCIENCE AND TECHNOLOGY

BACTERIA ABLE TO DISSOLVE ORGANIC PHOSPHORIC ACID DISCOVERED

Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 pp 82-83

[Text] * The Fermentation Research Institute of the Agency of Industrial Science and Technology has discovered bacteria which efficiently dissolve organic phosphoric acid compounds contained in drainage from agricultural chemical plants, and has found clues to applying them into practical use. No successful isolated of bacteria which dissolve organic phosphoric acid, has been reported worldwide, and thus, agricultural chemical plants troubled with the disposal of organic phosphoric drainage are hopeful that such bacteria can be put into practical use.

The bacteria discovered and isolated by the Institute include two types, although they have not yet been identified in detail. The addition of these bacteria to active sludge for drainage disposal causes the two types of bacteria to cooperate in dissolving dimethyldithiophosphoric acid and dimethylthisphosphoric acid, intermediate compounds in the manufacture of organic phosphoric agricultural chemicals, into inorganic phosphoric acid. In this process, sulfuric acid is generated, resulting in a decrease in the pH of the drainage and also a decrease in the activity of the bacteria. So, a base has to be added to keep the pH at 6-7. Tests have shown that this method leads to the efficient dissolution of organic phosphoric compounds without causing any practical troubles.

Organic phosphoric compounds themselves are hard to remove from drainages. Once they have been changed into inorganic phosphoric acids with the aid of the bacteria mentioned above, organic phosphoric compounds in drainage are easy to remove by sedimentation in the pressure lime.

The study conducted by the Institute is outlined as follows.

1. Introduction

The removal of phosphorus from drainage in order to prevent eutrophication, which stimulates the generation of red tides and waber-bloom, is a very important task today. Phosphorus, in drainage, exists in the forms of organic and inorganic compounds. The removal of inorganic phosphorus has been extensively studied; it can be removed for instance, by aggregation sedimentation using lime or aluminum sulfate organic phosphorus, on the other hand, it cannot be removed efficiently unless these compounds are first transformed into inorganic compounds.

A typical example of drainage, which heavily contains organic phosphorus and thus is hard to dispose of, is the drainage from plants for organic-phosphorus agricultural chemicals. Organic-phosphorus agricultural chemicals include most of the insecticides currently in use for rice, vegetables, fruits, etc. and also for the control of the pine-bark beetles.

Drainages from plants manufacturing these insecticides contains various organic phosphoric compounds. The main components of these compounds are dialkylthiphosphoric acids: $(RO)_2$ PSSM or $(RO)_2$ PSOH (hereafter called DATP;R denotes an alkyl group), which are hard to disposed of.

DATP are intermediate compounds in the manufacture of organic-phosphorus agricultural chemicals and also are produced when the agricultural chemicals are dissolved in a natural environment. Although numerous studies have been conducted on the transformation of organic-phosphorus agricultural chemicals by microorganisms, no attempts have succeeded in the effective dissolution of DATP and DATP are recognized to be very hard to dissolve.

By using active sludge, the laboratory has succeeded after strenuous efforts, in dissolving dimethyldithiophosphoric acid: $(CH_3O)_2P(S)SH$ (hereafter called DMDTP), known to be the hardest to dissolve among DATP. This dissolution will be outlined below.

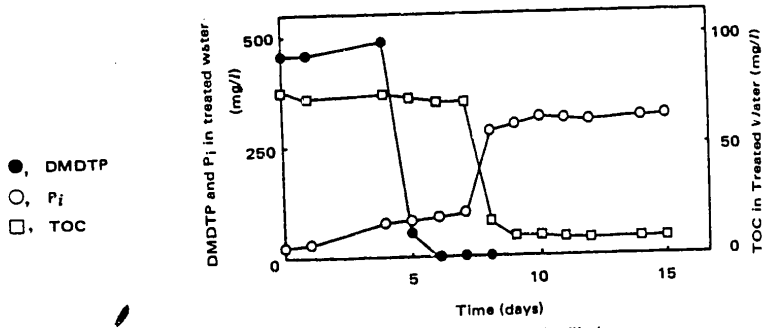


Fig. 1. Culture of Active Sludge

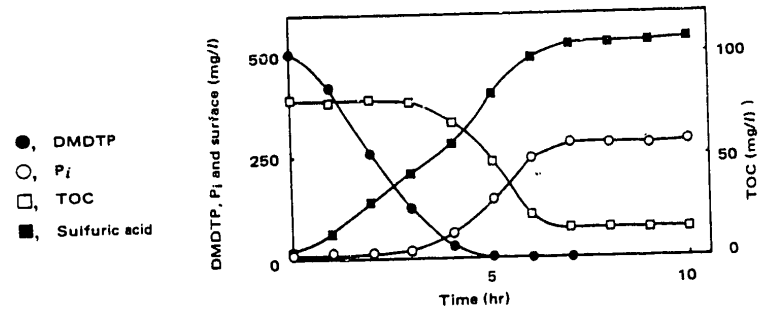


Fig. 2. Dissolution of DMDTP by Cultured Sludge

2. Cultures of Active Sludge

Active sludge was cultured with DMDTP by a batch process. More precisely, 1.5*l* of active sludge (MLSS 6000mg/*l*) was put into a small jar with a capacity of 2.5*l*. Then, DMDTP (an ammonium salt) was added in order to make its final concentration 500mg/*l*, and the mixture was aired with agitation, at 30°C. The liquid was kept still to remove 0.5*l* of its supernatant layer, once a day; Then, 0.5*l* of synthetic drainage composed of glucose (200 mg/*l*), a yeast extract (200mg/*l*) and DMDTP (500mg/*l*) were added. The pH was constantly adjusted to 7.0 with 1N-NaOH, by using a pH regulator. The results of the analysis of the supernatant liquid are shown in Fig.1. DMDTP was no longer detected on the 6th day of the culture, when there was no sign of decrease in TOC (total organic carbon) and increases in Pi (inorganic phosphoric acid). A decrease in TOC and an increase in Pi were observed on the 8th day, and DMDTP was transformed completely into inorganic phosphoric acid on the 9th day.

3. Dissolution of DMDTP by Active Sludge

By using the active sludge thus cultured, DMDTP (500mg/*l*) was dissolved under the following conditions: MLSS 500mg/*l*, temperature 30°C and pH7.0 0.1 (see Fig.2). DMDTP was rapidly dissolved to produce Pi and sulfuric acid. The material balance in the total reaction mixture shows that 2.9mM of DMDTP (500mg/*l*) was dissolved with the decrease of 5.3mM of TOC (64mg/*l*) and an increase of 2.7mM of Pi (260mg/*l*) and 5.3mM of sulfuric acid (510mg/*l*). In order to keep the pH at 7.0, 17mM of sodium hydroxide (680mg/*l*) was added. Thus, the total dissolving reaction can be formulated as follows:

$$(CH_3O)_2\,P(S)SNH_4 + 7O_2 + 6NaOH \rightarrow NH_4Na_2PO_4 + 2Na_2SO_4 + 2CO_2 + 6H_2O$$

Also, an analysis, using thin-layer chromatography, showed that DMDTP was first desulfurized to form dimethyl this phosphoric acid $(CH_3O)_2$ PSOH (DMTP) and further desulfurized to form dimethylthisphosphoric the active sludge dissolve dimethylphosphoric acid (DMP) and monomethylphosphoric acid (MP) very rapidly. Thus, the processes of dissolution of DMDTP in the active sludge are presumed to be as shown in Fig.3.

