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JPRS L/8448

10 May 1979

USSR

TRANSLATIONS ON USSR INDUSTRIAL AFFAIRS
(FOUO 4/79)

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CHEMICAL INDUSTRY AND RELATED EQUIPMENT

UDC 061.62(470.23)"1828/1978"

ROLE OF LENINGRAD TECHNOLOGICAL INSTITUTE IMENI LENSOVET IN THE DEVELOPMENT OF CHEMICAL INDUSTRY

Moscow KHIMICHESKAYA PROMYSHLENNOST' in Russian No 11, 1978 pp 18-22

[Article by Leonid Arkad'yevich Kostandov, Minister of Chemical Industry, on the occasion of the 150th anniversary of the Institute]

[Text] In the report of the General Secretary of the Central Committee of the CPSU Comrade L. I. Brezhnev at the 25th session of the CPSU, it was noted that the immediate task of the economic policy of the party remains the acceleration of scientific-technical progress. One of the main directions of this progress is the chemization [development of chemical industry and introduction of chemical methods and products into industry and everyday life] of all branches of the national economy. The chemical industry is one of those branches whose production, in the words of L. I. Brezhnev, "serves as a sort of catalyst, which accelerates the transition of the entire economy to the newest technical and technological base." Therefore, the surpassing development of the chemical industry is not a temporary phenomenon, but a constant course for the party's technical policy. Chemistry is now advancing to the forefront of world science. Scientists reckon that the age of chemistry will begin in about 1985: at that time the volume of polymer production will exceed the volume of production of the metallurgical branches of industry. Space, biology, genetic engineering, prolonging human life, synthesis of new medicines and dyes, production of new types of fuels, sharply raised production of agricultural crops and animal husbandry, radio-electronics -- it is already impossible for any of these areas of human activity to get along without chemistry.

"The main directions of development of the USSR national economy for the years 1976-1980" is predicted to be the conducting of scientific studies, opening principally new roads and possibilities for creating the engineering and technology of the future. This future is determined today, since the scientific-technical progress of tomorrow will depend on the level and direction of scientific investigation now and the use of the achievements that are made.

The significance and role of science in socialist society were determined in the first years of the Soviet regime. Now, when science has become a direct productive force, it is called on to play an important role in realizing the organic union of the advantages of the socialist economic system with the achievements of the scientific-technical revolution. The necessity of this was underscored in the decrees of the 25th session of the CPSU and a series of other program documents of the party.

At the dawn of the development of chemical industry in Russia a cadre of qualified chemical engineers and mechanics for the control of chemical enterprises, development and design of new plants began to prepare the Petersburg Practical Technological Institute, now the Leningrad Technological Institute imeni Lensovet. Founded in 1828, it became one of the largest technical institutions of higher education and the first technological institute in Russia, graduating more than 60,000 engineers before the October Revolution.

The close connection of the Technological Institute with production, constant contacts between its workers and students and the workers of Petersburg enterprises were the reason for the fact that the "Tekhnolozhka" became a seat of revolution in the capital of Russia. V. I. Lenin entered the Marxist circle of engineering students in the autumn of 1893. Remembering those years, G. M. Krzhizhanovskiy noted that "the revolutionary center then was very small and consisted mainly of students of the Technological Institute"*. The technologists lead worker's circles, which were then united by V. I. Lenin into the "Union for the Struggle for the Liberation of the Working Class," which was the embryo of the revolutionary Marxist party in Russia. V. I. Lenin and the technologists V. V. Starkov and G. M. Krzhizhanovskiy went into the directing distributing troika of the "Union". On 13 October 1905 the first meeting of the Petersburg Soviet of workers delegates took place at the institute. In commemoration of this event, in 1923 the institute was given the name Petrograd (and subsequently Leningrad) Soviet.

The development of Russian technical thought and the beginning of a national science are closely connected with the Technological Institute. Within its walls worked many chemical scientists who have made a great contribution to world science, including the creator of the periodic table of the elements, D. I. Mendeleyev; the founder of thermochemistry, G. I. Gess; the famous organic chemists A. Ye. Favorskiy, A. E. Porai-Koshits, F. F. Beil'shtein; the physical chemist D. P. Konovalov and many others.

The development of several important chemical industries took place on the basis of scientific discoveries and engineering developments of institute technologists: A. A. Letniy, the author of the pyrolysis of petroleum; I. I. Andreev, the creator of contact oxidation of ammonia; A. A. Yakovin, the founder of the production of aluminum oxide from bauxite. The beginning

* Such was Lenin. Recollections of contemporaries. Moscow, Gospolitizdat, 1965, p. 19.

of the nitrogen industry is closely associated with the names L. F. Fokin and K. F. Pavlov, and the plastic industry with the name S. N. Ushakov. The leading role of S. N. Danilov in the founding and development of the chemical fiber industry is well known. The authors of two methods of producing synthetic rubber, S. V. Lebedev and B. V. Byzov, worked at the Technological Institute. A triumph of Soviet chemistry was the startup in 1932 of the world's first synthetic rubber factory based on the method of S. V. Lebedev. The industrial production of synthetic rubber was mastered later in other countries: in 1937 in Germany and in 1942 in the USA.

The instructors and educators of the institute invested much labor and effort in the organization of new educational institutions (the Kharkov, Tomsk, Krasnoyarsk and Kazakh technological institutes, the Petersburg, Kiev, Donsk, and the first in Europe womens Petersburg polytechnical institutes, Taskent University and others), the largest scientific establishments in the country (the State Institute for Applied Chemistry, the Scientific Research Institute for Polymerized Plastics, the Institute of High Pressures, the All-Union Scientific Research Institutes for Synthetic Rubbers and Petrochemicals, the Scientific Research Institute for Lacquers and Paints and others), design organizations (Giprokhim [State Union Institute for Design of Factories for Fundamental Chemical Industry], Giproazotmash [State Institute for Design of Nitrogen Machinery Construction], Lengiprogaz [Leningrad State Institute for Design of Gas Pipelines and Gas Industry Enterprises], the State Institute for Mineral Pigments, the Leningrad branch of NIIKhIMMASh [All-Union Scientific Research and Construction Institute for Chemical Machinery Construction], Rezinoproyekt [State Institute for Design of Resin Industry Enterprises], Giprosteklo [State Union Institute for Design of Glass Industry Enterprises], Giprotsement [All-Union State Design and Scientific Research Institute for Cement Industry] and others. On the basis of some specialties of the institute, independent technological institutes were formed for the cellulose-paper industry, the food industry (subsequently moved to Voronezh), the refrigeration industry, textiles and light industry.

The Leningrad Technological Institute itself developed during the years of the Soviet regime as a chemical-technological institution of higher education, graduating chemical engineers and mechanics for the chemical and related branches of industry. The LTI imeni Lensovet has graduated in excess of 36,000 engineers, more than 3,000 candidates and 400 doctors of science during the Soviet regime. Now the institute graduates every year more than 1100 engineers in 30 specialities; in the departments of higher qualification more than 600 specialists perfect their knowledge every year.

More than 1800 pupils of the institute have assumed directing responsibilities. The following persons finished or defended their dissertations at the LTI imeni Lensovet: the former president of the State Committee on Inventions and Discoveries of the USSR Council of Ministers Yu. Ye. Maksarev, the chief of the Main Administration of the Microbiological Industry for the USSR Council of Ministers V. D. Belyayev, Deputy Minister of the Chemical Industry S. V. Golubkov, Deputy Minister of the Ministry of Machine Building V. N. Rayevskiy, the general director of the Leningrad industrial association

"Pigment" Ye. M. Surzhenko, the director of the Novomoskovsk industrial association "Azot" A. A. Zuyev, the director of the Gomel chemical factory V. V. Babkin, the director of the Leningrad layered plastics factory B. F. Basilayev, the director of the factory "Krasnyy khimik" I. S. Safonov, the director of the Vinnitsa chemical combine I. P. Khudoley and many other directors of chemical industry establishments. Other pupils of the LTI imeni Lensovet are the director of the State Institute for Applied Chemistry (GIPKh), Lenin Prize laureate B. V. Gidaspov and Heroes of Socialist Labor Ye. A. Sivolodskiy, S. F. Bulyshev, and V. S. Shpak.

