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INDUSTRIAL AFFAIRS

(FOUO 10/79)

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CHEMICAL INDUSTRY AND RELATED EQUIPMENT

UDC 665.6:54.002.2

DEVELOPMENT OF RAW MATERIALS BASE IN PETROCHEMICAL INDUSTRY

Moscow KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL in Russian No 6, 1979
pp 49-52

[Article by Ya. S. Amirov, D. Ya. Rusanovich, and V. Ye. Tishchenko: "Expanding the Raw Materials Base of the Petrochemical Industry"]

[Text] The development of the petrochemical industry in recent years has been characterized by concentration of production and enlargement of the unit capacity of individual installations (aggregate units) for the production of ethylene (300,000-450,000 tons a year), butylalcohol (60,000 tons a year), butadiene (100,000-120,000 tons a year), and isoprene (60,000-90,000 tons a year). Consolidating installations improves the economic characteristics of production of these products and creates favorable conditions for comprehensive use of raw materials, including by-products and waste. At the same time, when petrochemical production facilities are concentrated problems arise with supplying their raw materials. Thus, to operate domestic EP-300 and EP-450 ethylene installations it is necessary to have 1.5-2 million tons of directly distilled gasoline fractions a year. It is difficult to produce such a quantity of gasoline for pyrolysis at many of the existing fuel petroleum refineries. Only large refineries can provide a stable source of raw material. The fact that no such large refineries exist in numerous regions, however, makes it necessary to establish autonomous raw material bases and build special installations of the AP-6 type or plants for primary petroleum refining in order to produce raw material for petrochemistry.

The foreign literature [1-3] contains many reports on the promise of fuel petroleum refineries that produce engine fuels and raw material for petrochemistry as well as chemical petroleum refineries that specialize in the production of monomers. The principal difference between the plan of the "chemical" petroleum refinery and the widely known (classical) plans is that the chemical refinery subjects the gasoline fractions to pyrolysis, with the exception of the hydrocarbon fractions C_6-C_8, which are sent to catalytic reforming for aromatization. In addition, the medium (kerosene and gas oil) distillates are sent

for pyrolysis. The target products here are ethylene, propylene, butylene, butadiene, the aromatic hydrocarbons (benzene, toulene, and the xylenes), as well as coke and liquefied gas.

The questions of combined petroleum refining for the purpose of expanding the raw material base of the chemical industry have also been treated in domestic research. Works from the Institute of Petrochemical Synthesis imeni A. V. Topchiyev of the Academy of Sciences USSR [4, 5] consider petrochemical complexes with different variations of pyrolysis of liquid crude petroleum and secondary processes of refining petroleum and improving gasolines and diesel fuels. Processing petroleum according to the scheme which provides production of about 45 percent light petroleum products and 14 percent chemical output (variation I) can reduce calculated expenditures for gasoline production 30 percent, ethylene and propylene production 10 percent, and acetylene production six percent in comparison with expenditures at a typical unit of a fuel refinery. When the production of petrochemical output at a refinery is increased to 24 percent (variation II) and 34 percent (variation III), the overall efficiency of production is improved: profit, return on capital, and profitability rise (see Table 1 below).

Certain economic regions have a practical interest in building petrochemical complexes that combine traditional petroleum refining processes (catalytic cracking, coking, hydrocracking, hydraulic cleaning, and others) with simultaneous production of engine fuels and monomers for petrochemistry. This affords a significant savings of capital and operating expenditures. However, the construction of such complexes today is held back by a slight drop in the separation of light oil products that occurs with growth in the production of petrochemical products. For this reason, it is advisable in regions with high engine fuel consumption to build petroleum refineries with complete and comprehensive processing of refinery hydrocarbon gases and production of raw material for chemical processing. Chemical processing should involve not just the hydrocarbons C_3-C_4, but also C_2 with separation and utilization of the ethane, ethylene, and hydrogen fractions.

Comprehensive and efficient use of refinery hydrocarbon gases today takes many forms. They can be processed for fuel and chemicals. The competition between these two areas determines the current state of the production and use of light hydrocarbon raw material in petrochemistry. The problem is made more difficult by the fact that there are many types of hydrocarbon raw materials that are partially or completely interchangeable for the production of both petrochemical products and gasoline components. For example, alkylate is mostly obtained from butylenes, but also comes from propylene. In the production of commodity gasoline, however, it can be partially replaced by butane, isopentane, or an isomerizate. The propylene and butylenes separated from refinery hydrocarbon gases may be used to synthesize many very different petrochemical products. Because of the great diversity of methods of producing the very same products from different raw materials, it is impossible with

Table 1. Economic Indexes of Petroleum Refining at Petrochemical and Fuel Refineries [2, 3].

(a) Показатели	(b) Вариант			Типовой блок НПЗ топливного (c) профиля
	I	II	III	
Условная мощность по нефти, тыс. т/год (d)	6000	6000	6000	6000
Выработка валовой продукции, % (e)	118	169	217	100
Приведенные затраты на 1 т продукции, % (f)				
бензина автомобильного (g)	70	65	74	100
этилена, пропилена (h)	90	66	66	100
ацетилена (i)	94	73	73	100
Прибыль, % (j)	232	345	446	100
Фондоотдача, руб./руб. (k)	0,74	0,86	0,92	0,54
Рентабельность, % (l)	58	72	79	23
Срок окупаемости капиталовложений, годы (m)	1,7	1,4	1,3	4,5

Key:
(a) Indexes;
(b) Variation;
(c) Typical Fuel Petroleum Refinery Unit;
(d) Conditional Capacity for Petroleum, thousands of tons a year;
(e) Production of Gross Output, percentage;
(f) Calculated Expenditures per Ton of Output, percentage;
(g) Gasoline for Motor Vehicles;
(h) Ethylene and Propylene;
(i) Acetylene;
(j) Profit, percentage;
(k) Return on Capital, rubles/rubles;
(l) Profitability, percentage;
(m) Payback Period of Capital Investment, years.

traditional methods to determine the optimal ways to use propylene and the butylenes.

Moreover, the high requirements made by transportation for the quality and quantity of motor vehicle gasolines create a large demand for high-octane components. The existing State All-Union Standards for commodity gasolines, which limit the pressure of saturated vapors, the boiling point, and the content of aromatic hydrocarbons, restrict the use of particular components.

For example, gasolines must not contain more than 4.5-5.5 percent butanes because this is necessary to maintain the proper pressure of saturated vapors. The aromatic hydrocarbon content must not be greater than 40-45 percent or scale formation intensifies. Thus, commodity motor vehicle gasolines are produced by combining different components in different

ways. The optimal ratio of these components can be determined by linear programming techniques.

We give below a solution to the optimal problem for the use of the hydrocarbons C_3 and C_4 to produce petrochemical products. This solution insures maximum profit while maintining appropriate quality characteristics in motor vehicle gasolines and the necessary production level [6, 7]. In mathematical form the problem looks as follows:

$$\sum_{j=1}^{n} \alpha_j X_{ij} \leq Q_i \qquad (1)$$

$$\sum_{i=1}^{m} X_{il} \left\{ \begin{matrix} \geq \\ = \end{matrix} \right\} B_l \qquad (2)$$

$$\sum_{i=1}^{m} X_{il}\beta_{Ri} \left\{ \begin{matrix} \geq \\ = \end{matrix} \right\} \beta_{Rl} \qquad (3)$$

$$F = \sum_{i=1}^{m}\sum_{l=1}^{r} X_{il}\,\Pi_{il} \Rightarrow \text{макс} \qquad (4)$$

$$X_{ij} \geq 0; \quad X_{il} \geq 0 \qquad (5)$$

where a is the number of installations for industrial process j; Xij is the amount of component i necessary for optimal loading of industrial process j; n is the number of processes that use component i as raw material; m is the number of types of raw material considered in calculating material balances; r is the number of types of commodity products (gasolines and petrochemical products); Qi is stocks of component i; X_{il} is the amount of component i used in commodity product l; B_l is the planned volume of production of commodity product l; β_{Ri} is quality characteristic R of component i; β_{Rl} is quality characteristic R of commodity product l (according to State All-Union Standard); Π_{il} is the profit received per ton of component i used in commodity product l.

The problem was solved for a hypothetical fuel petroleum refinery which had installations of the following capacities: two AVT's [atmospheric vacuum pipe-stills] — 6 million tons a year apiece; two catalytic cracking units — 1.37 million tons apiece; a catalytic reforming unit — 1.2 million tons; two thermal contact cracking units — 1.8 million tons apiece; two isomerization units — 68,000 tons apiece; two alkylating units — 68,340 tons apiece a year. These installations produce the basic amount of components of gasolines and initial gases for the production of propane-propylene, butane-butylene, butane, and isobutane fractions of hydrocarbons which can be put into gasolines either through an alkylate or directly (with the exception of unsaturated hydrocarbons which can be used in gasolines only through an alkylate or polymer-distillate).

The problem was solved in three variations.

In the first variation gasoline production equals a given volume; the use of the hydrocarbons C_3 and C_4 is envisioned to produce petrochemical output at standard installations.

The second variation limits the production of gasolines and petrochemical products at installations of standard capacity and uses the hydrocarbons C_3 and C_4 from a pyrolytic installation, that is, where the refinery has added an EP-300 installation.

The third variation is the same as the second, but without tying the volume of production of petrochemical products to standard capacity.

The results of solving the problems (see Tables 2 and 3 below) show that processing unsaturated hydrocarbons C_3 and C_4 into petrochemical products is possible with virtually no loss in production of motor vehicle gasolines. In the first variation with a precisely set volume of gasoline production this is possible only by substituting a propylene alkylate for the butylane alkylate. In this case 92,000 tons of butadiene and 60,000 tons of isoprene can be obtained from the butane-butylene fraction. In the second variation the assortment of petrochemical products obtained at standard installations is greatly broadened. With the third variation large-scale production of butylalcohol (about 110,000 tons), polypropylene (140,000 tons), butadiene (more than 150,000 tons), isoprene (60,000 tons), and polyisobutylene (74,400 tons) can be organized. When necessary the production of polyisobutylene can be significantly cut in order to produce more than 90,000 tons of isopropene (without dehydrogenation of the isobutane) or 130,000 tons (with dehydrogenation). In the second and third variations the production of petrochemical products on the basis of refinery and secondary pyrolytic hydrocarbons C_3 and C_4 is possible with a certain decrease in the production of motor vehicle gasolines.

Table 3. Figures on Production and Ratio of Grades of Gasoline.

Показатели (a)	Вариант (b)		
	I	II	III
Выработка товарных бензинов (c) всего	100,0	89,7	87,0
АИ-98 этилированного (d)	100,0	136,1	108,3
АИ-93 этилированного (e)	100,0	100,0	100,0
АИ-93 неэтилированного (f)	100,0	49,3	40,8
Соотношение сортов товарных бензинов (g)			
АИ-98 этилированного (d)	11,6	17,6	14,9
АИ-93 этилированного (e)	59,8	66,7	71,2
АИ-93 неэтилированного (f)	28,6	15,7	13,9

Key:
(a) Indexes;
(b) Production and Ratio of Grades, percentage;
(c) Production of Commodity Gasolines, total;
(d) AI-98 Ethylated;
(e) AI-93 Ethylated;
(f) AI-93 Nonethylated;
(g) Ratio of Grades of Commodity Gasolines.

Table 2. Results of Solving the Problem of Optimal Use of Unsaturated Hydrocarbons C_3 and C_4 [6].

Key: (a) Products;
(b) Production, thousands of tons;
(c) From Propylene;
(d) Phenol [numerator] and Acetone [denominator];
(e) Butylalcohol;
(f) Nitrile of Acrylic Acid;
(g) Polypropylene (from pyrolytic propylene);
(h) Alkylate C_7;
(i) From Butane-Butylene Fraction;
(j) Isoprene;
(k) Butadiene;
(l) Methylethylketone;
(m) Polyisobutylene;
(n) Alkylate C_8;
(o) From Pyrolytic Butadiene Fraction;
(p) Butadiene (extraction);
(q) Butadiene (dehydrogenation of n-butylenes);
(r) Butyl Rubber;
(s) From Isobutane.

(a) Продукты	(b) Производство, тыс. т		
	I	II	III
Из пропилена (c)			
Фенол и ацетон (d)	96/60*	60/37,5*	—
Бутиловые спирты (e)	—	30	110
Нитрил акриловой кислоты (f)	—	25	—
Полипропилен (из пиролизного пропилена) (g)	—	140	140
Алкилат C_7 (h)	93	—	—
Из бутан-бутиленовой фракции (i)			
Изопрен (j)	60	41,3	—
Бутадиен (k)	92	49,4	92
Метилэтилкетон (l)	—	13,5	—
Полиизобутилен (m)	—	9,64	74.4
Алкилат C_8 (n)	—	95,6	
Из пиролизной бутадиеновой фракции (o)			
Изопрен (j)	—	—	26,9
Бутадиен (извлечение) (p)	—	42,6	42,6
Бутадиен (дегидрированием н-бутиленов) (q)	—	—	16.6
Бутилкаучук (r)	—	27,5	—
Из изобутана (s)			
Изопрен (j)	—	18,7	35

Because none of the three variations has mandatory complete use of all gasoline components, there are residues, primarily from catalytic cracking gasoline. It is obvious that to increase hydrocarbon resources both catalytic cracking units should be switched to a high-temperature regime for a slight reduction in gasoline production and an increase in its octane number. When the catalytic cracking regime is made more severe the production of petrochemical products can be significantly increased. The efficiency of using propylene and the butylenes for this purpose is apparent: the profit is 154, 222.3, and 275.7 million rubles respectively for the three variations (see Table 4 below).

Solving an analogous problem to optimize the use of the hydrocarbons C_3 and C_4 for large industrial centers (the Ufa petroleum refinery group was taken as an example) showed that in this case too the stocks

Table 4. Results of a Calculation of Profit.

Key: (a) Profit, millions of rubles;
(b) Total;
(c) From Petrochemical Products;
(d) From Gasoline.

Вариант (Variation)	(a) Прибыль, млн. руб.		
	всего (b)	от нефтехимических продуктов (c)	от бензинов (d)
I.	153,99	89,75	64,24
II.	222,22	166,41	55,81
III.	275,72	221,87	53,85

of the propane-propylene and butane-butylene fractions can be turned over to petrochemistry without detriment to the production of motor vehicle gasolines. The production of high-octane commodity gasolines can be accomplished by using the components of catalytic cracking and reforming and by more extensive utilization of isomerizates and gaseous gasoline. Combined processing of refinery hydrocarbons C_3-C_4 and the butylene-butadiene fraction from pyrolysis will allow a significant increase in the production of petrochemical products (at least 50,000 tons of butadiene, 30,000-35,000 tons of isoprene, 44,000 tons of butyl rubber, 250,000 tons of phenol, and 30,000-40,000 tons apiece of butylalcohol and polypropylene). Table 5 below shows the production and ratio of commodity gasolines for the Ufa industrial center; the profit for the respective variations is 150 and 220 million rubles.