4. Effects of Various Factors on Dissolution

Tests were, generally, carried out under the

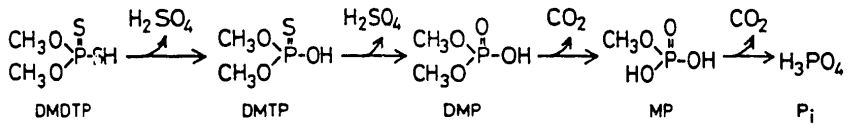


Fig. 3. Processes of Dissolution of DMDTP by Active Sludge

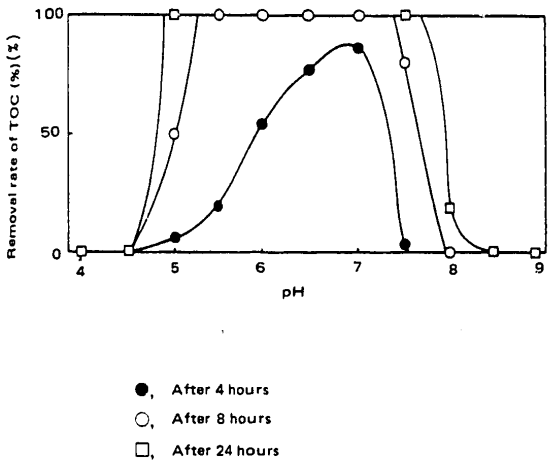


Fig. 4. Effects of pH on DMDTP Dissolution

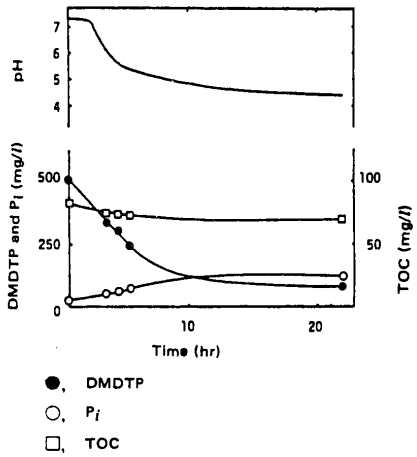


Fig. 5. Dissolution of DMDTP (without pH adjustment)

following conditions: DMDTP initially 500mg/*l*, MLSS 500mg/*l*, temperature 30°C and pH 7.0±0.2.

(1) Effects of pH

Dissolution tests of 500mg/*l* DMDTP were conducted while the pH of the mixture was adjusted to remain within a predetermined value ±0.2 (see Fig.4). In the range of pH 5.5–7.0, the dissolution was completed within 8 hours, while when the pH was below 4.5 or over 8.5, the dissolution was not under way even after 24 hours. Thus, the most suitable pH range was found to be 6.5–7.0. In another test, 500mg/*l* of DMDTP dissolution was conducted with the initial pH of 7.3 without further adjustment (see Fig.5). Sulfuric acid, generated during DMDTP dissolution, caused the pH to drop rapidly, causing the reaction to stop. The pH after 24 hours was 4.3. Thus, the pH control was found to be essential for the DMDTP dissolution.

(2) Effects of Sodium Chloride

Main reactions in the manufacture of agricultural chemicals mostly consist of desalination reactions, and thus, drainage from this manufacture contains NaCl in high concentrations. No effects of the NaCl concentration, were observed below 0.5%, inhibitory effects were observed at 1.0% and no dissolution was caused at 1.5%. Subsequently, combined effects of NaCl and pH were studied: no effects were observed in the pH range of 5.5–7.5 and NaCl was more obstructive in the pH range of below 5.0, allowing no dissolution at a concentration of 1.0%.

(3) Effects of DMDTP Concentration

An examination of the effects of initial DMDTP concentration showed that it was scarcely obstructive at 2.0% and that the time required for dissolution was nearly proportional to the initial DMDTP concentration in the range of 0.05–2.0%.

(4) Effects of Bacterial Concentration

The higher the bacterial concentration, the more rapidly dissolution progressed. When the concentration of MLSS was below 7000 mg/*l*,

the speed of dissolution was nearly proportional to the bacterial concentration.

5. Dissolution of Other Organic Phosphoric Compounds

By using active sludge cultured in DMDTP, dissolution tests for DMTP, DMP, MP, diethyldithiophosphoric acid (DEDTP), diethylphosphoric acid (DEP) and monoethylphosphoric acid (EP) were conducted. All of these compounds were rapidly dissolved into inorganic phosphoric acid. Those compounds which did not contain sulfur (DMP, MP, DEP and EP) were dissolved particularly rapidly, causing almost no decrease in pH.

Subsequently, by using the culture method mentioned above, noncultured active sludge was incubated with organic phosphoric compounds to find out that the active sludge acquired dissolving activity toward organic phosphoric compounds. It took 5 days to dissolve DMP, MP, DEP and EP, 10 days for DMPTP and DMTP and 20 days for DEDTP. This proved that this culture method was effective in dissolving organic phosphoric compounds.

6. Isolation of DMDTP Dissolving Bacteria

By using a culture which had DMDTP as its sole energy and organic carbon sources two kinds of DMDTP dissolving bacteria were isolated. They were named the TK-1 stock and the AK-2 stock. Further characterization of these bacteria are now in progress.

CSO: 4120

SCIENCE AND TECHNOLOGY

ENVIRONMENT AGENCY TO PERFORM INLAND SEA SURVEY

Tokyo JAPAN TIMES in English 9 Feb 81 p 2

[Text]

The Environment Agency will start in fiscal 1981 a seven-year environmental survey of the Inland Sea to collect data on its geological features, water pollution and marine life.

The agency intends to prepare plans to fight serious pollution of the Inland Sea on the basis of data collected in the survey.

The study will examine such items as the sludge accumulated on the sea floor, water quality, the biota such as fish and seaweed and economic value of the sea.

In the survey, the Inland Sea will be divided into about 1,200 sections of five sq. km each to collect data and analyze them in each section.

To study sludge, samples will be collected from the floor of the sea, and they will be checked for chemical substances, such as phosphorus and nitrogen which cause eutrophication of the water, and chemical oxygen demand (COD).

In the first year, the Harimanada area (off Hyogo, Okayama, Kagawa and Tokushima prefectures) and the Hiuchinada area (off Kagawa and Ehime prefectures) will be surveyed.

Water pollution of the Inland Sea has come to show signs of improvement thanks to strict regulations on the discharge of polluted water under the special law for environmental protection of the sea.

However, Environment Agency officials say that water pollution will continue as long as the sludge containing water pollutants remains uncleared on the sea floor.

CSO: 4120

SCIENCE AND TECHNOLOGY

SHIMANE ASSEMBLY APPROVES N-PLANT

Tokyo ASAHI EVENING NEWS in English 10 Feb 81 p 3

[Text2

The Shimane prefectural assembly virtually approved Monday the Chugoku Electric Power Co.'s nuclear power station expansion project despite protests from some local residents.

The assembly's special committee on the nuclear power affairs adopted only statements filed by residents who supported the project, and rejected those by objectors.

The adoption of the "go-ahead" petitions came after two Socialist members of the 15-member panel left their seats, complaining the pleas were not deliberately discussed.

The Socialists, who opposed the project, had demanded that intent of all the 148 pleas be explained before the freely-admitted public and experts, but the demand was turned down by the ruling forces of Liberal-Democrats and Democratic Socialists.

The panel, formed last December, thus ended its deliberations on the controversial issue in four days.

Ten of some 50 unionists and residents opposed to the project were arrested by police when they attempted to enter the assembly hall, causing a 90-minute delay in proceedings.