The Leningrad Technological Institute imeni Lensovet has prepared more than 400 engineers and 150 candidates and doctors of science for the socialist and developing countries. Many of them have become great scientists and leading specialists in their own countries. Thus, for example, LTI pupils Professor Ernst-Otto Reger, Dietrich Balzer and Klaus Hartman are department heads at higher educational institutions in the German Democratic Republic. Professor Jan Vosolsobe is a dean of the faculty and department head at the Prague Chemical-Technological Institute; Professor Yaroslav Kallal is deputy director of the scientific research institute in Prague. Ryszard Matejski heads a department at the Krakow Polytechnical Institute. Departments in the Budapest Technological University are headed by member-correspondent of the Hungarian Academy of Sciences Gyula Haroy and Dr. Peter Feldes. Professor Elec Szabo represents the Hungarian Peoples Republic in the international Agency at the UN, and Dr Jeno Nemeth heads a laboratory in the Institute of Chemical Technology of the Hungarian Academy of Sciences. Many pupils of the institute have assumed leading responsibilities in Bulgaria, including Dobre Dobrev, Nikola Dochev, Lyudmil Nikolov, Strakhil Khristov, Ivan Ivanov. All of them maintain a constant creative connection with the scientists of LTI imeni Lensovet.

Today the Leningrad Technological Institute imeni Lensovet is preparing engineers of many types, dedicated to creating highly effective new processes, conducting automated design of enterprises and controlling modern large-scale electrotechnological factories. The Ministry of Higher and Secondary Specialized Education of the RSFSR has adopted a detailed decision on the future development of the institute as a technical university.

Now there are more than 3700 persons working at the institute, including 119 doctors and 777 candidates of science. The institute performs a great volume of scientific research, with complex solutions to the most important problems characteristically being obtained with the participation of several departments (chemical, chemical-technological, mechanical and economic) and wide application of the methods of instrumental research and computer science. Engineering solutions, production tests and industrial introduction of fundamental and applied research are conducted in creative concord with branch institutes and industrial enterprises.

LTI is bound in fruitful creative cooperation with many scientific research institutes and enterprises of Minkhimprom [Ministry of Chemical Industry], including the Scientific Research Institute of Insectofungicides and Fertilizers imeni Ya. V. Samoylov (NIUIF), the State Institute of Nitrogen Industry (GIAP), the Scientific Research Physical Chemical Institute imeni L. Ya. Karpov (NIFKhI), the Ural Scientific Research Institute of Chemistry (UNIKhIM), the Scientific Research Institute of Organic Intermediates and Dyes (NIOPIK), production associations and factories in Voskresenske, Gomel, Chardzhou, Maardu, Kingisepp, Vinnitsa, Novomoskovsk, Novgorod, Dneprodzerzhinsk, Chirchik and other cities. LTI has especially close contacts with Leningrad institutes and enterprises: LenNIIGiprokhim [Leningrad State Scientific Research and Design Institute of Fundamental Chemical Industry], GIPKh [State Order of the Red Banner of Labor Institute of Applied Chemistry], the scientific-production associations "Plastpolimer" and "Pigment", the factories "Krasnyy khimik", layered plastics, imeni Komsomol'skaya pravda.

The themes and methods of the scientific research of the great creative collective LTI are many and varied. In a short article it is only possible to give separate examples of the developments made at the initiative and with the participation of the workers of the institute.

Under the direction of professors M. Ye. Pozin, R. Yu. Zinyuk and B. A. Kopylev at the LTI imeni Lensovet, effective methods of producing mineral fertilizers have been developed and introduced into production, a significant contribution to the development of the phosphor industry. The process of producing concentrated phosphoric acid by extraction in the hemihydrate regime was created here, giving impetus to the introduction and development of new variants of the process and the further develonment by many enterprises of this effective method. A study of the process of producing phosphates of calcium permitted intensification of production of double superphosphate and several other fertilizers. The problem of producing feed phosphates and pure technical phosphate salts from extraction phosphoric acid was solved, obtaining products not inferior in quality to those obtained from thermic acid. The theoretical basics and efficient methods were worked out for the development in our country of the production of mineral fertilizers by nitric acid decomposition of phosphates. Especially deserving of mention is the work of LTI directed toward the use of low-enrichment (for example Karatauskiy) and low-grade natural phosphates. Methods were proposed that allowed high quality fertilizers to be obtained from them, making it possible to considerably widen the raw-material base of the fertilizer industry.

Research in the area of mineral fertilizer technology have great significance for the future development of that branch. Especially important are the recently undertaken studies on making mineral fertilizers with regulated solubility, working in synchrony with the vegetative rythm of the plants. All of this work brings LTI into close contact with branch institutes and enterprises of Minkhimprom.

The head of the department of electrothermics, Professor V. A. Yershov, proposed methods of modeling the processes taking place in ore ovens on the basis of studies of the reaction space in the ovens.

The results obtained have been used in mastering high power oven units in phosphor production at Minkhimprom enterprises. This allowed the raw-material base of the phosphor industry to be considerably widened.

An example of the fruitful creative concord of the workers at the institute with chemical industry enterprises is the joint work of the branch laboratory of Minkhimprom at the department of catalyst technology with NIUIF, GIAP, LenNIIGIprokhim, UNIKhIM and many chemical factories. The workers of this department, lead by professors I. P. Mukhlenov and Ye. I. Dobkina, synthesized several effective catalysts after Minkhimprom factories had worked at the technology of obtaining them. In Voskresensk construction is being completed on the catalyst workshop KS [expansion unknown], designed by LenNIIGIprokhim according to original data given by the department of catalysts and Voskresensk chemists. In Novgorod an experimental trial is underway for a catalyst of methanol synthesis developed at the Novomoskovsk branch of GIAP jointly with Professor V. M. Pomerantsev of the department of catalysts and his colleagues. In Novomoskovsk a non-platinum catalyst for oxidation of ammonia made by workers of the department cooperating with workers of a branch of MKhTI [Moscow Order of Lenin and Order of the Red Banner of Labor Chemical-Technological Institute imeni D. I. Mendeleyev] and association has already been in use for several years. The SKTB [Special Construction-Technological Bureau] of catalysts worked out the technical conditions and technological regulations for the production of four catalysts synthesized under the direction of Professor A. Ya. Averbukh and candidate of technical science G. N. Buzanova. Trial batches of catalysts have been made, and experimental apparatus for their use is being constructed at factories. Brial baches of various types of vanadium catalysts synthesized in the department have undergone successful tests at the factory "Krasnyy khimik" and several other enterprises.

The branch laboratory of Minkhimprom at the department of catalysts is a pioneer in catalysis in a fluidized bed in the Soviet Union. Senior scientific worker of the laboratory A. T. Bartov and Professor M. F. Mikhalev jointly with workers of NIUIF and several other organizations worked out several constructions of contact apparatus with a fluidized bed for the treatment of both clean and dusty gases.

At the initiative of lecturer V. Ye. Soroko and engineers of the Maardu chemical factory, the first experimental installation for a waste-free process of producing sulfuric acid was assembled and tested. On the basis of this work NIUIF, Giprokhim and several other organizations developed jointly with LTI a principally new method of producing sulfuric acid in a fluidized bed of gas or liquid.

New constructions of valuable apparatus with a fluidized bed of liquid, made under the direction of professors E. Ya. Tarat and I. P. Mukhlenov, are being used successfully at many Minkhimprom enterprises and are playing an important role in cleaning the air basin of harmful wastes.

At the department of processes and apparatus of chemical industry under the direction of member-correspondent of the USSR Academy of Sciences Professor P. G. Romankov, new original methods have been worked out for drying various materials; high intensity technological processes of adsorption, desorption, extraction, division in separators, mixing, etc. have been developed. Much of the work of the department has been introduced into industry. At the "Beloruskally" combine, for example, the fluidized bed drying installations have been reconstructed. High productivity dryers have been introduced at the Maardu chemical combine, in the paint and varnish and aniline dye industry. In industrial trials a new absorber with a microspherical absorbent demonstrated high effectiveness and has been adopted for introduction.