Table 5. Figures on the Production and Ratio of Grades of Gasoline for the Ufa Industrial Center.

Key: (a) Indexes;
(b) Production and Ratio of Grades (in percentage); for two variations;
(c) Base;
(d) Optimal;
(e) Production of Commodity Gasolines, total;
(f) AI-98 Ethylated;
(g) AI-93 Ethylated;
(h) AI-93 Non-Ethylated;
(i) Ratio of Grades of Commodity Gasolines, total.

Показатели (a)	Выработка и соотношение сортов (в %) по вариантам (b)	
	базовому (c)	оптимальному (d)
Выработка товарных бензинов (e)		
всего	100,0	106,3
АИ-98 этилированного (f)	100,0	101,0
АИ-93 этилированного (g)	100,0	102,2
АИ-93 неэтилированного (h)	100,0	102,8
Соотношение сортов товарных бензинов (i)		
всего	100,0	100,0
АИ-98 этилированного (f)	12,1	11,6
АИ-93 этилированного (g)	64,7	59,8
АИ-93 неэтилированного (h)	23,2	28,6

Thus, the calculations made and solutions to the problem of optimizing gasoline production show the possibility in principal and economic advisability of using refinery hydrocarbon gases in chemical processing.

FOOTNOTES

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3. ERDOL UND KOHLE, 1976, No 6, p 244.

4. Rabkina, A. L. et al, KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL, 1977, No 6, p 23.

5. Borisov, P. A., et al, in "Voprosy Ekonomiki Neftekhimicheskoy Promyshlennosti" [Questions of the Economics of the Petrochemical Industry], Moscow, INKhS AN SSSR, 1977, p 55.

6. Rusanovich, D. A., et al, "Tezisy Dokladov Vsesoyuznogo Simpoziuma Molodykh Uchenykh i Spetsialistov v g. Minske 29-30 Marta 1972 g." [Summaries of Reports at the All-Union Symposium of Young Scientists and Specialists in the City of Minsk on 29-30 March 1972], Moscow, NIITEkhim, 1972, p 58.

7. Amirov, Ya. S., et al., "Ekonomicheskaya Effektivnost' Neftepererabatyvayushchey i Neftekhimicheskoy Promyshlennosti" [The Economic Efficiency of the Oil Refining and Petrochemical Industry], Ufa, UNI, 1977, p 149.

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CHEMICAL INDUSTRY AND RELATED EQUIPMENT

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DEVELOPMENT OF CHEMICAL INDUSTRY IN SIBERIA AND FAR EAST

Moscow KHIMICHESKAYA PROMYSHLENNOST' in Russian No 5, 1979 pp 3-7

[Article by N. V. Kuznetsov]

[Text] Our party, in following Lenin's precept, always turns to the abundant national experience in solving complex problems, consults with the people and absorbs its wisdom. In his book "Small World", L. I. Brezhnev has written: "...again and again you are convinced how right V. I. Lenin was when he suggested the tremendous value of communication with the masses, relating with workers, peasants, soldiers..." [1]. At a meeting of the first secretaries of kraykoms and obkoms of the Far Eastern CPSU, L. I. Brezhnev again recalled this major feature of Lenin's work style. He noted that it is an important matter to converse with workers, listen to them and examine what they say.

An importan event in the live of the CPSU and the entire country was the trip of L. I. Brezhnev, general secrety of the CPSU Central Committee and chairman of the Presidium of the USSR Supreme Soviet, to the regions of Siberia and the Far East that he completed in April, 1978. L. I. Brezhnev's meetings and conversations with workers of enterprises, builders of the BAM, other workers, with party management, troops of the Soviet Army and Navy were cast into a brilliant demonstration of the monolithic solidarity of the Soviet people around Lenin's party and gave a convincing demonstration of the party's concern about strengthening the potency of our Homeland, raising the national welfare and reinforcing peace on Earth. These conversations and meetings turned into a thorough discussion of the present and future of Siberia and the Far East, the outlook and problems of economic development of the country, further enhancement of the welfare of the Soviet people and problems in fulfilling the historic decisions of the 25th CPSU Congress.

As we know, at the 25th CPSU Congress the party adopted a broad program of thorough development of all economic regions of the country. In accordance with this program, further development will be derived by comprehensive assimilation of natural wealths and development of productive forces of Siberia and the Far East.

Since the first days of its existence, the Soviet state has shown constant concern for the study and utilization of the mineral resources of Siberia and the Far East. V. I. Lenin supported the first scientific research expeditions with the participation of great scientists. On his initiative was accelerated the prospecting of coal reserves and iron ore in the Kuzbass. In the years of Soviet

authority, these formerly wild sections that served as a place of exile for revolutionaries, became unrecognizable. Here grew new cities and villages, large industry and socialist farming developed.

A new stage in the development of this region began in the 1960s with the assimilation of Tyumen petroleum and gas and the recent creation of large regional complexes and industrial junctions such as the Western Siberian, Sayanskiy, Bratsko-Ust'-Ilimsk and others. The Western Siberia has already become the primary base of development of the petroleum and gas industry; oil fields of Tyumen' now produce almost half of the entire petroleum yield and a larger share of gas. A powerful boost for comprehensive development of this region will be given by the Baykal-Amur Mainline.

But interests in developing the country require still faster turnover of the rich natural resources of this region. In his speech before the 28th Komsomol Congress, L. I. Brezhnev stressed the importance for the country's economy of a more rapid development of these regions, in each of which is being mastered land of up to a million square kilometers, which is equal in area to several European countries put together [2]. In fulfilling this important task, it is very important to develop the chemical and petrochemical industry in the regions of Siberia and the Far East.

Even today such powerful, multi-sector chemical junctions and complexes as the Omsk, Barnaul', Kemerovo, Angaro-Usol', Krasnoyarsk and others are operating in this enormous region.

In the current and previous five-year plans, large growth of chemical and petrochemical production has been planned mainly for polymer materials—polyethylene, polystyrene, PVC, synthetic fibers, etc. Based on the development of petroelum and gas deposits of Western Siberia, in the 10th five-year plan construction has opened up on the Tobol'sk Petrochemical Complex. In Tomsk, Omsk, Zima and some other industrial centers of Siberia, industrial complexes closely coupled with other allied sectors of the national economy are being built. The scales of production noted in these complexes are so great that, for example, at the Tomsk Chemical Plant, first production of which will start up in this current five-year plan, the annual production of polyolefins (polyethyelen and polypropylene) will be much greater than was produced in the entire country in 1970. With the manufacture of these polymers, it will occupy one of the leading places in the Soviet Union. The plan developed by the Okhtinsk Scientific Industrial Association Plastpolimer envisages the manufacture of polypropylene, methanol, carbamide, formaldehyde, polyformaldehyde, ethylene and polyethylene.

Production of the Tomsk Chemical Plant will be used in all sectors of the national economy. Half a billion rubles of capital investment is earmakred for creation of just one phase of the enterprise (and there will be three of them). But these expenditures will be paid off rapidly. All the equipped facilities and production, equipment and units have increased unit capacity, maximum automation and mechanization and provide better working conditions than other enterprises. According to plan, labor productivity at the plant will be the highest in the sector. Reliable environmental protection is assured as well [3].

The Zima Chemical Plant is a great chemistry facility. By using the opulent deposits of common salt, it will manufacture chlorine, caustic soda, vinylchloride and PVC. This fact imposes on the collective an even greater responsibility for the timely assimilation of the industrial capacities now under construction.

Construction of several other chemical and petrochemical enterprises, reconstruction and technical re-equipment of currently operating enterprises, shops and production is envisaged.

For the working classes of the chemical and petrochemical industry, L. I. Brezhnev's trip to the regions of Siberia and the Far East had an especially important significance. Meetings and gatherings were held at enterprises at which workers, technical engineering workers and clerks warmly and unanimously approved the results of L. I. Brezhnev's trip, noted the tremendous value of this trip for the successful development of productive forces of Siberia and the Far East and for raising the welfare of Siberians and Far Easterners. Proposals were put forth to re-examine previously adopted high socialist obligations and to adopt higher ones, counter plans, acceleration of introduction of scientific and planning developments into practice, etc. On June 6, 1978 an expanded meeting of the Presidium of the Central Committee of the profsoyuz of workers of the chemical and petrochemical industry was held to discuss the issue "On organizational measures of republican, kray, oblast and urban committees of the profsoyuz of chemical and petrochemical industry to implement tasks emerging from the results of the trip of comrade L. I. Brezhnev, general secretary of the CPSU Central Committee, chairman of the Presidium of the USSR Supreme Soviet to the regions of Siberia and the Far East". Expanded meetings of the Presidia of republican, kray, oblast and urban committees of the profsoyuz, Plena and party management and profsoyuz active membership were also held. Detailed measures aimed at fulfillment of tasks advanced by L. I. Brezhnev during this trip were developed on the spot. Workers of the profsoyuz apparatus and ministries went out to enterprises with reports and conversations. In chemical and petrochemical enterprises, organizations, shifts and teams of the Khabarovskiy Kray alone there were 102 meetings held at which 6,456 persons attended. Five hundred twelve speeches were given. Party, profsoyuz and komsomol organizations took care to see that at all clubs, houses of culture, recreation centers and on the grounds of enterprises there were displays, photomontages, exhibitions and movies on L. I. Brezhnev's sojourn in the Khabarovskiy Kray, his meetings with the working classes—prime builders of the city of Komsomolsk on the Amur. The indications and recommendations of L. I. Brezhnev became the theme for profound study in the network of political education and in schools of communist labor. A great deal of work was done to implement proposals and advice of L. I. Brezhnev by the

Committee of the profsoyuz of workers of the chemical and petrochemical industry. On April 27, 1978 an expanded session of the Presidium of the Kray Committee of the profsoyuz was held to affirm measures to fulfill the indications and recommendations of L. I. Brezhnev.

Similar measures were developed by profsoyuz organizations locally.

In fulfilling the indications of L. I. Brezhnev on the need to improve the organization of socialist competition, the kray committee of the profsoyuz organized a check of fulfillment of adopted socialist obligations, their justification and intensity. At kray sector enterprises 90 percent of the workers, some 3,432 workers or 398 crews out of 450, are currently engaged in individual socialist obligations. All shops have concluded mutual agreements to compete. The overwhelming majority of technical engineers have personal creative plans. The initiative "Five-year plan of quality—a working guarantee" has become popular at enterprises. This is the slogan of competition for 3,597 workers, 29 shops and 294 crews. All labor collectives are in motion following the example of the Rostovites "Work without falling behind, efficiently and with quality". Other undertakings are also being supported.

The kray committee of the profsoyuz and the profsoyuz committees of enterprises and managers attribute particular meaning to the elaboration of measures to fulfill the recommendations of L. I. Brezhnev about the timely start-up of industrial facilities, concentration of efforts of collectives at major start-up facilities and enterprise reconstruction. At leading sector enterprises in the kray, operational groups have been set up to monitor the flow of capital construction.

Great work is being done to increase productive capacities at the Komsomolsk Sulfuric Acid Plant. The start-up of a new sulfuric acid shop in 1980 will almost triple the current level of sulfuric acid manufacture.

To fulfill assignments of the five-year plan, collectives of enterprises of the chemical industry ofthe Kemerovskaya oblast have to increase production output by a factor of 1.6, including ammonia by a factor of 2.3, mineral fertilizers by a factor of 2.2, synthetic resins and plastics by a factor of 1.4, chemical fibers by a factor of 2.5 and consumer goods by a factor of 1.5. There are twice as many funds earmarked for these purposes as in the last five-year plan. In solving this problem, primary meaning will be placed in popularization of the experience of the Rostovites "Work without falling behind". Work in this direction being done by profsoyuz and managerial organs under the supervision of party organizations yielded positive results: among chemical enterprises of the Kuzbass there are no laggard enterprises. The industrial association Azot leads the vanguard of chemists in the Kemerovskaya oblast. This collective is successfully handling established plans and socialist obligations. On May 31, 1978 a meeting of the working classes was held about the early fulfillment of socialist obligations of the third year of the 10th Five-Year Plan; the letter to L. I. Brezhnev, general secretary of CPSU Central Committee and chairman of the Presidium of the USSR Supreme Soviet, was adopted. In it, the working classes of the association promised to produce 70,000 additional tons of mineral fertilizers, 10,000 additional tons of ammonia, 2,000 additional tons of

caprolactam, and to over-fulfill production output with the State Seal of Quality by 42 percent. Chemists kept their promise. In the years of the current five-year plan, the volume of industrial production has grown 8.7 percent; the entire growth of production was assured because of the growth of labor productivity. The output of production with the State Seal of Quality was ten times as great; by the end of the first quarter of 1978, its relative significance was over 60 percent. More than 2,500 workers of the association are working with personal accounts of economy: this let the collective as a whole produce goods above the quota in 1977, saving raw materials and other materials amounting to 700,000 rubles and a significant amount of energy.

Enterprises of chemistry and petrochemistry have made a ponderous contribution to the economy of the Primorskiy kray. Mining chemistry is being thoroughly developed in the kray. The industrial association Bor represents a large enterprise of the mining chemical industry united in the Far East; it has modern technology, leads in yield of raw material, its enrichment, chemical reprocessing of ore and concentrates into highly concentrated, high-quality boron products. The enterprise is a prime supplier of boron products to both the internal market and abroad. The quality of the main kinds of production of the association are among the best in the world and even exceed them in terms of some indicators. The comprehensive approach to the solution of organizational and policital tasks of development of labor and creative activities make it possible for the association's collective to increase the rates of production and improve its quality more rapidly than was envisaged by the control assignments of the five-year plan. By firming up successes attained in 1977, when the collective was awarded the Red Banner of the CPSU Central Committee, USSR Council of Ministers, AUCCTU and Komsomol Central Committee, and by guiding themselves by proposals expressed by L. I. Brezhnev during his trip through cities in Siberia and the Far East and decisions of the July, 1978 and November, 1978 Plena of the CPSU Central Committee, the chemists of the Far East have unfurled socialist competition to fulfill and over-fulfill the industrial assignments and socialist obligations, taking up arms with the slogan "Work without falling behind, efficiently and with quality". Leading workers and collectives, by supporting the developing the initiative of I.M. Kozlov, crew chief of excavators and winner of two Orders of Lenin, at the start of 1978 took on increased obligations--to fulfill the assignment of three years of the five-year plan by the day of the first anniversary of the USSR Constitution. I. M. Kozlov's crew, consisting of nine men, took on the obligation to remove one man from its ranks for the entire period of agricultural work without reducing production and guaranteeing the assigned growth of labor productivity. This initiative was supported in 20 crews of the main shops.