CSO: 4120

SCIENCE AND TECHNOLOGY

DEVELOPMENT OF URANIUM FROM SEAWATER URGED

Tokyo ASAHI EVENING NEWS in English 10 Feb 81 p 3

["Today's Science" column by Shunichi Takabe]

[Text]

To Japan, which is dependent on other countries for most of its energy sources, the surrounding sea around it is a treasurehouse awaiting development. One of the projects to open the doors to this treasury will get under way soon. Construction of a pilot plant to establish the technology of recovering uranium from seawater will begin at Nio Town, Kagawa Prefecture, Shikoku, this spring.

Attempts to extract uranium dissolved in seawater are being made in such Western countries as Britain and West Germany. Japan is the first country in the world to make a similar attempt with a pilot plant. Much interest is being shown in what the results of the trial operation of the pilot plant three years hence will be. Of course, uranium derived from the sea will not be able to compete with uranium resources on land. The aim of the project is to curb soaring uranium prices and give Japan more bargaining power with countries supplying uranium. Consequently, success depends on whether a highly efficient system is set up.

The world's seawater contains more than 4 billion tons of uranium. However, in terms of the density of seawater, this is only 3 parts per billion (3/1 billionths). Since this uranium is about 1/3 millionth of the sodium, which is the main constituent of seawater, it cannot be enriched by ordinary means. In research conducted so far, the method of recovering uranium by passing seawater through substances that selectively adsorb uranium has looked promising.

In tests conducted for three years by the Metal Mining Corporation at the request of the Ministry of International Trade and Industry, titanic acid was used to adsorb uranium. The acid was then removed and uranium in a soluble state was produced by using sal volatile (hartshorn). In this solution, uranium was enriched to a density of about 10 parts per million.

In the second-stage process, uranium was enriched to a 0.3 percent liquid by the ion-exchanging method. With the uranium ore refining technology, this liquid can be finished into refined uranium ore, or "yellow cake."

Laboratory - scale experiments conducted so far have only yielded "yellow cakes" weighable in grams. The goal for the projected pilot plant is to produce 10 kilograms of "yellow cakes" a year. Including tests on various kinds of adsorbents and assessment from the engineering point of

view of integrated process continuous operation, a feasibility study will be made for commercialization of the process. The cost of building the pilot plant is about ¥2.4 billion. It is very interesting to note that part of a salt field where salt was made from the water of the Seto Inland Sea back in the old days is about to be reborn as a base for making "yellow salt" for the nuclear age.

Basic experiments in a project of deriving energy directly from the sea are making headway. The generation of power from waves is already in wide use as a minor source of power for channel marks. From now on, wave power generation will be designed to supply energy to small communities living along coasts or on remote islands.

Last year, joint experiments were conducted by the International Energy Agency and related Japanese quarters in the Japan Sea off Yura, Yamagata Prefecture. For commercialization, a technology that converts the energy of the waves more efficiently into electricity is needed.

A much bigger, but possible, dream is the utilization of the energy of the Black Current flowing in the Pacific along the Japanese archipelago. The Black Current has a flow that is from 300 to 500 times that of the Amazon, the largest river on earth, and its currents contain vast energy.

To establish a "Black Current power station" around 1990, the Marine Science and Technology Center of the Science and Technology Agency is conducting a basic survey on candidate sea areas. A marine complex combining such a sea current power plant and a uranium recovery plant may be built.

However, it should be borne in mind that the sea is a storehouse of biological resources very closely connected with meteorological conditions. It goes without saying that minute technological assessments are essential prior to conducting development work that will influence sea currents and seawater temperatures.

CSO: 4120

SCIENCE AND TECHNOLOGY

MOVES TO INTRODUCE CANDU REACTOR REVIVE

Tokyo DAILY YOMIURI in English 13 Feb 81 p 5

[Article by Mikio Kuwamori]

[Text]

Moves for introducing the CANDU nuclear reactor from Canada have been reviving in Japan because of a complete change in the circumstances surrounding the reaction to introduction of the CANDU over the past two years.

The semigovernmental Electric Power Development Company and the International Trade and Industry Ministry (MITI) started moves in favor of introducing the CANDU reactor five or six years ago, but the Atomic Energy Commission, which holds a decisive power over Japan's atomic power policy, decided in August 1979 to shelve the introduction of the reactor.

When International Trade and Industry Minister Rokusuke Tanaka visited Canada this January, however, he told Prime Minister Pierre E. Trudeau and other Canadian officials that he would seriously study introduction of CANDU, suddenly bringing the issue into the spotlight once again.

In a press conference after his return to Japan, Tanaka said introduction of CANDU should be studied from a wider perspective as part of Japan's economic security. This remark made the issue more realistic.

As to the question whether an influential cabinet minister can easily reverse the decision made two years ago, a knowledgeable source said that the Atomic Energy Commission will move toward introduction of CANDU after its chairman, Suzumu Kiyonari, is replaced by Takashi Mukaibo, who has just retired as president of Tokyo University.

As a matter of fact, MITI and Electric Power Development Company did not give up introduction of CANDU when the commission made the decision against it. They have been steadily taking step toward its eventual introduction.

Japan's nine electric power companies, which used to take a negative attitude toward introduction of CANDU, have now adopted a policy of diversifying nuclear reactors and become flexible about the issue.

The time to introduce CANDU is now believed to be ripe since a summit of industrialized democracies will be held in Ottawa. During the past few years, Canada has also created circumstances that will make Japan introduce CANDU. Canada, for instance, has indicated that supply of its crude oil will

be tied with Japan's introduction of CANDU.

The position of those who oppose introduction of CANDU has been weakened in political and business circles and in the press. Toshiwo Doko, who opposed CANDU introduction two years ago, has resigned as president of the Federation of Economic Organizations (Keidanren) and been succeeded by Yoshihiro Inayama, who supports the introduction. The Suzuki cabinet seems to have been influenced by former prime minister Kakuei Tanaka, who reportedly was in favor of the introduction.

The basic reason for these changes in the situation is presumably an alteration in the people's opinion about the energy issue.

Two years ago people's opposition to nuclear power plants mounted extraordinarily due to an accident at the nuclear power plant on Three Mile Island and other incidents. Laymen as well as experts warned against an easy-going introduction of CANDU in this country.

Between the summer and autumn of 1979, however, the second oil crisis occurred, pushing up crude oil prices abnormally. The Iran-Iraq war and other factors added to uncertainty. Under these circumstances, calls for stable supply of energy resources increased.

The advantages of introducing the CANDU reactor include diversification of risk by breaking away from the nuclear power policy depending solely on the US and supply to Japan of Canadian crude oil in return for the adoption of the reactor. Access to Canadian resources will lead to Japan's overall security.

Electric Power Development Company points out that the CANDU reactor itself is advantageous in that uranium enrichment is not necessary because natural uranium is used and its operation rate is higher than the light water reactor that Japan has already adopted.

But experts still question the safety of CANDU. According to sources, the Atomic Energy Commission has indicated that permission for only a research reactor, instead of a commercial reactor, for the time being will not present any problem.

Japan is forced to depend on atomic power for its alternative energy and to tackle the task of diversifying energy supply sources. It will, therefore, be necessary to confirm the safety of CANDU with a research reactor.

At a time when many municipalities are opposing construction of atomic power plants in their communities, a mood to welcome CANDU is prevailing among people on the Shimokita peninsula in Aomori-ken, the proposed site for the reactor.