The workers of the institute have developed a direct method of ion exchange extraction of iodine from natural iodine containing waters in an apparatus with a circulating layer of ionite. In this case a high degree of iodine extraction (90%) and the possibility of realizing a filterless process for extracting iodine from any iodine containing raw material are attained. Three factories are being designed according to the new method by the design administrations of GIPKh and its Permsk branch.

At the department of chemical technology of plastics, headed by Professor A. F. Nikolayev, fundamental and applied research is underway on the synthesis of water-soluble polymers, and also polystyrene and polyvinyl acetate. New catalytic systems have been chosen which are complexes of compounds of metals with variable valency (Mn, Co, Ni, Fe and others). The use of such catalysts allows a considerable intensification of the processes of polymerization and copolymerization of vinyl monomers. Research on epoxide-phenol compositions concluded with the introduction into industry of a series of materials: epoxide-novolac bonding agents for production of foiled fabric glass laminate at the Leningrad factory of layered plastics, a powdered semiproduct for foaming at the Gorlovka production association "Stirol", an epoxide-novolac block copolymer at the Orekhovo Zuyevo factory "Karbolit". Plastic foams, produced from powders by an original technology, have been introduced at more than 40 factories of twelve ministries in the capacity of sealants, heat and sound insulating materials, floats and other uses. The department does part of its research jointly with the Leningrad NPO [scientific production department] "Pigment". The Okhtinsk NPO "Plastpolimer" has mastered the experimental production of a film thermoreactive adhesive BEN, whose introduction into industry will considerably raise the productivity of labor, the reliability and lifetime of products and produce a great economic effect. In just the period from 1971 to 1977 the department has received 100 author's certificates, a portion of which have already been realized in industry.

Under the direction of professors A. D. Yakovlev and I. S. Okhrimenko at the department of chemical technology of organic coatings, organodispersive and powered dyes based on thermoplastic polymers have been developed and then introduced into industry.

A great contribution to the development of chemical industry and chemical machinery building is being made by the workers of the engineering-cybernetics department, who are conducting scientific work jointly with other departments. Thus, the departments of modeling chemical-technological processes and automated systems of process control in cooperation with the department of catalyst technology have developed mathematical models of individual processes in chemical-technological systems. In particular, work is being done on the application of computers for optimizing the technological regime of sulfuric acid systems at the Cherepovets chemical factory.

Professor V. N. Sokolov and lecturer I. A. Domanskiy have applied a semi-empirical theory of turbulent transfer to the design of chemical apparatus, allowing a theoretically based description of heat and mass transfer phenomena in apparatus with complicated hydrodynamic properties, such as for example bubbling chemical reactors or rotor film apparatus. The new approach to analyzing the operation of chemical apparatus has accelerated its introduction into industry.

The construction of bubbling extractors for the double extraction of caprolactam, assembled in one of the shops of the Grodnensk production association "Azot", is interesting. Due to the use of the principle of pneumatic dispersion of liquids by inert gases, the operating reliability of such apparatus is being raised substantially. Similar extractors can be used successfully in other chemical productions also.

The economic effect of the introduced scientific developments of the institute's workers is 15 million rubles per year. However, some promising work of the LTI scientists has not yet found application in the chemical industry.

"The introduction of new scientific ideas into production," said Comrade L. I. Brezhnev at the 25th session of the party, "is today a question no less important than their development." The systematic development of science and the organization of introduction of its results are provided for in the new Constitution of the USSR as an integral part of the function of the Soviet government. The problem of introduction lies at the meeting point of two areas of human activity: science and production. And one of the routes to its solution is found in this very junction.

The immediate task of the scientists of LTI imeni Lensovet and the directors of the branch institutes and production associations of Minkhimprom is the intensification of joint work on the creation and introduction of new effective production methods for high quality fertilizers, catalysts, sorbents, plastics, dyes and paint materials. The union associations of the Ministry of Chemical Industry should make fuller use of the creative energy of the institute's scientists, drawing them into the solution of the problems of technical progress by concluding economic agreements or in the course of creative concord. It is necessary to encourage in every way possible the opening of the basic laboratories and experimental stands of the institute to Minkhimprom enterprises. The joint work of the qualified workers of the institute and the workers of the enterprises, undoubtedly, will lead to the most rapid realization of developments and, what is no less important, will stimulate the creative initiative and energy of the production workers.

It is necessary to regulate the joint use of the unique and scarce research equipment and instruments available at the institute and at Minkhimprom enterprises. The enterprises have the right and should in the essence of creative concord give to the institute on an equal basis in the course of technical help the necessary machines and apparatus, as long as this does not damage the productive activity of the enterprise.

Minkhimprom enterprises must, in greater numbers than before, direct to the institute the best young production workers into the preparatory division (rabfak) and in the capacity of student-directors of industrial enterprises. The departments of the institute and the enterprises of the ministry must intensify the joint leadership of young engineer graduates in the period of their probation at the enterprises. The best engineers, showing themselves the most creative workers, should be directed into specialized post-graduate study at the institute. Another effective form of creative contacts is the mutual probation of LTI instructors at ministry enterprises and workers of the scientific research institutes and factories in the scientific research laboratories of the institute.

Of great significance for the ministry enterprises is the organization at LTI imeni Lensovet of a department of higher qualification of engineers which would not only attract qualified teachers, but would also use the laboratories of LTI, equipped with modern equipment and instruments, and also the powerful computing center, which the Institute of higher qualification of Minkhimprom does not have.

It is well known that practical production experience is a necessary part of the preparation of an engineer, a most important form of technical perfection and ideological education. Therefore, heightened attention should be paid by the leaders of both the ministry enterprises and the institute to the production practical experience of the students.

Congratulating the collective of many thousands of students, teachers, scientific colleagues and workers of the Leningrad Technological Institute imeni Lensovet on its glorious 150th jubilee, I want to wish it future development, creative successes and strengthened fruitful concord with industrial enterprises.

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CSO: 1821

CHEMICAL INDUSTRY AND RELATED EQUIPMENT

UDC 66 (574)

DEVELOPMENT AND LOCATION OF CHEMICAL INDUSTRY IN KAZAKH SSR

Moscow KHIMICHESKAYA PROMYSHLENNOST' in Russian No 1, 1979 pp 54-57

[Article by D. A. Volkov]

[Text] The constant growth in scale of chemical production requires a thorough study of the various natural and economic peculiarities of the national republics and large economic regions of the USSR with the goal of rational and effective placement of the chemical industry. Deserving special attention is the development and location of chemical industry in the eastern regions of the country, in particular in Kazakhstan. These regions possess enormous resources of the necessary mineral raw materials and fuel, and sources for production of cheap electrical energy.

Chemical industry is a comparatively young branch of the Kazakhstan economy. Although its first enterprises, very small in comparison with modern scales of production, were started at the end of the 1920's and beginning of the 1930's, the extensive development of this branch began only after the Second World War, in the 1950's. During the next 15 to 20 years a large and many-branched chemical industry took shape in the republic, supported by the resources of various chemical raw material deposits found here: first of all the phosporites of the Karatau basin, and also the mineral salts, barites, chromites, quartzites, carbonate and sulfur containing ores, etc. The use of local and imported hydrocarbon raw material -- petroleum, natural and by-product gases and products processed from them -- is taking on greater significance. The presence of enormous sources of cheap energetic coal and the possibility of obtaining a large amount of electrical energy both from utilization of the coal and by bringing in electrical energy from elsewhere (from neighboring Central Asia) facilitates the creation here of large fuel and power consuming chemical industries. A characteristic of the chemical industry of Kazakhstan is the concentration of a whole series of its industries (sulfuric acid, several types of mineral fertilizers, products of organic synthesis, etc.) at enterprises of non-chemical branches -- non-ferrous and ferrous metallurgy and others, which is connected with the complex use of the raw materials that they require and the utilization of the wastes of basic production.