In fulfilling the advice and recommendations of L. I. Brezhnev, the Primorskiy kraykom of the profsoyuz attentively studied the organization of socialist competition at several enterprises and made substantial changes to its organization. During L. I. Brezhnev's stay in the city of Krasnoyarsk, he called attention to the need to organize socialist competition based on agreements and creative cooperation. The great experience of organizing this competition was accumulated by profsoyuz organizations of the Krasnoyarskiy Kray. The profsoyuz's kray committee constantly utilizes its self-recommended form of public monitoring of fulfillment of contractual obligations of cooperating

participants, such as the creation of operational groups in plant committees of the profsoyuz. Every day they analyze the state of affairs at start-up facilities, maintain constant communication with regular organizations, contribute their proposals and comments on acceleration of rates of construction. Efficiency of this form is supported by practical business. The operational group of the chemical fiber plant obtained complete work forces for construction facilities. Previously they had been 50 percent short of workers. The profsoyuz's kray committee is working to see that the positive experience of creative cooperation of collectives united in a single technological chain is spread. By suggestion of the profsoyuz kraykom, work-through teams have been set up at the chemical fiber and tire plants; this improved the quality of tires manufactured by 8 percent. Creative cooperation of primary organizations of plans of synthetic rubber, chemical fiber and primary organizations of their head institutes and other organizations has been organized to improve systems of production control and introduction of new technology.

Guided by indications of L. I. Brezhnev given in his speeches, profsoyuz organizations of Krasnoyarskiy Kray, activated work to raise the level of organization, further improve forms and methods of management by primary professional organizations. This is greatly facilitated by a plenum of the profsoyuz kraykom of workers of the chemical and petrochemical industry held in July, 1978 to discuss the question "On the further improvement of work of professional organizations in selection, placement and training of profsoyuz personnel and active members". The kray committee of the profsoyuz drew up a work plan to improve the style and work methods with the professional active members which envsiages continuous, purposeful organizational, methods and current work with the profsoyuz active members. Collectives of chemical and petrochemical enterprises of Krasnoyarskiy Kray, such as the Kvant chemical fiber plant, synthetic rubber and industrial rubber goods plants and others, together with all working classes of the kray, have opened up socialist competition under the slogan "Let us give the Motherland more products because of early start-up and assimilation of industrial capacities of the 10th Five-Year Plan". This initiative of workers of the kray, approved back in January, 1977 by the CPSU Central Committee, poses a concrete task—to assure the output of additional products by kray enterprises amount to one billion rubles; including the chemical and petrochemical industry, this comes to 70,000,000 rubles. Economically justified contribution-obligations are constantly at the center of attention of the profsoyuz's kray committee. On its initiative, personnel and coordinating councils have been set up at enterprises to monitor the timely start-up and assimilation of industrial capacities. These measures promoted the attainment of high results. In two years of the 10th Five-Year Plan alone, chemists put out 8,600,000 rubles of additional products because of the Krasnoyarsk billion.

In indications and recommendations of L. I. Brezhnev, a great deal of space is given to educational work in the eastern regions. L. I. Brezhnev called attention of meeting participants—representatives of working classes of the city of Komsomolsk—to the comprehensive strengthening of labor discipline,

intensification of the struggle with anti-social manifestations. These indications of L. I. Brezhnev form the foundation of educational measures implemented now by profsoyuz organizations at sector enterprises. Guided by decisions of the 25th party congress, profsoyuz organizations intensified comprehensive education in labor collectives. The Khabarovskiy Kray committee of the profsoyuz of workers of the chemical and petrochemical industry, plant and local committees developed measures to intensify the struggle against violation of social behavior standards. A serious discussion on these topics was held at the plenum of the profsoyuz's kray committee which discussed the work of profsoyuz committees and managers in strengthening labor discipline, intensifying the struggle with law-breakers, etc.

The same work is being done by plant committees of the profsoyuz. Questions of strengthening labor and social displine are systematically brought to the floor of working meetings. Now at kray sector enterprises there is not a single case of violation of displine that goes unpunished by administrative and social measures.

Important conclusions from the trip of L. I. Brezhnev through the regions of Siberia and the Far East were drawn by management, party and profsoyuz organizations of the Zima Chemical Plant now under construction. Meetings were held at the plant with the summons "Increase the role of the labor collective in the light of speeches of L. I. Brezhnev to workers and the national management active membership during his trip through the regions of Siberia and the Far East". Measures of mass organizational work were drawn up and are being implemented by the profsoyuz to bring to life the advice and recommendations made by L. I. Brezhnev. So-called Lenin Fridays enjoy great popularity in the collective: on those days, management, party and profsoyuz managers have conversations and give reports in plant subdivisions. This lively communication with the working classes promotes better understanding of their interests, mood and needs. This is all aimed at shaping the collective, at creating a propitious moral and psychological atmosphere and is an important reserve for raising production efficiency. Profsoyuz organizations are actively utilizing various forms of educational work with youth. At chemical and petrochemical enterprises of Omskaya Oblast and Primorskiy Kray, the primary thrust is being placed on the work of the profsoyuz group. In May, 1978, the profsoyuz obkom held an oblast meeting of professional group organizers at which the question of improved education of profsoyuz members and strengthening of labor displine was thoroughly discussed. They properly assumed that the final result depends on the work of each section, each crew, where the struggle to fulfill the plan goes on.

The presidium of the Primorskiy kraykom of the profsoyuz of workers of the chemical and petrochemical industry jointly with the kraysovprof held a seminar and meeting with professional group organizers to improve the forms and methods of organizational and educational work of professional groups in the light of requirements of the December, 1977 Plenum of the CPSU Central Committee and fulfillment of indications and suggestions given by L. I. Brezhnev during his trip through cities of Siberia and the Far East. Questions of educational work and labor discipline were discussed in detail at the fifth plenum of the profsoyuz kraykom with the agenda: "On the work of profsoyuz and

managerial organizations of the chemical and petrochemical industry of the kray to strengthen socialist labor discipline based on suggestions of L. I. Brezhnev given during his trip through the cities of Siberia and the Far East".

By understanding the enormous role of labor discipline in the matter of raising efficiency of production, profsoyuz committees of enterprises of the chemical and petrochemical industry of the Altaysk kray jointly with managers began to more actively implement work on introducing the experience of the Rostov association Lakokraska under the slogan "Not a single laggard beside us!". The Altaysk kraykom of the profsoyuz organized a competition among shop organizations and professional groups for better formulation of work to introduce a comprehensive work system without laggards. Labor reports came into practice at enterprises on fulfillment of socialist obligations. More attention was given to individual competition. The number of pieceworkers participating in the competition to raise labor productivity in terms of personal quotas increased 7 percent in 1978 versus 1977, reaching 97 percent; 88 percent of the technical engineering workers worked in 1978 on personal creative quotas. This all certainly has great educational value and at the same time has a direct effect on the results of enterprise work. In the past year, 600 leaders of production reported on fulfillment of three years' quota of the five-year plan by Chemical Workers' Day. Seven leading workers had completed five-year quotas by the same time. But the main point is not in the individual records. The essence is that the number of workers not fulfilling production norms dropped to a third of its previous level in 1978 (versus 1977), coming to only 2.3 percent. In realizing the experience of the Rostovites, all committees of the profsoyuz defended their socialist obligations, making them more concrete and intense. Individual workers and collectives that did not fulfill production norms and quota assignments were taken into consideration and were given specific assistance.

An important educational value is expressed in mass verification of the state of work to reveal internal reserves of production at enterprises and in organizations that was done by the Altaysk kraykom of the profsoyuz of workers of the chemical and petrochemical industry, as well as work on dissemination of experience of the collective of the Monino Worsted Combine gained in organizing socialist competition based on crew accounts of economy. The experience of the Moninians has been introduced in collectives of the Barnaul Plant of Industrial Rubber Articles, Barnaul Professional Society Khimvolokno and other enterprises. Competition based on accounts of efficiency, to a considerable degree, promoted the discovery of internal reserves of production and had a direct effect on strengthening labor discipline. In 1977, at enterprises of the chemical and petrochemical industry of the kray, the number of no-show workers was sharply reduced, though overall losses of work time are still great.

At meetings with workers in cities of Siberia and the Far East, L. I. Brezhnev recomended paying more attention to the establishment of better labor conditions and life-style for those working in Siberia and the Far East. this emerges directly from decisions of the 25th party congress on the advantageous development of productive forces of the Far East and is linked with the struggle to reduce personnel turnover and strengthen it in this region. "We have to give serious consideration to how to strengthen personnel in the Far East", stated L. I. Brezhnev at a meeting of first secretaries of kraykoms and obkoms of the Far Eastern CPSU. "Labor turnover seems to be due to the insufficient amount of quarters and the lag in cultural and personal construction. Neither can we ignore the climate".

By implementing the agrarian policies of the party, workers of Siberia and the Far East have achieved certain successes in developing agriculture, despite the severe natural and climatic conditions. But this is not enough. L. I. Brezhnev posed the task of creating a strong agricultural base in the eastern regions of the country to provide the population of these regions with meat, milk and vegetables.

Managerial and profsoyuz organizations of chemical and petrochemical industrial enterprises, in fulfilling the indications of L. I. Brezhnev and decisions of the July 1978 Plenum of the CPSU Central Committee, have facilitated the development of ancillary farms, personal farming sections and are obtaining additional agricultural products for public dining. The collective Omsknefte-orgsintez showed good initiative when it set up its own complex (hothouse where inexpensive cucumbers, onions, other vegetables are grown, a pigsty and fowl processing factory). It has its own dining sections, and all questions associated with feeding the workers of the association are virtually resolved. But not all managerial and profsoyuz organizations show genuine concern about this important matter. They try to wave away some of these issues and feel that they are unimportant or secondary.

Health care of workers has a great effect on the problem of strengthening working personnel and technical and engineering staff in regions of Siberia and the Far East. In recent years not much has been done about this. In the Ninth Five-Year Plan alone, more than 100,000,000 rubles have been spent here to build sanitorium and resort institutions. By the end of the current five-year plan the regions of Siberia and the Far East should have twice as many or more sanitorium and resort institutions as in the last five-year plan [4].

Much attention has been given to fulfillment of the socio-economic program at enterprises of the sector united by the profsoyuz of workers of the chemical and petrochemical industry. For additional reinforcement of personnel at enterprises of chemistry and petrochemistry of Siberia and the Far East, party, managerial organs and profsoyuz committees have taken steps to see that large quarters, children's pre-school institutions and personal and cultural facilities are constructed, and conditions of labor health are improved. Profsoyuz organizations of Altayskiy Kray are trying to comprehensively solve questions of creating good conditions of labor, family life and relaxation of workers and clerks. In 1977 alone, over 1,300,000 rubles were utilized here to improve labor conditions. In March of last year a kray profsoyuz and management meeting was

held; it noted means of further improvement of working conditions and labor protection; in the summer of 1978, upon the initiative of the kray committee of the profsoyuz, enterprises held a monthly meeting on labor protection which had positive results in reducing traumatic injuries. Profsoyuz committees of the kray intensified monitoring of fulfillment of comprehensive plans to improve labor conditions and medical service to workers, as well as to assure dietary nutrition to those requiring it. In comparison to 1977, provision of areas with dietary dining rooms for public dining rose 26 percent; in 1978 it was 87 percent of the norm. In the current year, all those needing dietary nutrition will get it. Profsoyuz organizations of chemists and petrochemists of the Omskaya Oblast are assisting in introducing about 50,000 square meters of domiciles, several kindergartens, stores and other personal and cultural services. A great gift for chemists and petrochemists of Omsk is the construction of an enormous complex housing a whole series of various service organizations.

Solution of questions of cultural and personal and domestic life require the fixed attention of managerial and profsoyuz organizations. At many enterprises of chemistry and petrochemistry in Siberia and the Far East, there are still not enough day-care centers, schools, pioneer camps, polyclinics, clubs; their construction is lagging behind industrial construction. In Novosibirsk, for example, a usual chemical plant was constructed. Its collective works rhythmically, produces high quality products and generously shares its experience with other enterprises. But the plant does not have its own pioneer camp; there are no kindergartens or day-care centers, although funds have been released for construction of a children's complex. Despite the presence of funds and technical paperwork, Glavkrasnoyarskstroy has for several years unjustifiably held up the start of construction of dispensaries at the Krasnoyarsk Chemical Fiber Plant and the Krasnoyarsk Tire Plant planned to open in 1980. Or take this example. Some enterprises and organizations of Minkhimprom situated in Novosibirsk have from 150 to 500 employees. This situation is also noted in some other places. Naturally it is not obligatory to have your own pioneer camp, polyclinic or kindergarten with such a small number of employees. At the same time, this problem must be resolved. Minkhimprom should apparently come to the aid of these enterprises in constructing cultural and personal service institutions.

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CHEMICAL INDUSTRY AND RELATED EQUIPMENT

REPORT ON PROPOSALS FOR FURTHER AUTOMATION

Moscow KHIMIYA I TEKHNOLOGIYA TOPLIV I MASEL in Russian No 6, 1979 p 61

[Article by D. M. Lepskiy: "On the Meeting of the Section of Automation of the Scientific and Technical Council of USSR Minneftekhimprom On the Use of Computer Technology in ASUP and ASUPO"]

[Text] The creation and utilization of automated enterprise and industrial association management systems on the basis of economic and mathematical methods and modern computer technology is an important factor in raising the efficiency of production in the sector.

Further development of automated industrial association and enterprise management systems was the subject of an expanded meeting of the automation section of the Scientific Technical Council of USSR Minneftekhimprom held in the city of Angarsk (association Angarsknefteorgsintez); issues of raising efficiency of computer technology in ASUP and ASUPO of oil processing and petrochemical industry were discussed. Over 70 specialists connected with the development and operation of ASUPO and ASUP from 45 industrial associations and enterprises, scientific research and planning organizations of USSR Minneftekhimprom, Azerbaijan Minneftekhimprom, Minpribor, Minvuz and USSR Academy of Sciences participated in the work of the section.