CSO: 4120

SCIENCE AND TECHNOLOGY

TELECOMMUNICATIONS MINISTRY TO PERMIT 'TELETEXT'

Tokyo MAINICHI DAILY NEWS in English 6 Feb 81 p 5

[Text]

The Posts and Telecommunications Ministry has informally decided to permit the commencement of the Japanese version of the Teletext or character multiplex telecasting services in 1983.

Teletext is the name of a similar character MPX telecasting being operated in the United Kingdom. Similar broadcasting, including testing, is being conducted in France, West Germany, Sweden and the United States.

The character multiplex (MPX) telecasting enables broadcasting stations to air the character information concurrently with the existing image by taking advantage of unused spaces in the TV airwaves. The viewers, by installing an adaptor, can read such information as news, stock market quotations, weather reports, and traffic information on the TV screen at home. The character MPX telecasting will also make possible the electronic newspaper — a newspaper to be read on the TV screen.

The ministry is planning to formally decide upon the technical standards for the character MPX telecasting by the end of March and amend the broadcasting law for the commencement of commercial Teletext broadcasting in 1983.

The Radio Technical Council recently recommended a technical standard on the character MPX telecasting to the ministry after seven years of deliberations. The ministry is to formalize the decision in late March.

According to the ministry plan to allocate 10 airwaves at the start, one is to be dedicated to the transmission of the characters for the hard of hearing, to enable them to enjoy television programs. This is at present being done by the Public Broadcasting System (PBS) in the United States.

The remaining nine airwave channels of the initial allotment will be made available for utilization by organizations other than TV stations. The public will be able to receive these nine airwave channels on the present blank channels of existing TV sets.

The Teletext broadcasting licenses are to be granted to non-TV stations, primarily to newspaper companies. By use of printers, "hard copies" (printed copies) of electronic newspapers will also become available at home. And this possibility meets the ministry's policy of decentralizing the power of the mass media, the ministry said.

But actual Teletext broadcasting by third parties requires the use of some facilities of existing TV stations. If these TV stations refuse to offer the pertinent facilities for third party use, the character MPX service will become impossible.

To resolve this problem, the Radio Regulatory Bureau of the ministry intends to submit to the Diet next year an amendment to the broadcasting law to make it obligatory for TV stations to offer their facilities for Teletext broadcasting by third parties.

The association of broadcasting stations are, however, firmly opposed to such legislation on the grounds that the amendment will infringe upon licensed TV stations' property rights.

CSO: 4120

SCIENCE AND TECHNOLOGY

LDP URGED TO SEEK SUPPORT FOR NUCLEAR PLANTS

Tokyo MAINICHI DAILY NEWS in English 14 Feb 81 p 5

[Text]

The ruling Liberal-Democratic Party (LDP) should caravan throughout the country to encourage unionists, consumers and local leaders to support the government's nuclear power projects to a greater degree, an LDP member proposes.

The private proposal, made by Tsunezo Watanabe, former parliamentary vice minister of international trade and industry and secretary general of the LDP's new task force for promoting nuclear power, was contained in a nine-point recommendation disclosed Friday.

In the recommendation, to be submitted for consideration to the task force's first session next Tuesday, Watanabe aims at putting back on the track derailed nuclear power projects within two years.

The power site construction promotion headquarters should carry out a powerful national movement with local administrators, entrepreneurs and residents to remove hindrances to their efforts and to defend the future livelihood of people, he proposes.

More concretely, he proposes to send caravans with such a mission to Ishikawa, Mie, Yamaguchi and some other prefectures where nuclear power projects are an issue.

The headquarters should also try to improve safety-checking systems at nuclear power plants at the same time, Watanabe says.

The proposed action policies are likely to arouse arguments among local governments and residents who still remain concerned over the safety of nuclear power stations, and draw new criticism from antinuclear campaigners.

The nation now depends on nuclear power for about 12 percent of its energy production.

The government hopes to increase the dependence rate to around 23 percent in a decade by building or planning 14 more nuclear reactors by 1985.

But, persistent opposition from some people has not only blocked the state's efforts, but has also undermined them.

The government set the target for nuclear power output by 1985 at 60 million kilowatts 10 years ago.

It was reduced to 49 million kilowatts five years ago and further to 30 million kilowatts two years ago.

The government party is thus keen to repromote its energy plans toward greater reliance on nuclear power, possibly timing such campaigns with local elections.

CSO: 4120

SCIENCE AND TECHNOLOGY

MITSUBISHI UNVEILS TINY TURBOCHARGER

Tokyo MAINICHI DAILY NEWS in English 17 Feb 81 p 5

[Text]

Mitsubishi Heavy Industries Ltd. unveiled Monday for the first time in the world a tiny turbocharger that can fit the 1- to 1.8-liter gasoline and diesel engines of various motor vehicles such as small passenger cars, motorcyles, agricultual machines and small vessels.

Turbocharger developers around the world have been jockeying for perfection of extremely difficult to design small turbos.

Since the turbo boosts engine output by 30 to 50 percent, it has been regarded as a key element in developing small passenger cars that are more fuel-thrifty and agile than current fuel-efficient small passenger cars.

Preceeding Monday's press announcement, MHI introduced the TC03 and TC04 newly developed turbochargers to several domestic automakers between late last year and early this year. The developer has received 10 cases of inquiries from Japanese companies of which seven cases came from automakers.

MHI said several foreign automakers have placed inquiries.

The TC03, weighing only 3 kilos, fits 15-65 horsepower gasoline or diesel engines while the TC04, weighing 3.5 kilos, fits 22-100-horsepower engines. MHI said the smaller TC03 can also be fitted to 800cc engines.

MHI said that its production capacity is close to 10,000 units a month at present. The developer predicted that there will be a demand for at least 100,000 units per month in three years.

CSO: 4120

SCIENCE AND TECHNOLOGY

ASAHI CHEMICAL GETS RIGHT TO USE GOVERNMENT NUCLEAR FUEL

Tokyo THE JAPAN ECONOMIC JOURNAL in English 3 Feb 81 p 12

[Text]

The Science & Technology Agency has allowed Asahi Chemical Industry Co. to use nuclear fuel at its planned uranium enrichment facility at Hyuga City, Miyazaki Prefecture.

The permit paves the way for Asahi's attempts to win the prefectural government's agreement on constructing its model plant based on chemical (ion exchange resin) enriching process. The company expected it can shortly start construction.

The plant, it is hoped, will confirm the chemical route's enriching feasibilities so that a commercially-sized plant can eventually be built. It will become the second Japanese enriching technology along with the gaseous centrifuge process being pursued by the Government's Power Reactor and Nuclear Fuel Development Corp.

Asahi developed basic know-how by taking advantage of the principle that two uraniums with different chemical characteristics, when present simultaneously, help the useful uranium (U-235) move toward one uranium. The principle was discovered about 30 years ago.

The model plant is intended to confirm the economic feasibilities and technical soundness of Asahi's basic process. It will consist of four columns, measuring 2.5 meters in height and 1 meter in diameter, for the chemical exchange reaction.

The product will be uranium enriched 3 per cent, which is good enough for consumption by light water reactors. When fully utilized, the test facilities can produce about 500 kilograms of the enriched fuel a year.

Asahi is scheduled to complete the plant by the spring of 1983 for operation until fiscal 1985. Of the total estimated cost of ¥12 billion, two-thirds are being financed by the Science & Technology Agency and Ministry of International Trade & Industry.

The STA approval for nuclear material use was granted largely because it involves no radioactive waste problems. About 5 tons of natural uranium will be consumed annually.