The chemical and petrochemical industry of Kazakhstan during the last decade (1966-1975) has developed at rates outstripping the national average. The gross output of chemical enterprises of the branch during this period increased by more than a factor of 4.1 nationally, and by a factor of almost 4.5 in Kazakhstan. In just the years of the ninth five-year plan the output of production of chemical industry in the Kazakh SSR increased by a factor of 1.9, while the industrial production as a whole grew by a factor of 1.4 [1]. The role and significance of the republic in national chemical production, in the cost of basic industrial production stocks of the branch, in the number of personnel employed in it have increased noticeably. As a result of the growth in production of several energy consuming types of production, Kazakhstan occupied first place among the large economic regions of the country in terms of its proportion of the total electrical energy consumption by chemical industry in the USSR.

The chemical industry is beginning to play a more and more important role in the national economy of the republics: its proportion in 1975 was about 4.2% of the total cost of industrial production. In terms of the volume of capital outlays alloted to its development, it occupies one of the leading positions alongside such branches as non-ferrous and ferrous metallurgy, electrical energy and branches of the fuel industry. In just the years of the ninth five-year plan about a billion Rubles were invested in the development of chemical industry [1].

The most significant growth of production is seen in the leading branches of the chemical industry -- mining and fundamental chemistry, especially in the output of phosphate raw materials and manufacture of mineral fertilizers. More than 3/4 of the total cost of commodity chemical production goes to these branches. They basically determine the modern specialization of Kazakhstan chemical industry in the country. In 1975 about 90% of the yellow phosphorus, 60% of the feed phosphates, 30% of the phosphate raw materials, more than 40% of the calcium carbide and chromium salts, one-sixth of the phosphor fertilizers, approximately 1/10 of the sulfuric acid, etc. were produced and manufactured here for the nation [1]. During the ninth five-year plan the "Karatau" production association turned into a leading phosphate raw material producing enterprise in the country, second only to the production association "Apatit" in scale of production. The output of phosphorites increased by a factor of 3.3 and reached more than 10 million tons per year [2,3]. In the attainment of such considerable growth the large scale opening up of the Dzhanatas deposit had great significance: its open-pit mines became the main supplier of phosphate raw material. The growth in mining of phosphorites permitted increasing the output of yellow phosphorus at the factories in Chimkent and Dzhambul.

Sulfuric acid production has been increased both by expanding the output of the existing chemical industry enterprises in Aktyubinsk and Dzhambul and by the startup of new sulfuric acid plants at enterprises of non-chemical branches in Dzhezkasgan, Balkhash and several other cities. The manufacturing of sulfuric acid in the republic grew during these years by more than a factor of 1.4: from 1,229,000 tons in 1970 to 1,732,000 tons in 1975 [4].

Due to the considerable development of the raw material and semi-product base, the production of mineral fertilizers has increased sharply. In 1975 it was more than 5.8 million tons (in comparison units) and 2.9 times greater than by the beginning of the five-year plan [4]. Kazakhstan went to the forefront of the country in the development of this branch, becoming one of the largest producers of phosphorus fertilizers (the output grew by almost a factor of 10 from 1961 to 1975). A considerable increase in the scale of manufacturing of yellow phosphorus allowed an expansion of not only the output of phosphorus and compound fertilizers, but also of such products as sodium tripolyphosphate (a raw material for the production of synthetic detergents), phosphorus salts, etc.

During the ninth five-year plan in Kazakhstan the production of feed phosphates, chromium salts, was increased; output of caustic soda and several other chloroproducts got underway.

Considerable strides were made also in the development of the organic chemical branches. At the metallurgical factory in Temirtau the production of coking byproducts is growing; at the Karagandinsk factory SK -- production based on the use of calcium carbide and carbide acetylene. The production of synthetic resins and plastics at the Gur'yevsk chemical factory and chemical fiber at the factory in Kustanay increased. Output of synthetic detergents, fiberglass products and everyday chemical commodities has been organized. In Sarani (Karagandinskaya Oblast') a resin products factory has come on line. At the same time it should be emphasized that the volume and range of production of the organic chemical branches are still not large. Especially weakly developed are the branches of organic synthesis and polymer chemistry, which is a distinguishing feature of the structure of chemical industry in Kazakhstan. This is caused by the insufficient development of production by treatment of petroleum and byproduct gases, and consequently of the semi-products of organic synthesis production.

A fairly wide dispersal of the factories is characteristic of the contemporary placement of chemical industry in the republic. At present there are chemical enterprises and factories (a total of more than fifty) at 37 locations in Kazakhstan, located in all five of its large subregions: the Western, Southern, Northern, Central and Eastern. Together with this the high concentration of chemical industry in the south of the republic should be noted. In recent years the main volume of new construction, and also reconstruction and expansion of existing enterprises of the branch, has been in the Southern subregion. Here one of the largest territorial-production complexes in Kazakhstan has taken shape: the Dzhambul-Karatauskiy, whose specialty is the mining and treatment of phosphate raw material. Closely connected with this complex are the chemical enterprises of the Chimkent industrial center. The main part of the chemical production in the republic takes place now in Chimkent, Dzhambul and Karatau. In the ninth five-year plan the role and significance in the branch of the Central subregion (Karagandinskaya and Dzezkazganskaya oblasts) has considerably increased, the chemical industry developing in close connection with ferrous and non-ferrous metallurgy, and also using local resources of carbonate raw material. Large chemical production centers have formed here: Temirtau, Saran', Balkhash and Dzhezkasgan. In the Western subregion, on the basis of the use of local mineral and petroleum-gas raw material resources, chemical industry centers have also arisen, such as Aktyubinsk, Agla, Gur'yev and others. The Northern and Eastern subregions are considerably behind the first two subregions in the level of development of the branch, which is due to absence up to recent times of the necessary conditions and prerequisites for this. However, in recent years the situation has begun to change in connection with the opening up of local resources of mineral raw material, the expansion of complex use of other mineral riches and the considerable strengthening of the fuel and power base. Chemical enterprises and factories have located in Kustanay, Ust'-Kamenogorsk, Leninogorsk and other cities.

In determining the outlook for future development of chemical industry in Kazakhstan, many factors must be taken into account. As was mentioned above, the advantageous factors include the presence in the republic of large and various chemical raw material resources, and also cheap fuel (and in recent years cheap electrical power using the coals of Ekibastuz) in combination with advantageous conditions for utilizing them.

The economy of Kazakhstan displays a constant, always growing demand on chemical production. Especially great is the need of agriculture for mineral fertilizers. According to some calculations, in order to satisfy the entire demand of the republic's agriculture for mineral fertilizers, not less than 15 - 20 million tons per year must be produced (the present level of use is about 3 million tons) [4]. The demand for synthetic and polymer materials (plastics, chemical fiber, production of the resin-asbestos industry, etc.) is growing rapidly.

The convenient transport and geographical situation of Kazakhstan facilitates the export of surplus production to the neighboring regions of Povolzh'ye, Ural, Western Siberia and Central Asia and the import of lacking raw materials and prepared chemicals.

A stimulant for the future development of chemistry is the rapidly growing economic potential of the Kazakh SSR, its many-faceted economy, playing the roles of not only an enormous consumer, but also a supplier of chemical raw material and ready production.

Another propitious factor is the presence in several regions of the republic of sufficient resources of labor, large construction organizations, fairly good transportation facilities in the northern and southern regions, the presence of areas for construction, and also barren closed basins for the disposal of harmful industrial wastes, etc.

At the same time the existence and effect of factors holding back the development of chemical industry must be taken into account. In the first place there is the strained balance of water resources and their uneven distribution over the territory of the republic. The choice of locations, and also the scales of development of water-consuming industries are limited. The zonal surcharge coefficients for construction and assembly work and wages effective in some regions of the Kazakh SSR, due to the higher cost of living and the more rigorous conditions for labor and construction as compared with the central-European regions of the country, will worsen the technical-economic indicators of production for several capital- and labor-intensive chemical products.

Studies conducted during the last few years have shown that Kazakhstan is one of the regions of the country in which in perspective the production of a comparatively wide circle of chemical products is economically advantageous. Thus, in the production of a series of chemicals the republic can specialize on the national scale, since the export of a considerable portion of such products from here to many large economic regions will be more efficient than producing them at the places of consumption.