V. A. Panfilov, manager of this group and chief designer of the Technical Administration of Minneftekhimprom gave an overview and proposals prepared by a group of specialists and experts. Rapt attention was given to reports and communications of I. Ya. Shapiro (All-Union Scientific Research and Planning Institute of Petroleum), Ye. G. Syvorotkin (Moscow Special Design Bureau of NPO Neftekhimavtomatika), V. V. Aranovich (State Planning and Scientific Research Institute of the Synthetic Rubber Industry), and P. P. Koptev (All-Union Petroleum Institute Soyuznefteorgsintez)—on the results of familiarization with the work of ASUP and ASUPO of VPOs Soyuznefteorgsintez, Soyuzkauchuk,Soyuzshina and Soyuzrezinoobuv', as well as the report by B. I. Koval'skiy (association Angarsknefteorgsintez)—on the experience of introducing and operating ASUPO in that association.

To date, certain experience has been accumulated in creating ASUP and ASUPO in the oil processing and petrochemical industry. By the efforts of sector organizations and enterprises and attraction of organizations of Minpribor, Minkhimprom and institutes of USSR Academy of Sciences and Minvuz, 29 automated management systems have been developed and put into operation by industrial associations and enterprises. In addition, 15 computer information centers (IVTs), which are the technical base of the ASUs developed, have been put into operation. In ASUP, ASUPO and IVTs which have been put into operation, up to 150 problems on planning, accounting and analysis of administration and management activities of enterprises and industrial associations are solved. The percentage of industrial products manufactured by industrial associations and enterprises at which ASU have been introduced comes to about 40 percent of the total volume of production in the sector.

It has been noted that the ASUs created in the sector are still lagging behind the scientific and technical level planned and actually attainable economic indicators. The main portion of ACUs introduced do not handle problems of optimum planning and control of primary production yielding the greatest economic effect, but on-line accounting of management activities of enterprises, bookkeeping calculations, etc.

Participants of the meeting of the automation section of the Scientific and Technical Council of USSR Minneftekhimprom developed concrete measures to eliminate these deficiencies and raise the efficiency of ASUP and ASUPO being created or operating. In particular, the section meeting recommended concentrating efforts of specialists and developers at a limited number of facilities to accelerate development, test and introduce ASUP and ASUPO problems and standard planning solutions. It was recommended to improve methods and scientific and technical superivision and planning of work in the creation of ASUP and ASUPO, development and utilization of standard planning solutions and applied program packages. To accelerate the development of ASUP and ASUPO, their assimilation and reproduction, it is advisable to set up sector laboratories at base enterprises of VPOs to develop and introduce ASU. Within the association Orgneftekhimzavody it was recommended to set up a subdivision for introduction of developed complexes of ASUP and ASUPO problems.

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CONSTRUCTION, CONSTRUCTION MACHINERY AND BUILDING MATERIALS

INFLUENCE OF INVESTMENT STRUCTURE ON CAPITAL INTENSITY OF CAPITAL CONSTRUCTION

Moscow VOPROSY EKONOMIKI in Russian No 6, Jun 79 pp 129-133

[Article by V. Dan-Chin-Yu, Yaroslavl': "Influence of the Structure of Investments on the Capital Intensity of Capital Construction"]

[Text] The increased influence of branch improvements in the structure of capital investments upon the capital intensity of construction[1] has come about owing to the growing importance of investment flows aimed at creating new production efforts and branches and also the high proportion of investments for expanding, rebuilding and modernizing the traditional branches. Thus the capital intensity for the construction of hydroelectric power plants is more than two times higher than the capital intensity for the construction of a majority of the industrial projects and the installation of drainage systems calls for a capital intensity for construction that is 1.76 times greater than that for the construction of hydroelectric power stations and 3.5 times greater than the capital intensity for complex industrial construction.

The coefficient for capital intensity of construction is presented in Table 1[2].

Such differences in the coefficients for capital intensity are responsible to a considerable degree for the inability to compare the capital intensity levels for construction in different branches and thus they should be taken into account when planning and forecasting the availability of capital for construction organizations.

The existing control structure for construction at the present time reflects to a definite degree branch specialization in the reproduction of fixed capital. Thus the structure of the inventory of construction machines in each of the construction ministries or departments is affected by the branch structure for construction projects. For example, compared to USSR Minsel'stroy [Ministry of Rural Construction], high powered excavators are concentrated in Mintyazhstroy [Ministry of Construction of Heavy Industry Establishments] and USSR Minpromstroy [Ministry of Industrial Construction].

At the same time, USSR Minsel'stroy is characterized by a considerable concentration of low power and mainly mobile cranes. The capital intensity of the branch is strongly influenced by organizational factors, technology and the progressive nature of materials and structures and yet at the same time the data cited underscores the tremendous importance of the branch structure for investment programs in connection with the formation of the capital intensity level for construction.

TABLE 1

Residential housing	1.00
Tunnels	1.03
Railroads	1.05
Ferrous metallurgy	1.09
Agricultural electric power transmissions	1.10
Chemical industry	1.13
Other branches of industry	1.17
Petroleum chemical industry	1.23
Construction at sovkhozes	1.32
Non-ferrous metallurgy	1.50
Industrial electric power transmissions	1.52
Mines	1.58
Thermal electric power stations	1.66
Flooding projects	1.67
Pipelines	1.90
Bridges	1.94
Highways	1.97
Agricultural water supply	2.03
Hydroelectric power stations	2.35
Irrigation systems	2.79
Drainage systems	4.15

One feature of modern regional investment policy is the creation of large industrial complexes and the channeling of considerable capital investments towards the development of slightly tamed or untamed regions in Siberia and the Far East. Notwithstanding the fact that production complexes are being created in the European portion of the USSR (for example, an industrial complex based upon the natural resources of the Kursk magnetic anomaly), improvements in disposition are obvious.

As a result, a new question has arisen: to what degree will the level of utilization of fixed production capital in construction be affected by differences in natural-geographic conditions?

The raised requirements for enclosing and supporting structures, the peculiarities involved in the erection of bases and foundations and, finally,

the scales of construction for modern and relatively autonomous, from both a territorial and socio-economic standpoint, industrial complexes are bringing about substantial changes in construction organization and technology and increasing the requirements with regard to the means of labor. According to a number of economists, a high capital intensity for production is being observed in the eastern part of the country owing to "stern conditions and a shortage of working hands in this region, a shortage which must be compensated for by means of a raised capital-labor ratio." At the same time, in the European part of the USSR, where "considerable greater opportunities are available for recruiting new manpower,"[3] there must be higher rates of economic growth coupled with a slower increase in the capital-labor ratio. The existing view concerning the inevitability of a capital-intensive type of development for investment branches, with the mastering of new regions in Siberia and the Far East, has exerted a definite influence on the formation of a capital-intensive concept and this has been reflected in the forecasting variants for fund availability for construction organizations.

Meanwhile, the actual cost for production construction work in regions of Siberia and the Far East is quite often lower than the cost for building similar projects in regions located in the European part of the USSR. This results from the low expenses involved in procuring and transporting the construction materials and raw materials. For example, production expenses for electric power and fuel in Irkutskaya Oblast are more than 50 percent lower than that for the central regions and in Omskaya and Tyumenskaya oblasts -- 30-40 percent lower; the production cost for cement at the Krasnoyarsk Cement Plant is 20-25 percent lower than at the Podol'sk Cement Plant.

The actual and potential hydrological and power engineering resources of Siberian, Far Eastern and Central Asian rivers (such as the Angara, Yenisey, Zeya, Nurek and others) are considerable higher than those found in the plain regions of the European part of the USSR. Moreover, the erection of the Bratsk GES, for example, along the Padunskiy Rapids range, has made it possible to reduce sharply the construction costs and schedules and to save many thousands of tons of bulk dirt, construction materials and structures.

The data furnished on specific investments[4] (see Table 2), underscores the effectiveness of building a GES in the eastern regions.

The dynamics of capital intensity for construction carried out in various territorial regions of the country also points out that instead of the anticipated high growth in capital intensity, caused by complicated climatic conditions, at the beginning of the Ninth Five-Year Plan the capital intensity for construction in regions of Western Siberia was only 0.18 of a point lower than the index for the RSFSR as a whole; the capital intensity for construction in regions of Eastern Siberia was 0.294, or somewhat higher than the average for the RSFSR. At the same time, the capital intensity for construction in Krasnoyarskiy Kray (0.304), Irkutskaya Oblast (0.345),

Chitinskaya Oblast (0.162) and the Buryatskaya ASSR (0.155) testify to the fact that a "stern" climate alone is not the decisive factor in the formation of capital intensity tendencies. This is also borne out by the capital intensity structure for construction in a majority of the large administrative regions in the Soviet Union. For example, at the beginning of the Ninth Five-Year Plan the capital intensity for construction in Kuybyshevskaya Oblast was 0.322, in Moscow Oblast -- 0.202 and in Sverdlovskaya Oblast -- 0.179. The difference in the capital intensities for construction in the union republics was even greater: whereas in the Belorussian and Armenian SSR's this index was 0.150 and 0.140 respectively, the figures for the Turkmen and Lithuanian SSR's were 0.390 and 0.440 respectively, compared to an average capital intensity for construction in the Russian Federation of 0.220.

Hence the effect of the zonal investment structure on the capital intensity for construction is determined not so much by the action of the natural-geographic conditions, although a great amount of attention must be focused on this factor in many instances (for example, when carrying out investment programs of the pioneer type), but rather by the branch structure of investments and the level of operational expenses, conditioned by the capacity of the fuel-energy and raw material potential.

The modern scientific-technical revolution is introducing substantial corrections into the capital investment structure. New sources of raw materials and energy are being included in national economic turnover, improvements are being realized in the technological processes, production operations are becoming more specialized in nature and the branch structure for capital investments and their territorial distribution are becoming more dynamic. Under these conditions the formation of new branches and production efforts and also the development of remote geographic regions of the country are inevitably associated with raising the proportion of new construction. At the same time, there is a predominance of investments for expanding and modernizing existing enterprises in regions having a developed economic structure.

Notwithstanding the rather convincing advantages of expansion and modernization over new construction in the plan for reducing capital intensiveness[5], the capital intensity for construction production during a period of expansion and modernization will not undergo any substantial reduction. Actually, modernization construction is extremely limited in terms of both available production areas and the absence of specially adapted machines, mechanisms and a well developed organization for the expansion production work. This is obviously the result of failing to take into account, in previous plans, the developmental prospects for equipment and production technology which, at the moment of expansion, takes the form of a tremendous volume of additional capital investments for carrying out the expansion work. Thus extreme importance is attached to converting over to the creation of long term standard integrated modular systems both in machine-building and construction -- the leading and concluding branches for the investment process.

Modernization differs from new construction in terms of the technological structure of the capital investments. For example, the proportion of construction-installation work in new construction is 52.7 percent and for modernization and expansion -- 44.9 percent[6]. On the average for the RSFSR, construction-installation work constitutes approximately 60 percent of the capital investment structure. This index is considerably higher in almost all of the territorial regions of Siberia, for example, in Krasnoyarskiy Kray -- 66.0 percent, in the Buryat ASSR -- 68.5 percent and in the Tuvinskaya ASSR -- 70.2 percent.

Under modern conditions, new construction makes it possible to ensure a broad front of work for all enterprises, organizations and farms engaged in carrying out construction and installation processes, to combine to a maximum degree the work of a general contractor and the sub-contractors and to employ more modern forms for organizing construction production based upon the use of flow line daily and hourly schedules, network models and automatic control systems. Thus a lower capital intensity for construction in regions of Siberia is the consequence, to a certain degree, of the peculiarities in the structure for the reproduction of fixed capital.

An important aspect and one which defines the trend in capital intensity for construction carried out in zones of pioneer development is the fact that construction production in these zones is supplied with massive amounts of equipment. In addition, relative uniformity prevails in the formation of mechanized complexes. These factors make it possible to ensure synchronous services and compensation and to create a more rational structure for the pool of construction machines and mechanized complexes.

In the traditional regions of construction, the wear and tear of a portion of the construction machines often exceeds the normative level. For example, on 1 January 1973 at the Spetsstroymekhanizatsiya Trust of Glavverkhnevolzhstroy, 1,000 leading machines of mechanized complexes included labor means which should have been declared obsolete, including 29 excavators, 55 bulldozers, 17 cranes, 9 tractors and so forth, or approximately 15 percent of all units in the pool. Under conditions involving the combining of new machines with means of labor that are obsolete or worn out, it is practically impossible to achieve a truly harmonious mechanized complex.

The ratio of the "active" and "passive" portions of fixed capital occupies an important place in the formation of the level of capital intensity for construction. Thus, during the Ninth Five-Year Plan the proportion of buildings and installations in the structure of fixed production capital for construction in the USSR amounted to 20 percent, in Krasnoyarskiy Kray -- 38, in Irkutskaya Oblast -- 50, in Kemerovskaya Oblast -- 35, in Eastern Siberia on the whole -- 40 and in Western Siberia -- 26 percent. At the same time, one of the leading groups of fixed capital -- "working machines and equipment" -- accounted for 51 percent of the overall volume of fixed

production capital, in Tyumenskaya Oblast -- 40 percent, in Irkutskaya Oblast -- 32 percent, in Eastern Siberia -- 40 percent and in Western Siberia -- 46 percent. Hence, whereas natural-geographic conditions played a decisive role in the formation of the "production buildings and installations" group, the group of leading machines was affected to the greatest degree by structural changes taking place in the zones of pioneer and traditional development.

The forecasting variants prepared by the Scientific Research Institute of Construction Economics of USSR Gosstroy for distributing investments among the principal trends in industrial construction (excluding power engineering, the gas industry and the transporting of petroleum) assume that during the period from 1975 to 1990 the proportion of modernization and technical re-equipping, with regard to the overall volume of capital investments, will increase from 22 to 36 percent and, accordingly, that the proportion of new construction will decrease from 42 to 28 percent. Moreover, the proportion of construction-installation work in the case of modernization and technical re-equipping will increase from 17 to 31 percent and new construction will decrease from 45 to 32 percent.

Similar sharp changes in the structure of capital investments will inevitably affect the proportions in associated branches and the trends in construction capital intensity. Thus, when planning the availability of funds for investment branches and capital investments in the construction industry, the changes taking place in the structure of capital investments should be taken into account.

FOOTNOTES

1. The capital intensity for construction, in the narrow sense (in conformity with branch methodology), is defined as the ratio of the value of the fixed production capital remaining on the balance of construction organizations to the volume of construction work carried out.