CSO: 4120

SCIENCE AND TECHNOLOGY

COAL ASH UTILIZATION IS DEVELOPED

Tokyo JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 6

[Text]

Coal ash utilization know-how has been developed by civil-engineering researchers at Electric Power Development Co. to solve the largest problem with promoting coal-fired power projects. EPDC succeeded in developings concrete substitute by mixing cinder ashes, which account for more than 70 per cent of coal ash, with cement and gypsum. The next step calls for developing concrete blocks measuring 1 cubic meter for utilization as fish "apartments."

This sort of know-how is expected to help Japan in realizing its goal to consume 69 million tons of steam coal annually for power generation by fiscal 1990. Most of the coal will be consumed by electric power companies, with cement and paper makers expected to use some portions. The single largest problem with coal use for power is the coal ash, as steam coal contains an average of 20 per cent ashes. By 1990, an estimated 13 million tons of ashes will be generated every year.

Ashes include clinker (regarded as valuable material for filling in land), cinder ashes (presently posing treatment troubles) and fly ashes (already utilized by the cement industry). To solve the cinder ash problems, EPDC in the past year produced 150 combinations of ashes, cement and gypsum. When cement is added, the cinder ashes are hardened strongly enough comparable to conventional concrete. Gypsum is made available from flue gas desulfurization.

CSO: 4120

SCIENCE AND TECHNOLOGY

YANMAR DEVELOPS NEW ENGINE OPERABLE ON GAS OF SEWER SLUDGE

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text]

Yanmar Diesel Engine Co. has developed a new kind of gas engine that runs even by burning sewer sludge and garbage-generated gas.

At present, every city sewage or garbage treating station in Japan requires a large amount of electric power or other energy sources for burning or thermally treating sewer sludge or garbage.

According to the Osaka company, its new engine will directly use the gas generated by the bacterial digestion of such sludge and garbage. This will save between one-third and two-thirds of the electric power or other fuel needed by such a station. Besides, it will recover the heat of its cooling water and exhaust gas for neighborhood heating and hot-water supply purposes, it says.

It will thus turn to account between 70 and 80 per cent of the entire gas energy generated by such stations. In the case of a normal sewage treating station, it has experimentally proved to derive at least 35 per cent of the total availabe energy as its own fuel and 42.5 per cent as heating and hot-water producing energy, making up a combined gas energy utilizing efficiency of 77.5 per cent.

The new engine which also runs on natural gas or oil-releated gas features a solution to the problem of wide changes in heat efficiency when different kinds of gas are used in conventional types of gas engine.

Though almost identical in structure with the company's diesel engines, it is equipped with a specially-remodelled gas mixer, instead of a fuel injector, and a special electric ignition system. It has a microprocessor to properly control its work loads.

A series of models raging between 50 and 500 kilowatts in output will be commercially produced for sale sometime after June.

CSO: 4120

SCIENCE AND TECHNOLOGY

AUTOMATION MINIMIZES CHIP DAMAGE

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text]

A new all-automatic semiconductor inspection microscope that eliminates the usual manual trouble of picking up each printed wafer chip with pincers and observing it under a microscope has been developed by Nippon Kogaku K.K. of Tokyo.

According to the company, almost all processes of producing such semiconductors now have been automated to the extent of eliminating the human hand to avoid soiling. But inspection of the wafer chip with pincers that could damage the chip surface so far had been unavoidable.

The new microscope more than solves this problem by its ability to:

—Automatically pick any wafer chip, between 3 and 5 inches across, from a cassette containing a large number of such chips, screen each chip, and fill all the good chips into another cassette.

—Scan a wide area up to 13 centimeters square and concentrate on any of a maximum total of eight points previously instructed to focus its "eye" on.

—Divide good and bad chips and register and display their respective numbers.

The microscope will come in different models including a very large visual field type that can see an area double that for human eyes, and a triple watch type combining its own lens sight with the human eyesight and the television picture camera sight to show results on a TV screen, all catching a three-dimensional image of the chip as seen from the top.

The Nikon Wafer Inspection Station will sell for about ¥5 million a set. An annual production of 300 units is planned.

CSO: 4120

SCIENCE AND TECHNOLOGY

COMPRESSED AIR STUDIED IN ELECTRICITY GENERATION

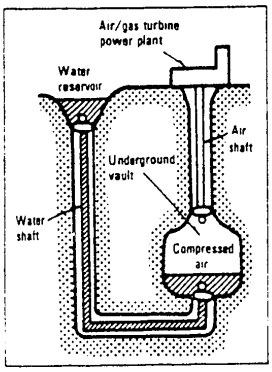
Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text]

Japanese electric power and construction companies are studying a new energy-saving idea for power generation, featuring the use of compressed air.

Compressed air can be produced at night in a gas turbine electric power plant and then stored in an underground vault to be let out to turn the turbine whenever it is wanted.

According to Tokyo Electric Power Co. and the Central Research Institute of Electric Power Industry, both of Tokyo, the compressed air storage-power generating system would be more efficient than the pumping type of hydroelectric power generation. The latter type, already widely used, utilizes surplus power generated by a hydroelectric station during the night to return the water to a dammed-up



reservior above the turbines for re-use during daytime. Demand for power naturally decreases at night.

At present, the oil or coal-burning gas turbine power plant produces compressed air to boost its turbine revolutions by using part of the high-pressure gas it generates to run an air compressor and send the compressed air to its turbines.

The new idea is to let such a plant apply all its generated gas force to its turbine operations, and make the most of the surplus electricity it produces at night to create the compressed air and store it up. Drawing out the stored-up pressurized air to turn its turturbines at the peak of demand will greatly help conserve its fuel.

In the case of Japan's standard power plant with a capacity of 270,000 kilowatts, about 230,000 cubic meters of air compressed to 30 atmospheres in pressure could be stored up in an underground cave if the rock structure below is suitable. Such a vault is to be built about 300 meters deep and its internal air pressure is to be kept always even by building an accompanying water reservoir and leading its water into the bottom of the vault by an underground channel.

CSO: 4120

SCIENCE AND TECHNOLOGY

UNIQUE GALLIUM-ARSENIDE LINEAR IC

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text]

A gallium-arsenide (GaAs) linear integrated circuit (IC) for application to general civilian electronic appliances, the first of its kind, has been developed by Matsushita Electronics Corp. of Takatsuki, Osaka.

The electronic device-making subsidiary of Matsushita Electric Industrial Co. said such a type of IC unit that makes the most of the six-times faster speed of electron movements in gallium-arsenide compared with silicon, previously was known to have been developed only for application to special kinds of measuring and checking instruments.

Originally intended for improving the efficiency of the tuners and boosters of television receiving sets and video tape recorders, the new IC unit has proved so good as to apply also to the amplifying circuitry of automobile telephones and other radio equipment.

The new product is produced by building two layers of gallium-arsenide — a buffer layer and an active layer — upon an also gallium-arsenide substrate, and concentrating a field-effect transistor, a resistor, and a capacitor on top of the active layer.

It will work within a wide range of radio frequency bands between 50 and 2,000 megahertz to promise application to the amplifying circuitry of both the VHF and UHF TV broadcast receivers. Its noise index proved to be only 2.2 decibels at the maximum, almost half the hybrid type of IC unit combining different types of circuitry.

CSO: 4120

SCIENCE AND TECHNOLOGY

NEW METER FOR TESTING PHOTOMASK GLASS

Tokyo THE JAPAN ECONOMIC JOURNAL in English 10 Feb 81 p 13

[Text] A unique surface stress meter for testing the chemically hardened glass photomask necessary for printing integrated circuits and other circuit patterns on silicon substrates has been jointly developed by Toshiba Corp. of Tokyo and its affiliate, Toshiba Glass Co. of Yoshida, Shizuoka Pref., it was recently learned.