At the same time, in determining the prospects for the development of chemical industry in Kazakhstan and, in particular, in determining the scales of manufacturing and the assortment of chemical products, a very careful and complete consideration of the specific character of the republic and its separate large subregions from the point of view of the possibility of obtaining water, energy, labor resources and construction bases for the chemical industries created is required.

The current five-year plan is a new, qualitatively important stage in the development of chemical industry in Kazakhstan. Some figures will give an idea of the large scope of work done here. 2.5 billion rubles have been allocated to the development of the branch, 2.7 times more than in the last five-year plan. The volume of production output should increase by a factor of 2.4 [1].

As in the previous five-year plan, considerable attention is paid to the development of the chemical mining industry, which has great significance both from the point of view of supplying the continuously growing demand of the economies of the republic and the country as a whole for a series of products obtained from the chemical mining of raw material in Kazakhstan and from the point of view of an efficient approach to the utilization of labor and especially water resources. Chemical mining industries make relatively low demands on labor and need practically no water for production purposes.

As before, the mining of phosphorites will occupy a leading place in the chemical mining industry. The growing demands of the national economy for phosphorus fertilizers, phosphorus and its salts dictate the necessity of a considerable increase in the mining of phosphate raw material in the Karatau basin and the beginning of exploitation of the Atyubinsk phosphorites. In the five-year plan about 1 billion rubles of capital outlays have been allocated to the future development of existing mines (first of all in Zhanatas) and the opening up of new deposits in the Karatau basin, 1.5 times greater than in the eighth and ninth five-year plans [5]. Annual output of 20 million tons of phosphorite ore and 13 million tons of commercial ["fossyr'ye" —

meaning unknown] will be implemented. Three new mines are slated for exploitation at the newly opened deposits of Kokdzhon, T'yesay and Koksu [5]. The capacities of the crusher-grader and crusher-grinder factories, the siliceous flux factories and other important objects are growing.

Calculations show the advisability of bringing the scale of annual phosphorite mining in Karatau up to 40 million tons and greater. The ore reserves in the basin (in excess of 1.5 billion tons) can supply such a high level for several decades [1].

Special attention is being given to the efficient and complex use of phosphate raw material. The introduction in the tenth five-year plan of the Novo-Dzhambulskiy phosphorus factory will make it possible to start treating the fine ore that has not yet found use and goes into the tailings. Also proposed is wider use of the relatively low-grade ores (with phosphorus anhydride content up to 24%), which make up about a third of the reserves of the basin. Both chemical (sulfuric acid) and electrothermal treatment of the phosphate raw material will receive development.

Wide exploitation of the new phosphate raw material centers of the country will be started: the Aktyubinsk basin with reserves exceeding 1 billion tons, in particular the Chilikaysk deposit. By the end of the five-year a mine and a separating factory will be built here. The output of phosphorite concentrate is projected to reach 950 thousand tons per year with the prospect of considerable increases in production in the period of the eleventh five-year plan [6].

The growth of production of yellow phosphorus and phosphorite concentrate from the ores of the Karatau and Aktyubinsk basins, and also the expansion of the use of local and central Asian natural gas, will create a real basis for future increases in the output of mineral fertilizers. Their production will increase during the five-year by a factor of 1.3 [7]. The production increase is projected to be mainly due to expansion of the existing enterprises in Dzhambul and Aktyubinsk. Construction of the Karatauskiy chemical factory, which will specialize in the production of ammophos, is underway. In the structure of manufactured fertilizers phosphorus fertilizers will, as previously, predominate (more than 3/4 of the total output). In the production of phosphorus fertilizers Kazakhstan is in fourth place among the large economic regions of the country and first place in the group of eastern regions. Mineral fertilizers will be produced mainly in the form of compound and highly concentrated phosphorus fertilizers: ammophos, nitrophos, double superphosphate, and subsequently nitroammophoska, ammonium polyphosphate and others [8].

In the present five-year a significant step forward will be made in the development of the organic chemistry branch. First to come on line will be a plastics factory specializing in the production of polystyrene. As raw material for this enterprise, the production of a Kazakh gas treatment factory is to be used. The country's first factory for polyvinyl chloride textile staple is to be started in Kustanay. This will double the production of chemical fibers in the republic [9]. At the resin products factory in Saran' expansion of the catalog and production volume of resin products is foreseen. In Chimkent a large resin-asbestos combine is being built, whose first units -- the carbon-black and tire factories -- will come on line at the end of this five-year [10]. Further development of the organic chemistry branches will be closely connected with the construction of petroleum processing factories in Pavlodar and Chimkent, the expansion of the Gur'yev petroleum processing factory and the capacity for treatment of byproduct gases on the Mangyshlak peninsula, to be accomplished soon. The startup or expansion of capacity of these enterprises, and also units of the chlorine industry, coking byproducts and other branches will allow the output of semi-products and products of organic synthesis, and also polymer materials, to be sharply increased.

It can be expected that the branches of polymer chemistry will occupy a leading position in the chemical industry of Kazakhstan. In addition, considering the limited possibilities for the territorial location of these, as a rule, water consuming branches, a careful choice of regions and points of location of their enterprises is required with obligatory coordination of the long-term development in these areas of other branches of the economy. It is crucially important to establish in these enterprises the most efficient structures and volumes of production so that they will be in balance with the water economies of their locations.

Among the problems connected with the necessity of improving the branch and territorial structure of chemical industry in Kazakhstan and on whose solution it is necessary to concentrate efforts in the near future, several of the most urgent ones should be mentioned. In particular, the pressing need for constructing a specialized varnish and paint factory in the republic has become imminent. The importation of varnishes and paints in considerable quantity and wide assortment from distant, mostly European regions of the country is economically inefficient and leads to increased production costs for the consumers. The republic has the necessary raw material resources in the form of semi-products and products of coking and petrochemistry, etc. for the creation of this enterprise. Analogous conditions apply in relation to the organization of soda production. The demand of the Kazakhstan economy for carbonate of soda is growing very fast and has for a long time not been fully satisfied. Besides, calculations have confirmed the economic advisability of constructing a soda factory in the Inder region, which is well supplied with raw material, water, energy sources and (what is especially important from the point of view of protecting the environment) prepossessing conditions for the evacuation of industrial wastes.

In planning the future construction of new factories in the mineral fertilizer industry it is necessary to pay attention to improving their territorial location, in particular in the development of this branch in the northern regions of the republic. As raw material here the natural gas of Western Siberia can be used, taking into account the projected export of it in the near future to the Pavlodar, Tselinograd and Karagandy regions.

From the point of view of meeting the demands of the economy and population of the republic for a wide assortment and volume of everyday chemical commodities and plastic products, and also from the point of view of the necessity of efficient use of the labor resources present in the small and medium cities (expecially in some places in Southern and Northern Kazakhstan), it is necessary to direct efforts toward the development of these industries.

The solution of the current and projected problems of the development and location of chemical industry in the Kazakh SSR will put this branch on a new, higher level. It will permit the level of chemization of the economy to be sharply raised, will enable increasing the economic efficiency of production and strengthening of the republic's role in the economy of the country.

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CHEMICAL INDUSTRY AND RELATED EQUIPMENT

BASIC TRENDS OF DEVELOPMENT OF PRODUCTION OF ELASTOMERS AND ITEMS MADE FROM THEM IN THE USSR

Moscow KAUCHUK I REZINA in Russian No 1, 1979 pp 3-7

[Article by V. S. Fedorov, minister of oil processing and petrochemical industry of the USSR]

[Text] In fulfilling resolutions of the Communist Party of the Soviet Union on strengthening the economic potential of our country, Soviet petroleum chemists in the last decade have ensured the accelerated development of the synthetic rubber, tire, and technical rubber article industry.