   We cannot agree with this approach, first of all because construction-installation subunits do not always maintain construction equipment on their balances, but rather they lease it; secondly, the product of construction should be not the volume of construction-installation work carried out, but rather a plant, complex, house and so forth that has been prepared for public use (productive or non-productive).

   It is our opinion that capital intensity of construction should be understood to mean the ratio of the value of all fixed capital used in construction-installation processes to the estimated cost of construction for a project or complex.

2. The capital intensity for residential housing construction was used as a unit.

3. See A.I. Anchishkin and Yu.V. Yaremenko. "Tempy i proportsii ekonomicheskogo razvitiya [Rates and Proportions of Economic Development], "Ekonomika" Izdatel'stvo, 1967, p 102.

4. See "Voprosy razmeshcheniya sotsialisticheskoy promyshlennosti" [Questions on the Disposition of Socialist Industry], "Nauka" Izdatel'stvo, 1971, p 287.

5. See L.M. Smyshlyayeva. Rationalization of the Structure of Capital Investments (in the Collection "Economics and Organization of Construction Production." Novosibirsk, 1971, No. 3, p 45).

6. See L.M. Smyshlyayeva. Rationalization of the Structure of Capital Investments (Economics and Organization of Construction Production. Novosibirsk, 1971, No. 3, p 48).

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METALLURGY

GREATER CONCERN FOR CONSERVING METAL

Moscow STAL' in Russian No 5, May 79 pp 322-325

[Article by Academician A. Yu. Ishlinskiy, Hero of Socialist Labor, chairman of the All-Union Council of the Scientific and Technical Society]

[Text] The growth of the economy of our country is continuously connected with the satisfaction of the demands of the national economy for metal. In accordance with the resolutions of the 25th Congress of the CPSU, the Tenth Five Year Plan calls for increasing the production of effective types of metal products by 1.5-2 times: cold-rolled sheet metal, sheet rolled products with coatings, bent profiles, rolled products with heat-treatment hardening, rolled products made of low-alloy steel, stainless sheet steel and cold-rolled transformer steel, high-strength pipes, high-quality metalwares, powdered iron, and so on.

In implementing the resolutions of the party, the metallurgists have achieved significant results with respect to increasing production capacity, improving the structure and raising the technical level of production, improvement of the technical-economic indexes and raising the quality of the produced metal.

For further increase in efficiency of the steel production, growth of the productivity of labor and improvement of the conditions of labor and also for efficient use of cast iron and scrap resources, it is becoming more and more significant to expand the converter and electric steel making production with pouring of the steel by a predominantly continuous method.

A characteristic feature of the development of the steel-making production is broader and broader use of the methods of treating the metal outside the furance (blowing with inert gases, evacuation, treatment with synthetic slags, and inoculation).

In recent years converter processes with bottom oxygen-fuel blowing have been further developed in the refining of phosphorus and ordinary conversion cast iron. The studies of the development of bottom-blowing processes have made it possible to develop the design by which the converter shop is being built at the metallurgical plant imeni Dzerzhinskiy.

Significant progress has been made in the field of electric steel making.

A series process for producing alloyed steel, including bearing steel, has been mastered on the 200-ton arc furnaces. A reduction in the heat time and improvement of the technical-economic production indexes have been achieved on the 100-ton furnaces equipped with high-power transformers.

The use of plasma as a source of heat for melting the charge in plasma arc furnaces is highly efficient. The process for making a number of complexly alloyed steels and alloys for responsible purposes has been successfully mastered on these furnaces. Processes have been successfully developed for special electrical metallurgy: electroslag, vacuum-arc, electron-arc remelting and vacuum induction heating.

Significant capacities are planned with respect to continuous pouring primarily in the converter and electric steel-making shops.

In spite of the progress made in the steel-making production area, an entire series of measures are slow in being introduced, and the actually achieved effectiveness of them still remains below the possible effectiveness.

The construction of specialized shops for producing effective slag-forming heating mixes (which are required for pouring in ingot molds and for continuous pouring of steel) and heat insulating linings of effective compositions is lagging significantly behind the established deadlines. The method of mechanical capping of rimming steel using bottle-top ingot molds has not found application to the present time; the cost benefit from using slide gates characterized, in particular, by the strength and cost of the refractory tiles is still inadequate. The strength of the ingot molds and also the ladles with monolithic lining is significantly below the possible strength. The application of the protective coatings of the ingot molds and stools and also the levitation of the metal in the ladle have not been organized.

The level of mechanization of the labor-consuming operations in pouring steel and preparing the composition of the mixtures also requires improvement.

These and other deficiencies and means of eliminating them have been indicated by the participants in the All-Union Scientific and Technical Conference on Improving the Effectiveness and Structure of Steel-Making Production held by the Central Board of the Scientific and Technical Society of Ferrous Metallurgy in Lipetsk in September 1978.

Specific problems were brought before the scientific and technical community: the creation and introduction of complex systems for automated control of the steel-making processes, killing, alloying and finishing of the metal in the ladle, the development of a method for cutting off the furnace slag when removing the metal from the steel-making units, slagging-off machines and devices for protecting the metal from secondary oxidation between the steel pouring and intermediate ladles, and so on.

"However, the basic solution to the problem of the most complete satisfaction of the growing demands of the national economy for metal," Comrade L. I. Brezhnev noted, "along with increasing its production, requires persistent control of the expansion of the assortment, improvement of the quality and improvement of the efficient utilization of metal products. The strictest economy and thrift are a necessary aspect of the socialist economy, an important condition of the further development of the economy of our country and improvement of the standard of living of the people."

A great deal of work is being done in our country to reduce the metal consumption of production, obtain broad application of advanced design solutions and improvement of the technological processes. New high-efficiency metallurgical units and equipment have been built for the production of economical profiles of rolled products and a broad assortment of pipe, and so on.

A great deal of work in the saving of metal is being done in the labor collectives of the enterprises and organizations of Moscow, Leningrad and also the Volgograd, Khar'kov, Novosibirsk and other oblasts, at the plants for power machine building, shipbuilding, machine building for animal husbandry and feed production and certain other branches.

An effective system for saving metal has been introduced at the enterprises of the Chelyabinsk Oblast, the experience with which has been approved by the Central Committee of the CPSU. In recent years the metallurgists of the Central Urals have mastered the production of many new types of steel; they have significantly expanded the assortment of products, they have doubled the rolled product output with negative allowances which has made it possible to save hundreds of thousands of tons of metal.

However, in spite of the measures used, greater and greater losses of metal are being permitted. Last year they amounted to more than 35 percent of the cost of all losses in the national economy. In machine building and metalworking alone, the annual waste and loss of metal exceed 18 million tons, of which 8.3 million tons are lost in chips. The wasted metal chips can be reduced significantly by decreasing the existing machining allowances by 50 percent. The calculations indicate that this measure alone can reduce the metal chip waste by 4 million tons, significantly decrease the time spent on machining all parts in machine building and metalworking and relieve 27,000 workers.

It is possible to achieve large reserves for saving metal in taking broad measures to combat corrosion. It is considered that approximately one and a half percent of the total mass of metal in use in the industrially developed countries is destroyed annually as a result of corrosion.

One of the most metal-consuming branches of industry is construction. More than 12 million tons of reinforcing steel, 8 million tons of section and sheet rolled products, and 11 million tons of steel pipe are consumed annually. In recent years a great deal has been done to protect structural elements and equipment against corrosion. At the present time corrosion protection

plans constitute a mandatory part of the normative-estimating documents; painted and unpainted formed galvanized sheeting is used in construction; the production of steel sheets with aluminum and polymer coatings has been mastered; the modification of the industrial unit for producing reinforcing steel with high corrosion resistance has been completed at the Makeyevskiy Metallurgical Plant; experimental lots of new polyfunctional chemical additives have been produced which increase the corrosion resistance, frost resistance and protective properties of concrete with respect to reinforcing, and so on.

In addition, up to the present time specialized large organizations have been created in the branches in order to carry out a set of operations to protect metal and reinforced concrete structural elements against corrosion (during the construction and in the process of maintaining buildings and structures). It is necessary to increase the introduction of protective measures for welded connections in prefabricated reinforced concrete structures under construction conditions. The quality of the corrosion-protection work during installation is not being evaluated by the engineering monitoring services.

The construction industry basically has at its disposal only low-efficiency means of protection against corrosion; the demand for chemically resistant materials to protect metal and reinforced concrete structures is no more than 10 percent satisfied; new developments of effective, economical materials and means to be used for protection are being introduced slowly.

It is necessary significantly to accelerate the development of the construction technology considering metal protection against corrosion, mechanization and automation of the protection processes and, above all, the cleaning and preparation of the surfaces under the protective coatings and restoration of the coatings.

Effective assistance of the scientific and technical community of the All-Union Chemical Society imeni D. I. Mendeleyev, the construction industry, and the social committees of the scientific and technical society is required here.

It is known that the capacity of metals to withstand the effects of corrosion-active media is a highly significant factor determining the reliability and surface life of any equipment or structure.

The efficient selection of the construction materials and means of protecting them frequently determines not only the economy expediency but also the possibility of practical implementation of the existing proposals.

This problem is partially solved by using alloyed steels. Previously the application of austenitic chromium-nickel steels played a large role in the creation of anticorrosion equipment for an entire series of technological processes. At the present time when a sufficiently good study has been made of the limits of corrosion resistance, the use of such steels in pure form does not appear reasonable. This arises also from the ever-increasing

shortage of nickel which is creating serious problems for all countries of the world; therefore both in our country and abroad intensive searches are being conducted for means of saving nickel and nickel-containing steel. One of these areas is the use of steel that is economically alloyed with nickel (up to 7 percent Ni), nickel-free chrome steel, titanium and its alloys and nonmetallic materials.

For the broad utilization of economically alloyed chrome-nickel and nickel-free chrome steels it is first of all necessary to increase the output of these steels.

Among the other causes holding up the solution of the problem it is possible to mention the insufficient assortment and nomenclature of equipment produced by the machine building plants from economically alloyed and chrome steels and also bimetals, the insufficient level of production of corrosion-resistant cast alloys, including cast iron and products made from it, and so on.

The solution of the investigated problem would be simplified to a great extent by expansion of the volumes of production and the assortment of economically alloyed and chrome steels (in particular, 0Kh22N5T, 0Kh18G8N2T), mastery of the series production of economically alloyed steels with low carbon content (0.03 percent) and chrome steel with a total carbon and nitrogen content below 0.015 percent, and an increase in the production of bimetal and high-chrome cast iron.

The Ministry of Chemical Machine Building must significantly increase the production of standard equipment made of economically alloyed and chrome steels (heat exchangers, columns and tank equipment, reactors, centrifuges, pumps, and so on). The standards for the margins of strength of the equipment and structural elements must be re-examined considering the use of corrosion-resistant alloys and steels to manufacture them.

A process has still not been developed for welding chrome steel, economically alloyed steel or bimetal ensuring that the level of the mechanical properties and corrosion resistance in the weld-affected zone will be no less than in the basic metal.

The scientists and specialists of the BSNTO Committee on corrosion and protection of metal are working on all of these problems; a great deal of work has been done with regard to the development of proposals offering the possibility of protecting metal and reinforced concrete structural elements from corrosion, the introduction of means and methods of protection against corrosion and scale formation on the surfaces of the cooling systems, internal combustion engines, chemical equipment and so on.

The VSNTO Committee on problems of wear resistance and friction are also working hard.

Among the most effective means of controlling wear and friction it is possible to mention the phenomenon discovered by Soviet scientists and called selective transfer.

Selective transfer is a type of friction characterized by almost complete exclusion of wear and a low friction coefficient. It arises from spontaneous formation of a thin, nonoxidizing platy metal film in the contact zone capable of creating polymerization products of the lubricant. The wear products in the presence of selective transfer can move from one friction surface to the other as a result of seizure and be held in the contact zone by electrical forces. The soft thin metal film is maintained in the presence of friction as a result of the oxidizing-reducing reactions occurring during the working of the friction pair.

The application of selective transfer in the friction assemblies of aircraft, electric drills, pumps, the machinery on maritime ships, and electric contacts for tools and instruments provides significant cost benefit.

The realization of selective transfer in the friction assemblies is realized by applying new metal-cladding lubricants, wear-resistant and friction-resistant materials. Final finishing of the parts and also the use of a bronze-steel pair coated with a surface-active lubricant.

The mission of the scientific and technical community consists not only in continuing the investigations with respect to the development of new methods of improving the wear resistance of machine parts based on the phenomenon of selective transfer, but also wide-spread popularization of the results already achieved.

A prospective area with respect to saving metal, reducing the mass of the structural elements of machines and equipment, improvement of their reliability and service life is the development of powder metallurgy.

At the Tulachermet Scientific-Production Association, a process has been developed for producing powder materials and plasma coatings based on them permitting significant increase in the wear resistance of the parts and assemblies of fast-wearing equipment. The application of corrosion-resistant and wear-resistant coatings increases the service life, for example, of the shafts of hydraulic pumps by two or three times and pump impellers by 1.5 times.

The production of iron and alloy powders has increased by 2.7 times in the last 10 years. The use of iron powder produced by the enterprises of the USSR Ministry of Ferrous Metallurgy in the national economy in 1977 alone has made it possible to save more than 35,000 tons of steel and release significant capacity in the machine tool fleet.

The primary organization of the scientific and technical society uniting more than 1,500 members has made a significant contribution to the solution of the problems facing the collective of the Tulachermet NPO [Scientific-Production Association].

The NTO [Scientific and Technical Society] Council is discussing the most important scientific and technical problems, and it is developing recommendations with respect to the basic areas of scientific research in the association.

The NTO councils of the association are the initiators of agreements on creative cooperation between the scientific organizations and enterprises for the solution of technical problems.

Thus, according to the agreement on the creative cooperation between the collectives of the Tulachermet Association and the MMK, a process is being introduced at the combine for the deposition and coating of the parts of metallurgical equipment. The surface hardening of the various pieces of equipment achieved in this way will permit significant increase in its service life. The application of this method in blast-furnace production will double the strength of the air tuyeres of the blast furnaces.

The organizations of the scientific and technical societies are constantly working on the problems of saving metal in the national economy.

Thus, the section on strength of machines of the Chelyabinsk Oblast board of the Mashprom Scientific and Technical Society, in dealing with the improvement of the evaluation of the stress on tractor frames, has achieved a 50 kg reduction in weight of the tractor frame with an overall increase in the reserve of the tractor by three times. The sections of the Volgograd, Leningrad, Sverdlovsk and a number of other boards of the Mashprom Scientific and Technical Society are also working actively.