The new apparatus, believed by Toshiba Corp.'s leading technologist to be the world's first of its kind, will immensely simplify and improve glass surface checking. Conventional methods require cutting and looking inside the glass or otherwise destroying it to check defects in the chemical processing. The glass needs precise checking since every possible flaw in its surface can mean circuits will be wrongly printed on it, leading to much loss of money and labor.

Wide exports as well as domestic sales are envisioned for the innovational device, which can be produced for about ¥600,000 and is operable by a single worker. It requires just looking through an eyepiece and doing some simple arithmetic.

The photomask, to be used many times in photographing a complex circuit pattern onto the surface of each silicon wafer chip, is produced by attaching a chromium covering film upon a sheet of glass by vacuum evaporation of gaseous chromium, and then photo-etching the original circuitry on the chromium film. The original circuitry is transposed on the wafer chip through the photomask. More recently, the photoetching and transposing jobs are done simultaneously. Many semiconductor makers, however, are still doing a separate transposing job by pressure-attaching the photomask on the wafer surface. Any flaw in the glass surface wrecks the whole transposing job.

The secret of the new device lies in making the most of two optical characteristics of the glass surface. The first is to produce a photoconductive wave guide effect to catch light by a light deflecting layer and release light in several directions of vibrations. The second is to have a photoelastic effect of sending out the captured light in different vibration directions when a testing deflection light filter is turned to change the stress of the glass against the light bombardment pressure. Stripes seen through the device's eyepice change position when the photoelasticity effect takes over. Such change provides the answer when checked by simple calculation.

CSO: 4120

SCIENCE AND TECHNOLOGY

BRIEFS

DIVERSIFICATION OF BLAST FURNACE FUEL--Leading steel makers, such as Nippon Steel Corp. and Nippon Kokan K. K. have decided to carry out full-scale development for diversifying blast furnace fuel. This is caused by a sharp rise in price of heavy oil which is blown into blast furnaces and which has been the trump card for cost reduction and increase in productivity. As an immediate measure, a turnover to all-coke operation which does not use any heavy oil at all has been increased. Further, it has been decided to make effective use of powdered coal, coal-oil mixtures (COM), coal-tar mixtures (CTM), etc. as blast furnace fuel. This will enable steel manufacturers to cope flexibly with any upheaval in energy conditions and to further strengthen corporate power. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 51]

PORTABLE GAS-LEAK DETECTOR--The New Cosmos Electric Co has marketed a high-sensitivity miniature gas-leak detector specially designed for manufactured gas. This device is very sensitive and can detect even very small gas leaks. The new detector has a detecting accuracy of less than 1/100 of that of the conventional checking methods using a detecting solution (a soup solution), and is very easy to operate. Thus, it is expected to attract attention as a powerful tool for use in general inspections for gas leaks. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 54]

INTERACTIVE INTEGRATION SYSTEM--Fujitsu Ltd. has developed a new variety of software named "INTERACT" and has launched it on the market; with this software, endusers who are not EDP (Electronic Data Processing) specialists, now can easily make use of a computer. Up to the introduction of this new software, a series of jobs including data retrieval, data processing and instructions about the reporting form needed the help of a specialist in order to use a computer. Now, using the new software, endusers can do all the necessary operations by themselves using a display terminal. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

PROGRAM DEVELOPMENT, MAINTENANCE--Hitachi, Ltd. and Canon, Inc. announce that jointly they have developed a support system named "CORAL" which develops and maintains programs for large-scale and complicated data base using Japanese, and are selling it as a charged program product. CORAL is characterized by its use of a development system using Japanese language (Katakana: Japanese syllabary) as well as by being an integrated tool which raises efficiency in

every step of system building, including the maintenance/improvement of the system. CORAL has the "CORAL Data Base" at its center, and due to this layout, it is possible systematically to manage and store various information which is needed to develop and maintain the system. Moreover, CORAL provides the following features; Japanese language used as the system description language, 8 kinds of system design specification, supporting function for debug test and interactive service function being available for all system building operations through a display terminal. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

DIAMETER MAGNETIC STORAGE DISK--Toshiba Corp. and Mitsubishi Electric Co., respectively, have each developed a compact fixed magnetic disk storage 8 inches in diameter, which has large storage capacity. As for the access time, both units are of the high speed type; it takes Toshiba's unit 40s on an average and 35s for Mitsubishi's. The application of auxiliary memory systems, such as magnetic disk storage, is increasing as being a necessary item of terminal equipment disks is becoming less from the traditional 14 inches to 8 inches because of scaling down and higher performance trends promoted by the expanding of LSI's (Large Scale Integrated Circuits) to a variety of applications. The development of 8 inches disk storage respectively done by Toshiba and Mitsubishi follows that after Hitachi as well as by Hokushin Electric Works Ltd. From now many new entries into this field are expected to be announced by other companies. [Text] Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

HIGH-SPEED COMPUTER DEVELOPMENT PROJECT--NEC (Nippon Electric Co., Ltd.) has started it's development project for a super high-speed computer (codename: "Super Computer") which can perform highly technical and complicated computations needed in such fields as nuclear energy development, research on the national defense plans and meteorological analysis. NEC are planning to introduce the "Super Computer" into the market in 3 years. The computer adopts an entirely new parallel processing architecture having several tens of processors. As a result of this architecture, the operational speed of the computer in terms of floating-point calculation speed, is expected to reach the fastest level in the world, or 750M flops (million floating operations per second) which is 5 times as fast as that of CRAY 1 which is currently the fastest machine produced by Cray Corp. in the U.S. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

MICROCOMPUTER WITH MOS STRUCTURE--NEC developed an 8-bit 1-chip microcomputer with an MOS structure named "μPD80C48C" and will market it next year. It is the world's first mass produced 8-bit 1-chip microcomputer with an MOS structure. Due to the CMOS (Complementary Metal Oxide Semiconductor) structure, the power consumption of the machine is 1/20 of former models. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

FACSIMILE AS COMPUTER TERMINAL--The application of a facsimile as input/output terminal equipment is stepping into the stage of reality from the laboratory stage. Recently, Matsushita Communication Industrial Co. and Matsushita Electric Transmission Equipment Co. jointly developed FAX & OCR system and have received first orders. NEC is now making efforts to get orders for their facsimile as a computer terminal, including a combination system of facsimile and

OCR (Optical Character Reader). Fijitsu has developed an image information retrieval system which uses a facsimile as an output terminal, and is pushing its sales. In brief, the third generation facsimiles, those for DDX (Digital Data Exchange) network and electronic editing are being unveiled one after the other. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

NEW KANJI DISPLAY EQUIPMENT--Totoku Electric Co., Ltd. developed a new kanji display system of high resolution, which is most suitable for high density displays such as for kanji wordprocessors and office computers, and it can display 1,000 characters per partition in terms of kanji (1 character structure is of 24 x 224 dots) or 10,000 alphabetical letters. Since former kanji display models were expensive and in the range of ¥400,000-500,000 per unit, the company has been making efforts to develop a cheaper model with similar performance. As the result of their efforts, the company has succeeded in developing the special deflection yoke having excellent features as below; vestigical magnet feature which helps to make full use of CRT (Cathode Ray Tube) performance, distortion focus feature, etc. Applying this special deflection yoke to the unique circuit design for the total system, the company has realized a low price model costing only ¥70,000. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 64]