By making wide use of the socialist system of management, modern achievements of science and technology, results of fundamental and applied research conducted in scientific organizations of the USSR Academy of Sciences and sector institutes; having laid basic emphasis on the reconstruction and expansion of operating enterprises, we have virtually doubled the output of these kinds of production. In recent years some new plants and mills have been put into operation: the Nizhnekamsk petrochemical concern, the Bobruyskshina manufacturing association, the Belotserkov manufacturing association of tires and rubber and asbestos articles, the Balakov, Karaganda, Angren, and Barnaul industrial rubber products plants; and manufacture of polyisoprene was organized at the Nizhnekamsk petrochemical plant.

Guided by resolutions of the November, 1978 plenum of CPSU CC, positions and conclusions contained in the speech of comrade L. I. Brezhnev at the plenum, petroleum workers and petrochemists last year achieved new labor successes by fulfilling annual assignments according to the primary technical and economic indicators and major kinds of production.

Workers of the synthetic rubber industry completed three years of the five-year plan on rubber manufacture ahead of schedule--on 28 December; workers of the technical rubber industry fulfilled three years of the five-year plan on the total volume of production by 21 December. The quality of products was raised. In the tire industry and synthetic rubber industry the relative significance of production with the State Seal of Quality exceeded 50 percent, while in the sector as a whole it constituted 33 percent.

Scientists and specialists of such leading scientific research institudes as All-Union Scientific Research Institute of Synthetic Rubber imeni Lebedev, Order of Lenin Scientific Research Institute of the Tire Industry, Scientific Research Institute of the Rubber Industry, Scientific Research Institute of Rubber and Latex Articles, and others, have made a ponderous contribution to this work.

In our country the largest industry of synthetic rubber in the world has been devised; its foundation was laid 46 years ago by an organization based on domestic developments of industrial production of polybutadiene using the method of Academician Sergey Vasil'yevich Lebedev.

Being an organic part of the oil processing and petrochemical industry, and having at its disposal significant resources of raw materials--products of oil processing and accompanying gases of petroleum extraction--this sector provides the national economy of the country with almost all known types of synthetic rubber.

The distinctive feature of the domestic synthetic rubber industry is the leading development of polyisoprene production. With a general increase of manufacture of synthetic rubbers in the last 10 years roughly equal to its growth in other countries of the world, the volume of production of polyisoprene increased during this period by a factor of 7; and now our country holds first place in the world in the production of this elastomer. In the general volume of production of synthetic rubbers, the percentage of stereoregular rubbers constitutes over 50 percent, and in 1980 it will reach almost 60 percent, and polyisoprene will comprise 40% of the total production.

Technical progress in the synthetic rubber industry at all major stages of its development was mainly linked with achieves of science in polymerizational catalysis and especially in the theory and application of polyisoprene production. Research on chemistry of polyisoprene first showed the possibility of controlling the growth and structure of the macromolecule, and made it possible to establish fundamental patterns in ion-coordinated catalysis, enriching science on polymers as a whole; information on the nature of active centers obtained by the method of nuclear-magnetic resonance first gate our scientists the possibility to propose a mechanism of polymer chain link formation common for all the 1,3-dienes. It is notably on this basis, by perfecting catalystic systems, that we were able in the production of polyisoprene to more than double technological productivity, raise output and stereoregularity of rubber, and improves its molecular composition.

The newly developed polyisoprene consists of 97 to 98 percent cis-1,4 links. Production of SKI-3 (synthetic isoprene rubber) free of the gel fraction has been begun. The "gel-free" highly stereoregular polyisoprene, manufactured today only in the USSR, is essentially a new rubber whose set of properties surpasses the polyisoprenes produced in other countries. It has wonderful technological properties. Increased average molecular weight, lesser polydispersity, high stereoregularity, and as a result, tendency toward orientation under conditions of deformation: these features ensure improved elastic and dynamic properties of the rubbers, as well as their higher strength and fatigue resistance. Good prospects for further improvement of the quality of this elastomer have been revealed by the possibility of controlling not only the stereoregularity but also the regiospecificity of macromolecular structure during the synthesis process. New catalytic systems have been developed which make it possible to synthesize polyisoprenes structured just like natural rubber, exclusively by the "head-tail" principle. Practical realization of the production method for this rubber in industry will be done in the near future.

Having concentrated efforts of the collectives of scientific research organizations in the study of possible further improvement of the quality of synthetic polyisoprene by means of chemical modification, we were able to raise the cohesion strength of rubber mixtures based on it, improve the set of elastoplastic, elastohisteresis, and fatigue characteristics of vulcanized rubbers and produce rubber whose properties surpass those of natural rubber vulcanizates. The results of scientific research completed in recent years provide actual grounds for synthesis of polyisoprene whose set of properties are superior to natural rubber.

The result of many years of research is the forthcoming organization of production of an alternative copolymer of butadiene and propylene: a new elastomer whose distinctive feature is the combination of wonderful elastic properties at low temperatures with high physical and mechanical indicators. This elastomer has better freeze-resistance, resistance to abrasion, and elasticity than polyisoprene; and better resistance to oxidation than stereoregular polybutadiene.

Optimum conditions for synthesis of butyl rubber in a hydrocarbon solvent have been found, ensuring higher technical and economic indicators of this process.

Research has been conducted on creation of new elastomers by means of polymerization with ring opening of low-stress or unstressed cyclic olefins, as well as work on synthesis of various kinds of oligomer rubbers with functional end groups by radical, catalytic and migrational polymerization methods. Production has been organized for oligomer rubbers with adequately broad spectrum of molecular parameters and functional groups. Several sectors of the national economic have already found it economically profitable to use oligodienes due to their valuable set of properties: technological effectiveness, high freeze resistance and elasticity, good dielectric properties and moisture resistance, compatibility with general purpose rubber and standard fillers, high resistance to hydraulic abrasion and cavitation.

The problem of creating elastomers for production of articles which operate at extreme temperatures, pressures, and mechanical loads was resolved by our scientists by means of synthesis of polymers with nonhydrocarbon main chains and short hydrocarbon residues in the framework. Maximum substitution of hydrogen atoms by fluorine in the main chain was also done.

In some compositions based on siloxane rubbers, a special place is occupied by self-adhesive, heat-resistant, electrical insulating materials LETSAR and RETSAR which operate in the temperature range -60 to +300 degrees Celsius. Original methods have recently been found for synthesizing siloxane elastomers with expanded temperature range of freeze and thermal resistance and enhanced oil and gasoline resistance. Rubber made of Lestosil brand is efficient in a temperature range of -80 to +400 degrees Celsius, while rubber items made of Silar rubber can be successfully used at temperatures running from -10 to +300 degrees Celsius.

It is fully understood that the creation of a wide range of elastomers of both general and special purpose is not a goal in itself, but a means of improving quality of rubber--a construction material for a large variety of items, most massive of which are pneumatic tires.

In the tire industry the greatest growth has been achieved by the manufacture of tires for light and heavy vehicles, as well as for tractors and agricultural machinery. The production volume for tires designed for tractors and agricultural machinery in our country has now become comparable with the total output of the countries of Western Europe and the United States of America.

A typical property of the tire industry of the Soviet Union is the high level of concentration and specialization of production. Plant capacities in manufacturing and reprocessing rubber mixtures go as high as 800 tons per day. Enterprises manufacture a comparatively limited variety of tires--about 15 to 20 types of tires.

The main trend in tire production technology was selected by the design of its maximum continuity, and the maximum automated complex lines, virtually to the complete exclusion of manual operations in the process. Tire plants now successfully utilize automated self-justifying flow lines for assembly and vulcanization of inner tubes. In the near future a completely automated vulcanization shop will be put into operation.

As concerns the construction of tires, radial ply tires have become the main interest: polyester cord in the body and steel belts in the breaker. The construction of tires constructed only with steel cord is being assimilated.

Work has been done to create low-profile tires which most fully meet the needs imposed on the cargo-carrying capacity of a vehicle, and to study the properties of synthetic fibers which can replace metal cord as applied to tire construction.

Research in mechanics of tires, both the external road-tire-automobile system and the internal structure is important: establishing a link between the external characteristics of a tire and its design and elaboration of methods of predicting tire properties in the planning stage form the basis for optimum tire design.