By the initiative of the primary organization of the scientific and technical society of the Ural Automobile Plant, the metal consumption of 1,000 of the Ural AZ automobile parts has been certified. Some structural changes have made it possible to reduce the weight of the parts while ensuring reliability and service life. This has made it possible to save more than 3,000 tons of ferrous and nonferrous metals recalculated for the annual output program. Certification has played a positive role in the creation of the program for further improvement of the structural elements of the automobile and the process for production of it.

Scientists, and the entire scientific and technical community must give still more attention to the problems of saving metal, they must make basic recommendations with respect to the all-around use of metal from obtaining it to utilization of it.

The efficient use of metal for agricultural needs remains an important scientific and engineering problem. These problems have been emphasized in the resolutions of the July (1978) Plenum of the Central Committee of the CPSU.

Insufficiently corrosion-resistant carbon steels are still being used for the manufacture of farm machinery and equipment and agricultural construction,

at the same time as the application of low-alloy, high-strength and corrosion-resistant steel will permit a reduction in the metal consumption of the machines and structures with doubling or tripling of their service lives.

The experience of the advanced enterprises indicates that even simple execution of measures with respect to proper organization and storage of farm equipment (All-Union State Standard 7851-71) offers the possibility of reducing the corrosion losses on the farm by approximately 25 percent.

The organizations of the scientific and technical society have developed proposals with respect to corrosion protection of farm equipment, they have proposed specific recommendations with respect to the application of effective protective coatings and corrosion inhibitors.

Thus, the social, scientific-production and coordination councils of the scientific and technical societies of agriculture and the building industry have developed recommendations for the application of No 444 rust inhibitor in farm construction and for corrosion protection of the process equipment in the animal husbandry facilities. When using this inhibitor there is no need for cleaning the surfaces of the parts before painting, and the service life of the paints has increased by two or three times.

However, the inhibitor has still not become widespread. Unfortunately, many other developments and proposals of the scientific and technical community are also being slowly introduced into production.

The problems of the societies with respect to efficient utilization of material resources, the creation and introduction of waste-free technological processes were discussed at the end of 1978 at the second plenary session of the VSNTO Society. A broad program has been planned for the long-range activities of the NTO Society in the future. The energy and creative search of the 9 million members of the scientific and technical societies constitute a reliable guarantee of the execution of this program.

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METALLURGY

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WAYS OF DECREASING THE MATERIALS USED IN ELECTRIC STEEL MAKING

Moscow STAL' in Russian No 5, May 79 pp 349-352

[Article by A. F. Kablukovskiy, D. I. Popov, and R. M. Khayrutdinov, Central Scientific Research Institute of Ferrous Metallurgy]

[Text] On the modern level of development of the economy of our country, reducing material outlays is one of the decisive conditions of improving the efficiency of social production. In the electric steel-making business there are large reserves for saving materials. Utilization of these reserves is especially urgent in connection with the fast growth of electric steel making planned for the future.

The development of electric steel production in our country was determined in the past primarily by the demand for high quality metal, the making of which in other units was either impossible or uneconomical.

In recent years, a trend toward increasing the unit capacity and power of the steel-making units has been clearly planned. Practice has confirmed that the construction of large arc furnaces and new power shops will permit a significant reduction in the specific capital expenditures and production overhead, an increase in the productivity of labor and significant improvement of the working conditions of the service personnel.

In spite of the significant progress in electric steel making with respect to expanding the assortment of steel made, improving the metal output per unit installed capacity, saving electric power, reducing the time required for the heat, improving the strength of refractory linings, a reduction in the metal charge and ferrous alloy consumption, and so on, there are significant reserves for further reduction of the material outlays in production and improvement of the efficiency of making steel in the electric furnaces.

At the present time favorable prerequisites have been developed in the country for accelerating the development of electric steel making. First of all this is connected with the necessity for efficient use of all of the scrap and waste reserves of alloyed steels. According to the data of the VNIPIlom Institute, the reserves and volumes of the procurement of this waste material in the country constantly exceed the possibilities for remelting it in the

electric furnaces. Accordingly, up to now a significant quantity of the alloy waste is being used in the open-hearth furnace charges, which is accompanied by significant losses of chromium and manganese contained in them and almost all of the vanadium and silicon.

The concentration of the making of all alloyed steels in electric furnaces is also expedient in order to reduce the furnace losses of the metal charge. The calculations of the scientific research institute of metallurgy (NIIM Institute) indicates that making alloyed steel in the open-hearth furnaces instead of the electric furnaces leads to significant over consumption of ferrochrome, ferromanganese, ferrosilicon, and other ferrous alloys.

The further development of electric steel making must also be accompanied by a reduction in the thorough (beginning with extraction of the ore and coal) energy consumption by 70 percent and the primary materials by 90 percent, a decrease in the discharge into the air by 88 percent and water pollution by 76 percent and a decrease in the production and consumption waste by 97 percent [1] by comparison with making steel by the "blast furnace and oxygen converter" system.

The changes in the raw material and the fuel and energy base of our country are also giving rise to preference for making steel in the electric furnaces by comparison with other units. The reliability of supplying electric power in the high-capacity integrated electric power systems is an important factor.

In the last eight years, the increase in electric steel production in ferrous metallurgy has basically been achieved as a result of the construction and introduction into operation of new electric steel-making furnaces with arc furnaces at a capacity of 100 and 200 tons.

The large arc furnaces are equipped with modern systems for automation and control of the movement of the electrodes, automated oxygen tuyeres, units for mechanized repair of the refractory lining of the furances and the discharge loaders, devices for removal and purification of waste gases and other new technological process equipment which will improve the productivity of labor and ensure high technical-economic indexes of the steel-making process.

The Central Scientific Research Institute of Ferrous Metallurgy jointly with the plants has developed and introduced a process for making construction, bearing, electrotechnical and other alloyed steels corresponding with respect to quality indexes to the requirements of the standard and the technical specifications in the large arc furnaces.

The NIIM Institute has worked on intensifying the process of melting the charge in the electric furnaces by using gas burners at the Novolipetsk and Cherepovetsk etallurgical lants.

On some of the 100 ton and two of the 200 ton arc furnaces the capacity has been increased as a result of redesigning the existing transformers from 25 and 45 megavolt-amperes to 38-60 megavolt-amperes respectively.

It is necessary to accelerate the introduction of superpowerful arc furnaces into production with a specific transformer power of 500 to 600 kilowatts/ton.

The superpowerful arc furnaces permit intensification of the process of melting the charge and refining the metal to remove phosphorus and carbon. The making of high-quality steel in various assortments in these furnaces with subsequent refinement of the metal outside the furnace (by reduction slags formed in the metal pool of the large furnaces before removing the melt, in vacuum chambers, by inert gases and active powdered reagents) will make it possible significantly to reduce the furnace losses of the metal charge and the alloying elements and to obtain metal of the required quality with a reduction in its cost.

In recent years the proportion of cast iron and scrap in the metal charge of the electric furnaces has been reduced, and the proportion of ferroalloys has increased significantly.

On the basis of the data of the VNIIOchermet Institute, the Institute of Economics of the Central Scientific Research Institute of Ferrous Metallurgy has put together the iron balances with respect to all methods of steel making, the enterprises and the branch as a whole. The calculations have shown that, in spite of an increase in the overall consumption of the metal charge, the efficiency of utilizing the iron when making electric steel in 1973-1978 increased by 0.42 percent.

In 1973 to 1978, a 14.9 percent reduction in metal losses with the pouring gates was achieved, 7.5 percent with incomplete pouring of the ingots and 10.4 percent with rejection in the first conversion. However, the losses with scrap and the furnace losses have increased noticeably. The increase in furnace losses when making electric steel has basically been caused by an increase in the oxygen consumption for blowing the pool. An especially high metal loss was observed in 1973 to 1975 when the oxygen consumption was highest.

Inasmuch as the furnace losses represent the greatest part (about 60 percent) of all losses when making electric steel, special attention has been given to the improvement of the conditions of blowing the pool with oxygen.

The best indexes with respect to economical utilization of the metal charge are found in the case of the electric steel-making shop at the Kuznetsk Metallurgical Combine. The 40 ton arc furnaces of the combine have quite high output capacity; predominately ballbearing and corrosion-resistant steel is made in them. The specific oxygen consumption with respect to the shop is 18.7 m^3/ton of steel. On achievement by the other electric steel-making shops of analogous indexes, about 200,000 tons of metal charge would be saved per year. The metal charge savings at the Kuznetsk Metallurgical Combine [KMK] are achieved as a result of a 30 percent reduction in the metal losses during pouring (with the scrap, the pouring gates and the incomplete pouring). The furnace losses during the process of making electric steel are appreciably less than the average for the branch; the rejection on the first conversion is 85 percent less.

It must be noted that the metal losses in the arc furnaces of the combine on the average are no higher than in the electric steel-making shops operating without using oxygen. This is ensured by constant improvement of the process of making corrosion-resistant steel with the application of oxygen and the overall high level of production culture. Here they did away with early blowing of the high-chromium pool with oxygen earlier than at the other enterprises of the branch. The blowing is done intensively, but only after complete melting of the charge and sufficient heating of the metal.

The heavy-duty electric furnaces are characterized on the whole by a relatively high specific consumption of metal charge. This is especially exhibited when analyzing the iron balances when the effect of the charge composition and the variety of electric steel is eliminated. Thus, the consumption of the metal charge in the 100-ton arc furnaces of the Cherepovetsk Metallurgical Plant in 1973-1978 decreased by 10 kg/ton. However, in spite of the low metal losses during continuous pouring, the use coefficient of the iron here is relatively low as a result of increased furnace losses of the metal during the making of the steel.

In the 100-ton arc furnaces of the Novolipetsk Metallurgical Plant, this index at the present time has been decreased by almost 2 percent. For relatively small metal losses when pouring at the MNLZ Plant, the furnace loss of the metal at this plant increased.

The increased furnace loss of the metal in the high-capacity electric furnaces, in particular, at the CherMZ Plant, the NLMZ Plant, the Krasnyy Oktyabr' Plant and the Chelyabinsk Metallurgical Plant (ChMZ) is caused primarily by the application of two large an amount of oxygen for acceleration of the melting of the charge with insufficient specific power of the transformers. In addition, the metal scrap used has low saturated mass, and in a number of cases it does not correspond to the requirements of the standard with respect to oxidizability and impurities [2]. The furnace losses of the metal can be reduced when conducting the heat without intensification of the melting of the charge by the oxygen, with an increase in the proportion of the transformers and the maximum reduction of the increased period of melting with transition to the single-slag steel-making process. The quality of the electric steel (of a defined grade) need not suffer from this. Here, a significant increase in output capacity and improvement of the technical-economic indexes of the operation of the arc furnaces is ensured. The transition to making carbon steel, low-alloy steel and electrotechnical steel by the single-slag process will permit reduction of the metal loss with a simultaneous increase in the productivity of the 100-ton arc furnace; thus, a specific output capacity of 100-ton electric furnaces was 22.7 tons per 1,000 kilovolts-ampere per day at the CherMZ Plant.

The single-slag process of making carbon and alloyed electric steel is widely used in the foreign plants with a specific oxygen consumption of 4-6 m^3/ton [3].

A further reduction in the specific consumption of cast iron when making steel in the large electric furnaces deserves an effective value of reduction of the furnace losses and the flow rate of the metal charge.

The increased consumption of cast iron in a number of cases is determined by the low content in it of residual impurities; therefore it is necessary to take measures to replace it when producing electric steel by metallized pellets carburized to 4-5 percent with a minimum content of sulfur, phosphorus and other impurities and also for the creation of cheap and effective carburizing agents.

Special attention should be given to increasing the quality of the electric furnace scrap. The scrap coming from the side is often spoiled with undesirable components; the carbon scrap is mixed with alloyed scrap, and the various groups of alloyed scrap often are mixed in each other. The remelting of this scrap leads to increased furnace losses of it and also creates significant difficulties in the operation of the electric steelmaking furnaces [4]. In the future with a sharp increase in electric steel making and an increase in the proportion of amortization scrap, the problems of improving the quality of the commercial scrap will become still more urgent.

The usual methods of preparation (packaging, pressing, gas cutting) as applied to the electric furnace scrap is insufficient; the processes of grinding and magnetic separation are also necessary.

The crushing of scrap in special shredders [1] has become widespread abroad; the application of the ground and purified scrap in the charge of the electric furnaces has given good results [5].

The single-slag making of many types of electric steel is an effective area for reducing the furnace losses of ferrous alloys. Thus, at the Cherepovetsk Metallurgical Plant, the savings of deoxidizing agents in this case amount to 3 to 5 kg/ton. After alloying in a ladle, the required blending of the metal is achieved by blowing it with argon [6]. The application of exothermal ferrous alloys when alloying the metal in the ladle will permit significant expansion of the assortment of steel made by the single-slag process and reduction of the cost of the finished rolled product.

A very effective means of saving ferrous alloys and deoxidizing agents is the treatment of the metal in a vacuum outside the furnace; in this case the assimilation of the alloying elements by the liquid steel increases significantly (to the left and right of the slash we have the assimilation indexes in ordinary and vacuum steel, %);

Carbon	Manganese	Silicon
85-90/100	70-75/95	65-70/95
Chromium	**Titanium**	**Aluminum**
75-85/98	45-50/90	30-40/80

When making complexly alloyed steels and alloys for responsible purposes, significant reduction of the furnace losses of expensive alloying elements can be ensured by oxygen-free remelting of the alloyed waste and ferrous alloys in induction or plasma furnaces with ceramic crucible. In this case combinations of new sources of heating with the application of protective gaseous media and a vacuum are possible. At the Zlatoustovskiy Metallurgical Plant when making steel for responsible purposes, the method of remelting without oxidation in the furnace can be used to increase the extraction of chromium, manganese, silicon, titanium, vanadium and other elements.

The experience of the Zlatoustovskiy Metallurgical Plant in making corrosion-resistant steel by the mixing method is of interest.

Inasmuch as with this process "pure" remelting of the waste alloyed with slightly oxidizing elements is realized, their losses with the furnace losses are found to be minimal. Simultaneously a relatively low carbon and phosphorus content is ensured in the finished steel. The mixing method is also used for specially low-carbon corrosion-resistant steel not containing titanium, but in this case it is expedient to mix the liquid low-carbon ferrochrome with iron-nickel melt.