NEW MAGNETIC SENSOR--Shimazu Ltd. has successfully developed, with the cooperation of the Basic Engineering Faculty, Osaka Univ., a magnetic sensor, having a sensitivity 100 times higher than those currently available. It employs SQUID, a superconducting quantum unit of an intervening device. This magnetic sensor is made up of a superconductive ring of niobium foil which has a bridge-type Josephson joint. It is highly sensitive 10^{-13} T, small in size, reliable, resistant to heat, and easy to manufacture. The practical uses for this highly sensitive magnetic sensor, are not only for precision measurements, magnetic detection, and in medical applications such as a heart magnetic meter and an encephalon magnetic meter; but also for effective for forecasting earthquakes. [as published] [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 66]

GAS LEAKAGE ALARM--The General Laboratory of Fuji Electric Co. has succeeded in developing a gas leakage alarm for city gas which for the most part is LNG. There are two methods available for LNG leakage sensors; contact burning and a semiconductor method. The semiconductor sensor is very sensitive to humidity change, and also susceptible to changes caused by other than a flammable gas. The contact burning sensor is, on the other hand is unaffected by humidity but has short span life of 3 to 6 months. [as published] The laboratory has been successful in lengthening sensor life up to 5 years by incorporating a mixed enzyme between a layer of porous aluminum and platinum, for the gas detecting element, and special oxidized metal catalyst as the complementary element. The sensor has preventive functions against alcohol affecting an effort of up to a maximum of 5,000 ppm. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 66]

CHEMICAL FROM SYNTHETIC RUBBER BY-PRODUCT--The Japan Zeon Co. has succeeded to produce on a large scale, a new chemical, from the refuse of raw materials for polyisoprene rubber. The water-soluble polymer, polycarboxylic acid, from isoamylene, which is a component of refuse in the manufacture of rubber was obtained by the company's own method. It is a world first to use such refuse on an industrial scale. The company has been conducting experiments using a pilot plant for some years and has now completed a fully commercial plant at their Mizushima factory with a production of 500 tons/year. Full commercial production has started. The polycarboxylic acid, a water-soluble polymer, is used as a water reduction agent for concrete (the strength of concrete becomes greater by its addition), a pigment filler and a dye dispersing agent. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 68]

TRANSPARENT NYLON RESIN--Unitika Ltd. has recently developed a transparent nylon resin by using its own techniques and is preparing for its marketing. Transparent nylon resin is already commercialized by Toyobo Co. and is also imported by four to five companies; Japan consumed 20t per month. Unitika's transparent nylon resin is mainly made of caprolactam and is designed to provide transparency without diminishing the characteristics of natural nylon such as resistance to oil and mechanical strength. It has the following features: 1) It has high mold ability. 2) Once molded, it can be dyed (post-dyeing). And 3) It can be recycled. The new products consist of types including one which is transparent up to a thickness of 5 mm and another which is transparent up to a thickness of 20-30mm. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12 Dec 80 p 70]

HIGH-PERFORMANCE FLEXIBLE CONTAINER--In accordance with the specifications of its own reinforcing lining cloth, tarpaulin, and by the use of computer designing, National Marine Plastics Co. has recently developed a process to integrate press forming and a novel lining-type flexible square container which has strength about 30% higher than the conventional types and has strikingly high loading and storing efficiency. The company has started the marketing of these products, expecting a rapid increasing of the demands for applications to resins such as polyethylene and polypropylene. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

LINEAR LOW DENSITY POLYETHYLENE--Recently, the manufacture of LL polyethylene has been under active development. It was first produced, 3 years ago, by an American company: VCC. Since then, some companies, including Dow Chemical and U.S. DuPont have commercialized it, and in Japan, Mitsui Petrochemical Industries and Showa Denko have started its commercialization. This LLPE permits savings of energy and resources and reduces manufacturing processes. If we call low-density polyethylene the first generation, we may call high-density polyethylene the second generation and LLPE the third generation. As for applications, LLPE is expected to substitute low-density polyethylene, the top product in the petrochemical industry, and is attracting much attention of industries concerned. It is also estimated that LLPE will enable the total manufacturing costs to be reduced by more than 30%, compared with those for low density polyethylene. Compared with low-density polyethylene, the following features of LLPE are emphasized: 1) It has a resistance to heat 10-20°C

higher. 2) It has rigidity. 3) It has film strength and thus can be extended 10-20% thinner. 4) It has high heat sealing strength. 5) It has resistance to oil and to cold. And 6) it has resistance to acids and alkalis. Thus, about 10 Japanese companies including Nippon Oil Company, Mitsubishi Petrochemical Company, and Idemitsu Petrochemical have signed technical option agreements with VCC, each contract amounting to $100,000. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

ENERGY-SAVING INJECTION MOLDING MACHINES--Energy-saving injection molding machines have been completed at four major makers of plastic-processing machines. Since Nissei Plastic Industry Co. disclosed an energy-saving injection molding machine in February, makers of extruding molding machines have followed it by marketing new models. More recently, Kawaguchi Tekko has also disclosed a new model able to complement the energy-saving molding machines from 4 major makers already on the market. These energy-saving molding machines are designed to reduce power consumption by 40-50%. For the model lately disclosed by Kawaguchi Tekko, the company intend to build a total system, aiming at energy and labor savings, including not only molding machines but also additional equipment, peripheral machines and factory environments. Because it will take 3 years to complete this project, the model lately disclosed seems to be a part of the whole system. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

SPECIAL PHENOL RESIN--Mitsui Toatsu Chemicals, Inc. has announced that it has developed and started the marketing of a special phenol resin made by chemically integrating phenol with rubber by using their own techniques. Its main features are: increased cracking resistance and dimensional stability, together with sufficient improvements to make up for the drawbacks of conventional straight phenol resin and novolak-type resin, made by mixing phenol with rubber. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

POLYETHYLENE TECHNOLOGY EXPORTED--Mitsubishi Petrochemical Company and Dainichi Nippon Cables, Ltd. have announced that they have decided to render technical assistance to Switzerland with regard to the technical exportation of a MDCV process for the insulator sheath of cross-linked polyethylene cable that they have developed. The companies' MDCV process has already been exported to Sweden and the Netherlands. Thus, the latest exportation is the third. The MDCV process is a novel cross-linked dry system. Because it does not use high-pressure steam in cross-linking processes, it greatly reduces smallest voids which will ill-affect voltage withstanding characteristics. Thus, the companies have fractically realized a void-free insulation. Compared with conventional steam cross-linked products AC wave destruction strength has been greatly improved contributing to supervoltage modification of cross-linked polyethylene cables, in addition to long-term stability and submersion chargeability. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

U POLYMER TECHNOLOGY EXPORTED--Explosive demands are coming from Europe and the U.S. for thermoplastic polyallylate resin U polymer as an engineering plastics first developed in the world by Unitika. Unitika granted an exclusive license for the marketing of U polymer to some companies in Belgium and the U.S., one of which decided to produce it domestically. Now, Unitika has announced that

it has reached an accord with this company upon exportation of manufacturing technology and an agreement will be signed shortly. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

MAGNETIC PLASTIC MATERIAL DEVELOPED--The Gunmaken Industrial Research Laboratory is developing a magnetic plastic material to be used in place of sintered ferrite magnets. It is made by injection molding after pasting a magnetic plastic system together with a powdered magnetic material such as ferrite. It has a high dimensional accuracy in processing and is easy to produce. Thus, it is drawing much attention. The laboratory is making efforts to improve the material by carrying out test manufacture and intends to promote studies for the development of molding machines suited for it and also wants to improve the molding techniques in order to commercialize such machines. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 70]