A large group of Soviet scientists, as before, are working on the fundamental problem of the composition and properties of rubber. Serious attention is given to improvement of rubber properties and from this standpoint, the study of the properties of boundary layers of polymers in microheterogeneous multicomponential elastomeric matrices, selection of an optimum combination of rubbers for each tire part, creation of effective modifying systems, the search for new fillers and methods of dispersion.

We know that the actual strength of rubber is only 8 to 10 percent of theoretical, and one of the central problems is the substantial increase in strength indicators of rubber by creating a technology of processing rubber of high molecular weight and seeking vulcanizing and stabilizing systems which ensure a minimum degree of destruction of molecular chains during the manufacturing process and use of the rubbers.

An important value for control of production processes and properties of the end items is offered by research on the rheological behavior of rubber mixtures during manufacture and reprocessing, the effect of chemical composition of rubber on various aspects of dynamic behavior.

A distinctive feature of the domestic tire industry is its orientation towards the use of synthetic rubbers in tire rubber formulas; thus the main trend of research in the rubber production technology is the development of general principles of rubber creation based on 100 percent synthetic rubber equivalent to natural rubber or surpassing its technical properties. Making tires out of 100 percent synthetic rubber is a complex problem, which includes development not only of the rubber formula, but also the design of tires and technological methods specific to synthetic rubber.

We can now say that due to the labor of a large team of scientists, engineers, workers of scientific research and planning institutes, enterprises in production of synthetic rubber and tire plants, scientists of the USSR Academy of Sciences, this problem has been successfully resolved. A major role in this was played by organization and intensive development of production of synthetic rubber of stereoregular construction and mainly polyisoprene. The average consumption of natural rubber in tire production was reduced to 7 percent of the total consumption of synthetic and natural rubbers with a simultaneous rise in tire life.

Attention of tire manufacturers throughout the world is fixed on the problem of manufacturing tires from oligomers, since the advantages obtainable by resolving that problem are so great they can justify expenditures for research and test studies. Consequently scientific research and design activity of the staffs of several scientific research organizations has been actuated to devise molded elastomers for the casing and tread of such tires, its constructions, foundations of molding technology, and so forth. Protype tires are being tested.

The development of production of industrial rubber articles has recently been directed not only towards increasing production output, but mainly toward wider incorporation of new, advanced technology; molding under pressure, liquid molding, vulcanization in molten salts, in a fluidized layer of heat-transfer agent, and so forth, as well as the use of new reinforcing materials and elastomers.

More rigid requirements from consumers, however, due to the increased load capacity of mechanisms, power of engines, expanded use of conveyer transport in ferrous and nonferrous metallurgy and mining sectors of industry; assimilation of large deposits of petroleum in western Siberia, present the problem of further improvement of operating indicators of industrial rubber articles. Assimilation of the North is linked with the need for designing industrial rubber items which function at low temperatures.

Based on analysis of modern scientific achievements, it is difficult to anticipate a breakthrough of new elastomers in the next 10 to 15 years applicable to production of general purpose industrial rubber articles. Research in our scientific organization to find interrelationships between composition and structure of elastomers and properties of rubber blends is very important; we must know their heat-, freeze-, and fire-resistance; mechanical and other indicators of rubber; increasing efficiency of industrial rubber goods by modification of rubber during synthesis or reprocessing, even of finished articles. Oligoesteracrylates and liquid rubber have been mentioned as possible modifiers for enhancing efficiency of various belt transmissions, conveyer belts and other items, as well as surface modification with haloids for finished rubber parts of friction assemblies: consequently temperature in the contact zone drops 20 to 30 degrees Celsius, friction is reduced, and wear resistance of some items is 1.5 to 2 times as great.

Work is developing in power technology for the production of rubber blends and items with the aim of improving quality and creating a waste-free process, complete automation of production, rise in labor productivity, and a significant decrease in energy expenditures.

Rubber goods for use in medicine, sanitation and hygiene are particularly important: in recent years their variety has expanded considerably. The complexity of producing these items is due to their specific properties: biological inertness, antithrombogenicity, X-ray contrastiveness, electrical conductivity, and so forth. As a rule, special kinds of siloxane elastomers and butyl rubber, whose production has been organized here, are used in the manufacture of these goods; but this field is still faced with important research in rubber synthesis for combined bioinertness of siloxane and strength of isoprene rubber in order to devise materials and goods designed for prolonged contact with the tissues of living organisms and drugs.

Development of residential construction and transport vehicles has given rise to the need for increased production of foam rubber and has established a link between colloid chemical and technological properties of latexes, study of the film firmation process based on dispersions of high polymers, the search for methods of intensification of technological processes.

In conclusion, let us mention the status of production of rubber and combination footwear. Assimilation of eastern regions of the country, development of mass forms of sports and tourism has engendered the need for increased output of rubber footware to a level of 200 million pairs. In the past this sector has adopted all practices of rubber methods known in the world: pressure molding, liquid molding, plastisol molding; domestic methods of press-fit molding of articles using internal pressure and aerosol coating have been adopted. The use of htese methods required basic research, including the merits of controlling the rheological properties of elastomers using oligomer fixatives, discovery of orientation effects on structure and physical chemistry of vulcanizates. This work was completed by devising multicomponential vulcanizing systems, including synthetic systems of accelerators and their incorporation into production.

Fulfillment of intense planned assignments of 1979 of oil-processing and petrochemical industries will have meaning for the success of our sector in the five-year plan as a whole.

"We must even more completely mobilize the creative efforts of the nation, seek and vitalize new resources of economic growth", indicated comrade L. I. Brezhnev at the November 1978 CPSU CC Plenum, "it is today the primary foundation of activity of all party organizations and all party members".

Workers in our sector have made worthy contribution to problem solutions according to the November 1978 CPSU CC Plenum and in fulfilling assignments of the five-year plan.

Particular attention should be given to increasing efficiency of production, reducing material intensiveness of our production, improving technology and devising waste-free production, increasing selectivity and speed of chemical processes.

It should be emphasized that modern chemical science, including high polymer science, reveals with its latest achievements the inexhaustible resources of increased production efficiency.

The high level of industrial development of the sector, the powerful technical base of the oil-processing and petrochemical industry, formed by the unflagging labor of the Soviet people under the leadership of the Communist Party, the presence of remarkable scientific and industrial cadres, the expansion of creative associations--all ensure favorable conditions for further development in our country of elastomer production and elastomer-based goods in the near and more distant future.

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METALWORKING EQUIPMENT

TECHNOLOGICAL PROGRESS AND PLANNING LABOR IMPLEMENTS STRUCTURE

Moscow VOPROSY EKONOMIKI in Russian, No 2, Mar 79 pp 36-46

[Article by D. Palterovitch: "Technological Progress and Planning the Structure of the Implemments of Labor"]

[Text] With the unfolding of the scientific and technological revolution, there is an increase in the diversity of the implements of labor, new spheres of application are created for them, and there is an increase in the dynamism of the branch, functional, technological, type and size, and age structure of machinery and equipment. Structural changes in the implements of labor appear as a direct form of scientific and technological progress, and the planning and management of the structure of the implements of labor as one of the chief objects of the planning and management of scientific and technological progress.

During the last two to three five-year plans positive changes have occurred in the structure of the production and of the pool of the implements of labor. The share of computers has increased in machine building output. From 1965 through 1977 its production increased by 31 times, while the production of automation devices and equipment increased by 4.1 times. The motor vehicle industry, tractor and agricultural machine building, and a number of other branches of machine building received an accelerated development. Cellulose and paper machine building began to be created. Substantial dimensions were reached by the production of modern power and metallurgical machines of great unit capacity, machine tools with digital programmed controls, and other types of progressive equipment. The rates of automation are being accelerated.[1] In various branches there is a growing production of machinery and equipment for fundamentally new or essentially modernized technological processes: Instead of flame heat methods, electro-thermal, plasma, and lazer methods are being used; instead of the traditional mechanical methods of acting upon a subject of labor, there are now electrophysical, electrochemical, hydraulic, pneumatic, explosion, and other methods.