When making 08Kh19N9F2S2 steel by the mixing method, the consumption of the ferrous alloys is reduced by about 10 percent (including the carbon-free ferrochrome, to 37 percent) and the entire metal charge, by 6 percent.

In foreign practice the basic area for saving ferrous alloys when making carbon steel and low to medium alloy steel is the vacuum treatment outside the furnace; in this case a noticeable narrowing of the limits of the fluctuations is achieved with respect to the alloying element content.

The Krasnyy Oktyabr' Plant has assimilated the process for oxidizing evacuation of the low-chromium corrosion-resistant steels not containing titanium, which offers the possibility of obtaining metal in the 100-ton arc furance with a carbon concentration to 0.03 percent using high-carbon ferrochrome and increasing the chromium extraction to 95 percent.

Abroad, the so-called AOD process has become widespread in the corrosion-resistant steel production. In this process the decarburization of the high-alloy melt is carried out in the converter type units by blowing with an argon-oxygen mixture of variable concentration; this process ensures increased extraction of chromium.

In 1978 the electric power consumption in electric steel-making production was reduced by 1 percent, which was ensured by successful operation and maintenance of the heavy-duty electric furnaces and intensification of the metal-making process.

The best index (506 kilowatt-hours/ton) is achieved in the electric steel-making furnace of the NLMZ Metallurgical Plant basically as a result of using

the gas-oxygen burners for acceleration of the melting of the charge. It is known that the use of the moving burners installed in the operating opening of the furance will permit a reduction in the electric power consumption by 26 kilowatt-hours/ton over the course of 1.5-2 hours [2].

Among the like units, the lowest specific electric power consumption is found for the arc furnaces specialized in making corrosion-resistant steel. Comparatively low specific electric power consumptions are observed in the arc furnaces when observing the power charts, reducing the idle times between heats and eliminating the idle time of the furnaces under current (delaying the heats for organizational reasons). Very important reserves for saving electric power are the following: reduction of the duration of the heat by taking the refining processes into the ladle, increasing the strength of the furnace lining and increasing the active power intake. It is natural that the greatest savings of electric power are achieved with efficient, all-around utilization of the high installed capacity and the sufficient resistance of the furnace with treatment of the metal outside the furance.

The combination of these and a number of other improvements at the Tosin Seyko Plant (Japan) has led to a reduction of the heat duration to 70 minutes, the electric power consumption to 350 kilowatt-hour/ton on the 50-ton arc furnace with a 22 mv-amp transformer [7].

A significant item of consumption with respect to conversion in the electric steel making shops is the graphited electrodes. Therefore all-around reduction of the specific electrode consumption and saving of them constitute an urgent problem.

A number of factors influence the electrode consumption. The loading of an unsized charge in the furnace can lead to breaking of the electrodes; prolonged idle times between heats cause cracking of the electrodes; if the electrodes are insufficiently tightly screwed in and there is poor seal of the roof openings, the heating and oxidation of the contact and side surfaces are intensified. The operating practice of the electric furnaces indicates that on the average 2.7 kg/ton of electrodes are lost with breakage, and about 1.5 kg/ton with burning; in order to lower these indexes it is necessary to organize the storage, transportation, and screwing in of the electrodes on mechanized devices in the corresponding way.

The best results with respect to electrode consumption are systematically achieved by the electric steel-making shop of the NLMZ Plant. As a result of using protective coating of aluminum, the specific electrode consumption in 1978 dropped to 5.3 kg/ton of steel at the plant. The work experience of one of the shops of the Krasnyy Oktyabr' Plant where the electrode consumption was 6.4 kg/ton in 1978 deserves attention.

The most successful design of the electrode seals was developed for the 5 to 20-ton arc furnaces at the ZMZ Plant and for the 100-ton furnaces at the NLMZ Plant [8]. A necessary condition of the further reduction of the specific electrode consumption, in particular the large diameter

electrodes, is improvement of their qualitative characteristics; in particular, the attainable current density must be increased significantly.

For successful assimilation of the large superhigh-powered electric furnaces further improvement of the electrode quality is needed.

It is of interest to make electrodes from "acicular" coke in the long filamentary structure on a binder made of high-temperature pitch. High-quality surface machining and thread cutting with rigid tolerances are needed for nipples and collars; there should be no stresses in the joints.

The refractory consumption for lining the furnace and pouring the metal is an important item in the cost of electric steel. Among the statistical data it is obvious that the specific refractory consumption for the repair of large electric furnaces is somewhat higher than that of the small and medium capacity furnaces; therefore the reserves for further economy of refractories have far from been exhaustive. In 1978, 10.5 kg/ton were expended on repair of the large furnaces at the Krasnyy Oktyabr' Plant, whereas 12.1 kg/ton were expended at the ChMZ Plant.

The increase in strength of the wall and roof linings of arc furnaces is determined primarily by reducing the time the liquid metal spends in them. Thus, at the CherMZ Plant, reducing the reduction period of the heat from 51 to 22 minutes on the average has made it possible to increase the service life of the walls and the roofs of the 100-ton electric furnaces by 53-54 percent.

The significant increase in strength of the hearth in banks of the arc furances and the reduction in the powdered magnesite consumption have been achieved as also the "pure" remelting of waste (excluding alteration of the cycles of saturation of the lining oxides and reduction of them).

Posirive results can be achieved also when shielding the electric arcs by continuously charged crushed scrap or metallized pellets.

Abroad, even when using high-quality refractory ceramics in the sections of the lining of the high-powered furnace walls especially stressed with respect to temperature, no noticeable increase in the run time of the units was noted, and only the application of elements with water cooling and coolers alongside the furnaces in the plants in Japan and the Federal Republic of Germany has offered hopeful results [7].

For a further increase in strength of the lining, computer optimization of such parameters as the power of each of the arcs, the temperature and degree of wear of the inside surface of the furnace, lining, the duration of the heat, and so on is needed.

Thus, the basic areas for reducing material outlays when making electric steel are the following: the construction of high-output arc furnaces

equipped with superpowerful transformers, optimization of the conditions under which the pool is blown with oxygen, maximum reduction of the time liquid metal is in the furnace and the removal of the metal refining operations and also correction of the chemical composition and temperature to the pouring ladles or special units, significant improvement of the quality and the bulk mass of the scrap, the development of oxygen-free processes of remelting alloyed waste in the plasma and induction furnaces, improvement of the strength of the refractory lining by using cooling elements.

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METALLURGY

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IMPROVEMENT OF INTRABRANCH PRODUCTION RELATIONS IN FERROUS METALLURGY

Moscow STAL' in Russian No 5, May 79 pp 386-389

[Article by V. A. Minenko, V. S. Kirsh, and O. V. Posylkina, VNIIOchermet Institute and Khar'kov Economic Engineering Institute[1]]

[Text] The intrabranch production relations are not only the target, but they also play an active role in improving the control system, having a direct effect on it. These relations create the prerequisites for the development of vertical integration--the most improved form of concentration characteristic of of the complex branches of industry.

The significance of the intrabranch relations is intensified some more with an increase in the unit capacity of the basic metallurgical units. Thus, the introduction of Blast Furnace No 9 with a volume of 5,000 m^3 into operation at the Krivogrozhskiy Metallurgical Plant presupposes the continuous flow of agglomerate from the NKGOK Mining and Enrichment Combine and coke from the Bagleyskiy Coal-Tar Chemical Plant; in this case the process relations of the three enterprises increased noticeably.

The vertical integration provides for the creation of production and industrial associations as interrelated complexes, the advantage of which consists in the close technological unity aimed at achievement of the final goals of the complex as a whole.

The effect on the production relations (just as on the object of control) is distributed over the hierarchical levels, on each of which autonomous adaptive systems are formed.

The development of production concentration based on close production relations is finding reflection in the creation of combined enterprises. The combination of production as a form of vertical integration is opening

1. With respect to the corresponding article by S. S. Aptekar', Yu. A. Dolgorukov and R. I. Abashina, STAL' (Steel), No 3, 1979, pp 222-227 [1].

up the possibility of carrying out a united technical policy to achieve the final branch results.

The intrabranch relations provide for normal functioning of the branch as an integral economic organism based on the interaction of the subdivisions making it up in the area of carrying out the general branch missions.

The coordination of the activity of the various subbranches with respect to organizing the successive advancement of the raw material along the process chain under a united production engineering management has important significance in controlling the complex branch. If the control of the intrabranch flows is realized from the outside, the advantages of the complex branch are reduced to a minimum, for independent regulation of a single interconnected process becomes impossible.

The solution of these problems on the interbranch level unavoidably involves duplication of them by the ministry system; in accordance with the operation of the branch as a whole, it is forced to intervene in the process of coordination of the activity of the subordinate subbranches and enterprises.

The organization of the interbranch relations is the primary goal of the system of the USSR Gossnab; the regulation of the intrabranch circulation with which it is charged distracts the marketing and supply agencies from carrying out their characteristic functions.

Therefore the organization and planning of the distribution of the intrabranch circulation production in ferrous metallurgy, in our opinion, must be realized by the branch control agency--the USSR Ministry of Ferrous Metallurgy.

At the present time the organization of the intrabranch turnover is carried out by the corresponding main marketing and supply union of the USSR Gossnab and the USSR Ministry of Ferrous Metallurgy which is charged with providing the branch enterprises with ore, fluxes and ferrous metal scrap. The intrabranch deliveries of coke, ferrous alloys, refractory materials and products and also other types of products are regulated by the organizations of the USSR Gossnab (just as the interbranch deliveries).

The cooperative deliveries of intermediate metal products are realized by the USSR Gossnab jointly with the USSR Ministry of Ferrous Metallurgy without sufficiently clear distribution of the functions among them.

One of the possible means of improving the control of ferrous metallurgy in the future is the creation of industrial associations in the form of large territorial complexes by the principle of closure of the production relations which can be regulated inside the complex without disturbing the upper levels of control and especially the organizations external to the branch.

At the present time, along with the interplant deliveries, the area of centralized distribution frequently includes the products made by the

combined enterprises to satisfy their in-house needs. The advantages of the complex branch of the industry are lowered in this case, for the interaction of the subbranches takes place with the participation of the agencies outside the branch; the united interconnected process of production, distribution and consumption for the branch is artificially disrupted. The combination of production has no real meaning when the external agencies intervene in the internal affairs of the united complex.

Therefore the correctness of the statement by the authors of the discussed article [1] regarding the expediency of retaining the functions of regulating the intrabranch deliveries of refractory products for the organizations of the USSR Gossnab is doubtful. About half of the commercial output of these products is consumed by other branches of industry, but the intrabranch consumption of the refractories, just as other types of products basically is for the products used by other branches in insignificant amounts.

The transfer of the intrabranch turnover to the supervision of the USSR Ministry of Ferrous Metallurgy is complicated by close intertwining of the organization of the intrabranch production relations with the problems of interbranch deliveries, for at the present time the nomenclature attribute according to which the defined type of resources is attached to one system or department predominates in the production distribution practice.

Therefore it appears appropriate to develop a model based, on the one hand, on the assumption within defined limits of regulation of the interbranch deliveries by the system of the USSR Ministry of Ferrous Metallurgy (with respect to the nomenclature attribute), and, on the other hand, the known assumption of violation of the nomenclature attribute for purposes of nonintervention of the ministry in the competence of the USSR Gossnab.

The relations of the intrabranch and interbranch deliveries of metallurgical production, as analysis shows, are quite stable and do not undergo significant changes over a prolonged period of time. During the 1969-1976 period, the proportion of intrabranch deliveries in the overall volume of the commercial output of the branch enterprises increased from 31.4 to 33.1 percent; in the future obviously no noticeable shifts are proposed in the complex structure of the delivery.

At the present time the proportion of the USSR Ministry of Ferrous Metallurgy in the consumption of the commercial resources with respect to the nomenclature attached to them is 82.4 percent, and with respect to the nomenclature regulated by the organizations of the USSR Gossnab jointly with the ministry, 79.4 percent: in this case the proportion of the ministry in the consumption of the production distributed by the Soyuzglavsnabsbyt [Main Marketing and Supply Unions] is on the average equal to 13.3 percent, but within this production there are types with high proportion of intrabranch consumption.

For example, the average proportion of the intrabranch consumption of commercial refractories is 47.1 percent, and about 73.2 percent of the

commercial output consumption goes for individual types of refractory products (refractories for the repair of the metallurgical units, the pouring and ladle provisions).

All forms of branch production can be distributed in three groups in decreasing order of the proportion of intrabranch consumption (to the left of the slash is the proportion in the commercial output of each group, and to the right, in the overall volume of intrabranch and interbranch deliveries, %):

Deliveries:	I	II	III	Total
Intrabranch	82.3/91.3	49.4/6.0	1.5/2.7	33.5/100.0
Interbranch	17.7/9.9	50.6/3.5	98.5/86.6	66.5/100.0
Total	100.0/37.2	100.0/4.3	100.0/58.5	100.0/100.0

The first group included the production, the proportion of the intrabranch consumption of which in the commercial output is 82.3 percent: ores, fluxes, ferrous metal scrap, carbon charge, ingots, the billets for rolling, skelps, coke (without foundry), ferrous alloys, refractory raw material, refractory products (for repair of the metallurgical unit, the ladle and pouring provisions), and so on. Only 9.9 percent of the intrabranch deliveries of metallurgical products and 91.3 percent of the interbranch deliveries are concentrated here.

The types of products in the first group can be transferred to the supervision of the USSR Ministry of Ferrous Metallurgy with observation of the nomenclature attributes; here the disturbance of the competence of the USSR Gossnab touches on 9.9 percent of the interbranch deliveries.

The second group included the production with a proportion of the intrabranch consumption on the average of 49.4 percent (the conversion cast iron, the grinding balls and certain other products). This group encompasses 6.0 of the intrabranch deliveries and 3.5 percent of the interbranch deliveries; considering its comparatively small proportion in both forms of deliveries and the undesirability of a further increase in the proportion of the interbranch deliveries regulated by the ministry, the provision with this production must be regulated beginning with the competence of the systems of the USSR Gossnab and the USSR Ministry of Ferrous Metallurgy.

Only 2.7 percent of the intrabranch deliveries and 86.6 percent of the interbranch were represented in the third group including the various forms of rolled products and other resources involved in the intrabranch consumption to an insignificant degree; in practice the nomenclature of the intrabranch turnover is exhausted by the second group. There it is expedient to leave the organization of the production relations for the products of the third group under the supervision of the USSR Gossnab system.