POLYETHYLENE, HEAT RETAINING CYLINDER--In response to recent demands for heat retaining cylinders with higher heat retaining performance suitable for piping for air conditioning, central heating and refrigerators and also for piping in spas resulting from desire for energy saving, Hitachi Chemical Co. has recently developed and started the production and the marketing of a foamed polyethylene heat retaining cylinder with a wall thickness of 20mm, twice the conventional thickness. Reportedly, the new heat retaining cylinder has the following features: 1) It has double wall thickness compared with conventional types and thus shows high performances for heat and cold retaining. 2) It can be used continuously in a wide range of temperature from -80°C to +100°C. 3) It has little water and moisture absorbing power and thus is adiabatically stable. 4) It does not corrode steel and iron pipes and is itself not corroded by steel pipes. And 5) It has a tubular shape, 2m long, and is easy to work with. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 71]

MAGNETIC-FIELD INJECTION MOLDING MACHINE--Tanabe Kogyo has recently developed a magnetic-field injection molding machine for the production of plastic magnets. The company is the sole maker of magnetic-field molding machines in Japan. The new machine has a movable excitation coil that saves energy and has higher operability. The plastic magnet is designed to mold materials which contain powdered magnetic components in high percentages (13% for nylon and 87% for barium ferrite). By its strong magnetism, it enables particles of the material to be turned into magnets. Plastic magnets are today used for television parts such as centering magnets and for parts for tape recorders, motors and automobiles. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 71]

RED-PHOSPHORUS INCOMBUSTIBLE AGENT--The Nippon Chemical Industrial Co. has recently developed a red-phosphorus incombustible agent by its own techniques and will enter the market as a second maker following: the Rin Kagaku Kogyo Co. Red Phosphorus is a component of an ignition chemical used on the sides of match boxes, alloys and synthetic organic catalysts. Although it has a very low ignition point, it can be converted into an incombustible agent, for stabilization. The red-phosphorus incombustible agent developed by the Nippon Chemical Industrial Co. has the following features: 1) It has a fire point of about 50°-60°C higher than that of ordinary types. 2) It is designed to

generate less phosphine than the ordinary types, displaying high safety for working and allowing no phosphine odor to linger on molded resin products. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 72]

INNOVATIVE HERBICIDE DEVELOPED--Meiji Seika Kaisha Ltd. has recently developed a nonselective stalk and leaf contact transfer herbicide "MW801" (the name of a test chemical which is considered to be similar to "Round up" (a product developed by Monsanto) and "Paracoat" (a product manufactured by LCI). This new agricultural chemical is a fermented product containing 32% Sodium salt of SF-1293 as an effective component and has such features as: an ordinary level of acute toxicity, low toxicity toward fish, and applicability to a wide range of herbs. It is quite able to wither herbs down to their roots. However, it has no efficacy as a soil treatment agent and thus has the feature, which is not shared by other strong herbicides, of enabling seeds to be sown without the need for an idle period after spraying. In early 1981, on the basis of the data obtained after toxicity tests, the company intends to develop gradually toward marketing by filing for registration of an agricultural chemical suitable for nonfarming land. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 72]

FUNGICIDE FOR RICE PLANTS--As the result of joint research, Sankyo Co., Ltd. with Ube Ind. Ltd. has developed under the trade name Shirahagen, a fungicide for the control of bacterial leaf blight. The common name of Shirahagen is Techlofthalam, and bacterial leaf blight is a principal disease of rice plants. Sankyo initially will sell the fungicide in the Republic of Korea (ROK) where bacterial leaf blight occurs frequently. As a result of test sales in the ROK this year (1980), the fungicide has been recognized as being very effective. Accordingly, the demand in the ROK is expected to increase considerably in the next pesticide year and Sankyo Co. Ltd. considers the ROK to be a very promising market. Since bacterial leaf blight also occurs in China and Southeast Asian countries, Sankyo is planning to export the fungicide to those countries as well. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 72]

STEPLESS SPEED CHANGE INVERTER--Miki Pulley Co has marketed an inverter able to steplessly change the speed of 3-phase induction motors. The circuitry in this inverter has been simplified by the use of a PWM system, a one-board structure, and a custom LSI specially made for inverters, plus drive circuits and protection circuits of hybrid ICs. Thus, it is made more compact (the weight is reduced to 1/3 of the conventional level), provides a high reliability and is low priced. The invester has the following features: 1) It is provided with protective functions, such as current control and timer tripping, against malfunctions likely to occur during operation. 2) It can be used in the 6-180Hz frequency range and has constant torque characteristics in the 6-60Hz range, constant-output characteristics, jump start circuits and soft start stop functions in the 60-180Hz range. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 54]

TIRE MANEUVERABILITY TEST EQUIPMENT--Yamato Seiko Co has developed equipment to test tyre maneuverability, that can conduct tests 4 times faster with 5 times higher accuracy than conventional equipment. The equipment has an originally developed loadcell which simultaneously measures 3 force components generated between a tyre and the road surface (cornering force, rolling resistance and vertical load) and 3 moment components (selfaligning torque, rolling resistance moment and overturning moment). The detection accuracy is very high, 0.1% at full scale. A computer controls the operation of the equipment, providing logging of data test as well as interference compensation computation and input data checks. Measurement validity checks and spring constant computation of tyres are also handled by the computer. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 59]

AUTOMATIC CAN MANUFACTURING MACHINES--Orders are increasing for 18ℓ-can manufacturing machines using a lock seam system. This system was developed last year by Yaguchi Iron Works, a can machine manufacturer. 18ℓ-cans are primarily used as oil cans. Recently, they are more often made of chrome acid surface-treated steel plate (TFS) rather than the conventional tin plate. However, since TFS can not be soldered, electrical welding and achesive bonding are applied in can manufacture. Although economical in can manufacturing, electrical welding has the drawback of quickly rusting the internal seams. The can manufacturing machine using a lock seam system makes a seam by bending and engaging two edges of a plate and applying an adhesive to the inside of the engaged portions, preventing the seams from rusting. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 54]

MICROWAVE CAMERA PICTURIZATION INFORMATION--NEC has succeeded in picturization of information concerning the earth's surface taken by a microwave camera mounted on Seasat (U.S. Satellite for Oceanographical observation) using digital processing by a large capacity computer. The image data was obtained by processing 100km x 15km area of information into an image on the basis of 25m x 25m area information for one image element. It is said that it took them fully 20-30 hours to picturize the area information of 30km square. Up to date, NASA (U.S.A.), MDA (Canada) and RAE (U.K.) have succeeded in the digital processing of such data. These are all national organizations specialized in space research. NEC developed its own processing method three months after their getting the Seasat observation data and succeeded in digital picturization. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 62]

FACSIMILE WITH EDITING CAPABILITY-- Toshiba will sell facsimile equipment with an editing function which enables a large reduction in work needed for the transcribing in the distribution industry, or in other industries, by use of its editing function including the automatic editing/making of distribution lists from sales slips, etc. More exactly, it can make an order sheet from plural sales slips or alternatively can make plural sales slips from one order sheet. Moreover it can automatically transmit the order sheet made by this machine to other parties. The following application of the machine is available: transmitting distribution lists made from sales slips inputted to a physical distribution center or outputting invoices for each user from an order sheet, which has been transmitted from sales branches. Slips can be set for each user, so, about five forms in general can be chosen. [Text] [Tokyo TECHNOCRAT in English Vol 13 No 12, Dec 80 p 62]

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