As a result 97.3 percent of the intrabranch and 9.9 percent of the interbranch deliveries will be regulated by the ministry, and the remaining 2.7 percent

of the intrabranch deliveries, by the USSR Gossnab. Here the nomenclature principle is disturbed only with respect to 4.3 percent out of all of the deliveries of the branch production (we have in mind that for this part of the production the delivery plans will be developed by the ministry and the corresponding main supply and marketing union within the framework of its competence).

At the present time this method has been used to organize the deliveries of the intermediate products from the coal-tar chemical production. The Soyuzkoksokhimsnabsbyt [Coal-Tar Chemical Supply and Delivery] Trust is transmitting the limits on the intrabranch consumption to the USSR Ministry of Ferrous Metallurgy, within the limits of which the Administration of the Coal-Tar Chemical Production of the ministry is organizing the deliveries of the products; here the possibility appears for uncoordinated actions on the part of the USSR Gossnab agencies and the ministry when distributing the orders to the manufacturers.

This deficiency can be eliminated by changing the organizational structure of the system (E--effective, P--proposed) of the intrabranch deliveries (on the left of the slash with respect to natural indexes, and on the right with respect to cost indexes, %):

Administration Agency:	E	P
USSR Ministry of Ferrous Metallurgy	69.7/28.0	99.4/97.3
Soyuzglavsnabsbyt	30.3/72.0	0.6/2.7
Including participation of the ministry	14.0/44.2	--/--

Thus, the proportion of the intrabranch deliveries planned by the USSR Ministry of Ferrous Metallurgy is increasing significantly. At the present time the ministry is regulating only certain forms of raw material resources; in the proposed system under its supervision there is also the intrabranch turnover of expensive intermediate products, as a result of which the volume of intrabranch deliveries will increase by 3.5 times.

Here, the proportion of the intrabranch deliveries in the commercial output by the nomenclature attached to the USSR Ministry of Ferrous Metallurgy, and in spite of significant expansion of it, remains on the former level (82.4 percent for the existing system and 82.3 percent for the proposed system).

The transfer of the intrabranch turnover to the supervision of the USSR Ministry of Ferrous Metallurgy is improving the mutual coordination of the production plans on an improved procedural base. Concentrating the entire complex of interrelated production facilities under their direction, the ministry will obtain the possibility of subordinating the delivery plans to a united economic strategy. In this way it will be possible to have a higher qualified solution to the problems of optimizing the intrabranch deliveries within the framework of a united branch plan considering the reduction of the hauling distances and also the production overhead of the manufacturers.

The most effectively stated problems can be solved by leaving the functions of attaching the consumers to the manufacturers to the industrial associations considering their economic interests. The attachment procedure must be coordinated with the existing system of financial settlements, beginning with the fact that at the FOB prices of the shipper, the user of the product is interested in efficient attachment, and at the destination FOB prices used without participation of the supply and marketing organizations in the calculations, the manufacturer is interested in reducing the hauling distance.

The attachment of consumers to suppliers can be realized in two versions. When selling the products at the shipper FOB princes the USSR Ministry of Ferrous Metallurgy must indicate in the delivery plans the distribution of the production volumes of the manufacturing enterprises with respect to the branch user associations approved by the industrial associations. In these plans it is necessary to indicate the volumes of deliveries to other users of other branches and also exports in accordance with the established demand. On the basis of the attachment plans, the consumer associations will send orders to the manufacturing enterprises within the limits of the provided production and consumption volumes.

For deliveries of products sold at the destination FOB prices, the USSR Ministry of Ferrous Metallurgy must develop attachment plans indicating in them the volumes of deliveries to the users from the supplier associations which will send orders to the manufacturers and the users.

Within the production allotted to the second group 85.2 percent is sold at the destination FOB prices, of which 77.4 percent is conversion cast iron which is predominantly exported.

Within the plan for interbranch deliveries of this type of production sent to the industrial associations of the USSR Ministry of Ferrous Metallurgy, the Soyuzglavmetall Union indicates the volumes of deliveries for each user of the product which the industrial association then attaches to the manufacturers subordinate to it.

With respect to the products sold at the shipper FOB prices, the Soyuzglavmetall Union must develop plans for interbranch deliveries for the manufacturing enterprises by agreement with the supplier associations. The industrial user associations will, on the basis of these plans, send orders to the manufacturers and the subdepartmental users.

One aspect of the organization of production relations in the branch is improvement of the planning of the internal turnover of the production associations and combines which has acquired great significance in connection with the creation of large production associations with an individualized administrative apparatus.

The proportion of the internal circulation in such associations in the aggregate production volume does not exceed 6 to 8 percent, but individual

production units send 70 to 90 percent of their production to satisfy the intrafirm needs. This is an urgent problem also for the production units having a comparatively low volume of intrafirm turnover.

In ferrous metallurgy, just as in certain other branches of industry, there is no united procedural approach to estimating the intrafirm turnover, which has a negative effect on the development of the production relations.

At the present time when planning and estimating the activity of the production associations (combines), the internal turnover is excluded from the cost indexes, but departure from the established procedure is permitted by agreement of the ministry with the superior agencies.

Under the conditions of the production associations of ferrous metallurgy, with respect to the scales and territorial spread which have no precedent in economic practice. The movement of the intermediate products has acquired many aspects of commerce. Thus, the same indexes as for the independent enterprises (volume of sales and commercial production, profits, profitability, and so on) are planned in almost full volume for the production units; these indexes are characteristic of the legally independent enterprises, and under the conditions of the production units, they are of a provisional nature.

The planning and accounting for the volumetric indexes of the production units are carried out without internal turnover, which while maintaining the nomenclature of the indexes invariant distorts the actual results of their work and lowers their interest in production output with respect to internal cooperation.

Therefore the internal turnover must be considered when planning and estimating the activity of the production units, extending it to the production associations of ferrous metallurgy with an individualized administrative apparatus and combines having independent production units in their makeup. When estimating the results of the activities of the association (combine) as a whole, the intrafirm turnover must be excluded in accordance with the established procedure.

The estimation of the intrafirm turnover is continuously connected with taking the profits into account. At the present time the production for subsequent refining in the association is transferred with respect to frost and the profit is taken into account only with respect to the commercial part of the production.

When transferring the intermediate product in the effective wholesale or balance prices, redistribution of the profit of the association takes place, which makes the intrafirm cost accounting more consistent and effective. This procedure for accounting for the intrafirm turnover is used in the AvtoZIL Association, and it deserves to become widespread in the production associations of ferrous metallurgy.

The transfer of the intrabranch turnover to the ministry supervision will permit concentration in the industrial association apparatus of the economic functions performed at the present time by the cost accounting organizations of the USSR Gossnab which do not have the actual possibilities for active influence on the course of the production deliveries. Among these functions is the organization of the contract claims work and the financial settlements, which follows from the "general rules on all union and republic industrial associations."

The creation of the industrial associations used to bring about an increased role of the agreements on deliveries as a result of improving the balancing of the production and distribution plans. The associations enter into agreements among each other and also with the enterprises making them up with the material responsibility following from these relations.

The centralization of the financial settlements with respect to intrabranch deliveries in the apparatus of the industrial associations will create the possibility of regulating the results of economic activity using the mechanism of internally calculated prices in accordance with the actual contribution of each enterprise and also the stated goals with respect to the production and sale of the products in the given variety.

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TECHNICAL ACHIEVEMENTS OF THE 'RYAZTSVETMET' PLANT

Moscow TSVETNYYE METALLY in Russian No 3, 1979 pp 9-11

/Article by A.N. Polyakov and Yu. Ye. Shuvayev: "Heavy Non-Ferrous Metals: Technical Achievements of the Ryaztsvetmet Plant"/

/Text/ The Ryaztsvetmet /Ryazan' Plant for the Production and Processing of Nonferrous Metals/ Plant is a large and modern enterprise unlike any other in the Soviet Union or abroad; it is unique in the raw material that is processes, the product that it turns out and the technological processes that it uses. The plant processes raw materials of a complicated composition containing tin, zinc and lead, low grade zinc-lead concentrates, waste slags and dusts from copper-smelting plants and various secondary tin wastes and others. The presence in the raw materials of copper, cadmium, iron, arsenic, chlorine, fluorine, sulfur and other admixtures complicates the technology for processing it and requires that steps be taken to protect the environment.

The plant produces a wide range of products: lead and tin solders in the form of ingots and articles of various grades and profiles (approximately 300 designations); tin and soldering powders, soldering pastes, babbitts, zinc vitriols (including a vitriol of increased purity) and copper and cadmium semi-products. Many of the plant's products are exported to various countries, including capitalist countries.

The waste slag from the plant's fuming unit is used in building highways and in manufacturing building brick.

The technological production lay out is very specific and differs significantly from the lay outs of other tin enterprises. It includes the roasting of tin concentrates in order to remove sulfur and arsenic from them with the recovery and disposal of the latter in the form of arsenite of calcium, the fuming of slags and poor tin industrial products with the sublimation from them of tin, lead, zinc and the recovery of sublimates and the hydrometallurgical processing of sublimates, dusts of copper-smelting plants, cinders and secondary raw materials.

The recovery of all valuable elements and their use in finished product provide for a high overall use of raw materials (94.5 percent in a cost expression).

The technology and equipment for extracting tin and other metals from poor tin-bearing materials by the fuming method using natural gas were developed and assimilated at the plant for the first time in the USSR and abroad. This made it possible to extract tin into sublimates with a high profitability (half as expensive as for the branch). Besides this, the bringing in of new kinds of raw materials to be processed has made it possible to significantly reduce the use of purchased metal tin.

The plant produces first and highest category of quality product; thirty kinds of its soldering articles have earned the State Mark of Quality.

The use of solders has made it possible to more economically expend tin and lead.

The committment to make thrifty use of nonferrous metals in the national economy, of which Minister of Nonferrous Metallurgy P. F. Lomako spoke in his article *, requires production workers to systematically improve the quality of product.

Plant specialists in cooperation with workers from the Institute of Arc Welding imeni Ye. O. Paton have created a technology for the production of a new, more progressive product - soldering fluxes, pastes, powders, multiplex tubes, microarticles, composite self-fluxing solders and others, the use of which on a broad scale will significantly reduce the expenditure of tin and will raise the product quality of machine building plants and other consumers.

The expansion of the plant's production capacities is needed to increase the output of such products.

A large-scale process for the scrubbing of fuming gases has been adopted at the plant; this process has ensured the highly efficient operation of the dust-and-gas purification units (efficiency = 99.64 percent); the sanitary purification of gases is being accomplished.

The constant improving of the operation of the gas purification installations has lowered the pollution of the air by combinations of lead, arsenic and other harmful exhausts. The content of harmful substances in the protective zone of the enterprise has been brought to within safe norms. The plant has fully switched to a recycling water supply and has stopped dumping relative pure water into the Oka River and has reduced the use of river water 30-fold.

* "Pravda", 1978, 11 Sept 78.

Many of the plant's designs are used at other Soviet enterprises (the gasification of the fuming process, the concentration of zinc solutions in combustion chamber ovens, the thorough purification of zinc-sulphate solutions from admixtures, the intensification of the condensation of slurry and others).

Twenty important operations, which have been adopted at the plant, are protected by patents; several have been patented abroad and licenses have been sold for several developments.

The achievements of the enterprises have more than once been demonstrated at the Exhibition of USSR National Economic Achievements. In 1976 the plant was awarded a first degree diploma at the Exhibition of USSR National Economic Achievements.

The planned indicators of the enterprise have been assimilated and significantly exceeded.

Governed by the decisions of the party and government concerning the constant growth and improvement of production and the raising of its efficiency and quality of work, the plant's collective has achieved significant successes in improving all basic production indicators.

Labor productivity for the period 1965 through 1977 increased 2.1-fold with a reduction in personnel. The plant is a highly profitable enterprise.

The growth of production volumes and its high economic efficiency are the results of intense creative work by the plant collective that is directed by Party and public organizations. Primary attention in solving these matters has been devoted to improving production, the scientific organization of labor, inventiveness and rationalization, the training of personnel, study, raising technical knowledge and improving production management.

Socialist competition has done much to promote the achievement of high indicators. The good work of the plant has more than once been noted by Party, state and trade union organizations.

During the period of 1971 through 1978 the plant was among the top winners in the competition between enterprises of the ministry. The plant was awarded the Jubilee honorary document in commemoration of the 100th anniversary of V. I. Lenin's birthday and the Jubilee honorary emblem in commemoration of the 50th anniversary of the USSR. More than 100 workers of the plant have been awarded USSR orders and medals.

In 1976 the work "Development and Adoption of Highly Efficient Technological Processes and Equipment for the Overall Processing of Tin-Bearing Raw Material of Complex Composition with the Output of New Kinds of Product at the Ryazan' Plant for the Production and Processing of Nonferrous Metals" was awarded a USSR State Prize; eleven workers at the plant were given the title of prize winner.

The socialist competition that has unfolded between the shops, shifts and individual workers, the disclosure and use of reserves, the adoption of new and the improving of existing technology, the constant work with personnel, the combining of material and moral incentives, the display of initiative and the creativity of workers have made it possible to obtain satisfactory results of activity for three years of the Tenth Five-Year Plan.

During this same time several million rubles worth of product were produced in excess of the assignments of the Tenth Five-Year Plan; labor productivity increased by 11.5 percent before 1975; and 3,500 tons of conventional fuel and approximately 9.7 million kilowatt hours of electric power were saved.

Many important technical measures were taken to further reoutfit the plant, to mechanize and automate production and to raise the plant's economic efficiency.

The workers, engineers and technicians in the past years of the five-year plan have adopted five important inventions, 898 rationalization proposals and have obtained an economic savings of more than a million rubles.

For the successes achieved in socialist competition in the Tenth Five-Year Plan, the plant collective has twice been awarded the Banners of the CC CPSU, the USSR Council of Ministers, the All-Union Central Trade Union Council and the Central Committee of the All-Union Leninist Communist Youth League and 10 times banners of the USSR Ministry of Nonferrous Metallurgy and the Central Committee of the Trade Union of Workers of the Metallurgical Industry.

An important contribution to the fulfillment of assignments and socialist pledges was made by leading production workers: smelters V. S. Amelin and A. V. Konyshev; fitter A. T. Malikov; electrician L. A. Yemshanov; instrument control operator Ye. A. Zaytsev; turner V. I. Yegorkin, chief of the refining shop S. F. Kirikov and others.

Inspired by the speech of CC CPSU General Secretary and Chairman of the Presidium of the USSR Supreme Soviet L. I. Brezhnev at the November (1978) Plenum of the CC CPSU, the plant's workers are filled with resolve to successfully fulfill the assignments of the Tenth Five-Year Plan for the production and sale of product.

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