At the same time, the imperfected structure of the implements of labor has given rise to a sharp differentiation of the equipment levels for labor in the different branches of production (equipment for the non-production sphere and for hoisting and transportation and other auxiliary operations is lagging in its development), to the use of a large mass of manual labor, to insufficiently high growth rates for the production of many types of output, and others. Among the shortcomings in the structure of the implements of labor one has to include the slow growth of the share of fundamentally new equipment and the not always rapid formation and development of the new branches and productions which create this equipment; the decreasing proportion of "young" machine building output which was put into production relatively recently;[2] and the disproportions between interacting or connected types of equipment -- between mobile power equipment and working machinery, between machine tools or other working machinery, on the one hand, and tools, rigging, power sources and their accessories, on the other, between various types of machines which operate simultaneously or sequentially in a single technological flow, between machines with close technological functions, but of different types, sizes, capacities, freight-lifting capacity, and so forth. All of this leads to the incompleteness of mechanization, to an increase in the machinery intensiveness of output in the branches of production, and to a decrease in the efficiency of the reproduction and use of the equipment pool.

The decree of the CC CPSU and Council of Ministers USSR, "On the Further Development of Machine Building in 1978-1980," maps out such important measures in improving the structure of equipment as the mastery of the production of automation machinery, devices, and equipment with a productivity of no less than 1.5 to 2 times greater than the 1975 level, the creation of new types of equipment which ensure a rise in the level of mechanization and automation, an expansion of the production of overall technological lines, of units and installation, and of specialized technological equipment, tools, and rigging, and an acceleration of the construction of new and the reconstruction and reequipping of operating machine building enterprises.

The creation of a planning system and of a management mechanism which guarantee the economy against the emergence of disproportions in the structure of machinery and equipment is of great importance for increasing the effectiveness of the measures which have been planned. This, in our opinion, requires the realization of the following measures. (1) The structure of the implements of labor has to become an independent object of planning. (2) Large branch and functional systems of machinery have to be made the basis for planning the development of the equipment of each branch and of its reequipping. (3) It would

be advisable to concretely develop a number of overall interbranch programs for the reequipping of the economy which embrace the sphere of the creation, production, and use of the implements of labor.
(4) There has to be a substantial increase in the dynamism of the branch and organizational structures of machine building and a guarantee of their rapid adaptation to changes in the technology and needs of production. Let us examine these directions in more detail.

The transformation of the structure of the implements of labor into an independent object of national economic and branch planning is becoming an urgent necessity under the circumstances of the scientific and technological revolution. The planning of structure makes it possible to accomplish tasks which can not be accomplished on the basis of planning growth rates or other indicators. We are not speaking, of course, about doing away with the planning of production growth rates, but about the fact that it is necessary to substantially enrich and improve the methods of the planned direction of the economy.

Putting the planning of the needs and structure of the equipment in the forefront essentially changes the psychology and tactics of planning. Only with structural planning is it possible to avoid disproportions in the level of the technical supplies for various productions, in the correlations between related types of equipment, of traditional and fundamentally new types, and of basic and auxiliary equipment, tools, rigging, and machinery of diverse sizes and capacities. The determination of rational proportions with top-priority planning of structure becomes an essential goal of the plan and a definite guarantee against a lack of balance in it.

One of the basic defects in the existing practice of planning growth rates is, as has repeatedly been noted in the economic literature, planning from what has been achieved. The endeavor of all branches and subbranches to increase or maintain achieved amounts and rates of growth frequently becomes an obstacle to radical structural changes. The necessity for improving the structure of production in the annual and five-year plans is emphasized in the "Methodological Instructions for the Development of State Plans of the Development of the Economy of the USSR." However, this instruction is not always realized in the concrete forms of plans and in the practice of developing them.

The planning of the structure of equipment has to proceed from the fact that the proportions between individual groups or types of means of labor are established on the basis of technological norms or economic criteria and that, in addition, available resources define the dimensions of the production of the entire structural aggregate. In other words, the planning of structure has to exclude the possibility of an annulment (in the event of a shortage of resources for the production of a specific quantity of means of labor which are part of the structural aggregate) of an assignment for the production of a part of the elements of this aggregate and, thereby, the possibility of disturbing the technologically validated proportions in its composition. A decrease touches upon the structural aggregate as a whole while its internal and objectively established proportions which correspond to needs are retained.

It is probably necessary to introduce a number of additional structural tables in the national economic plan a part of which should be filled out at the national economic level, while most of them are filled out at the level of branches -- the equipment producers. For types of equipment which are created by several branches the development of structural proportions should be made the responsibility of the basic ministry, and it should be given the functions of the head ministry for this type of equipment. In addition, the following types or sections of the structure of production and of the implements of labor pool have to be planned.

First, the top planning agencies should plan the branch structure of needs -- the equipment ratios for the reequipping of the various branches of material and non-material production -- and stipulate assignments on increasing the share of equipment for branches with a relatively low equipment level for labor[3] and with a large proportion of obsolete equipment. Clearly, a prerequisite for planning changes in the branch structure of the implements of labor will have to be relative studies of the degree of satisfaction of needs and of equipment levels, the development of norms, and an analysis of the machine intensiveness of the output of different branches.

Secondly, functional structure has to become the object of planning at the national economic and branch level, particularly the relationship between equipment for the basic and auxilliary production processes which has to change in favor of the latter. The planning of functional structure will make if possible to improve (on the basis of technical norms) the proportions between the production of power and working machinery,[4] of basic equipment on the one hand, and of auxilliary equipment, tools, spare parts, and power sources, on the other.

Thirdly, it is necessary to plan technological structure, ensuring progressive changes in the relationships of equipment for connected and interchangeable types of technology. What is meant here by interchangeable (in the wide sense) is not only different equipment which has been designed to perform the same operation, but also machinery for the production of interchangeable types of output; for example, castings and forgings, fabrics and knitwear. By connected equipment we mean machines which operate both in a single technological line in tandem and machines which operate in connected technological processes which, for example, are widespread in construction and in machine building.[5]

Fourthly, the type-size structure has to be planned; that is, the relationship between the various type-sizes and modifications of machines in each technological group in relation to capacity (for example, for electric motors), freight capacity (trucks, railroad cars, drilling units, or cranes), volume (blast furnaces or chemical capacities), the sizes of the products being processed (machine tools), coal productivity (compressors), unit productivity, and other parameters. The planning of type-size structure has to be carried out by the equipment producer branches in agreement with the consumer branches on the basis of an analysis of the use of the technical parameters of machines in their sphere of application. The type-size structure is to a large extent the determining factor in the use of every machine in its sphere of rational application, of the efficiency of the use of various types and models of machines, and frequently even the very possibility of mechanizing different operations.[6]

Fifthly, it is advisable to plan age structure. It can be looked upon in two aspects: (a) the relationships between the various age groups of equipment in the pool the planning of which should ensure bringing the actual service life of equipment into correspondence with the effective (since 1975) service life norms; (b) the relationships between the various age groups of equipment in production (calculated by the number of years since the beginning of production). The chief task here consists in overcoming the above-noted tendency toward a decrease in the share of "younger" groups of equipment and an increase in the share of "older" ones.

Finally, sixthly, it is necessary to plan future changes in the relationships between equipment of diverse technical levels in the various branches of machine building: the share of automatic machines, semi-automatic and automatic lines, equipment for fundamentally new technological processes, units and installations of great unit capacity, high-precision machine tools, special, specialized, aggregate machines, and so forth. The share of the basic types of new equipment has to, in our opinion, be planned both in production and in pool; moreover, not only must the quantity of new equipment be planned, but also its share in production capacities and in the production of output for which the equipment has been designed.

In practice, very often, the various sections of the structure of the implements of labor become objects of preplanning or postplanning calculations. The task, in our opinion, consists in making the entire system of structural sections a mandatory part of the national economic and branch plans. This will make it possible to join up production plans with plans for the realization of the achievements of scientific and technological progress.

The planning of structural proportions is closely connected with a determination of the need for equipment. The need calculations results should be used in establishing the proportions between the various groups and types of equipment, and, at the same time, the planning of group and type proportions is a direct path to the planning of the needs for individual types, type-sizes, and models of machines. Many-sided connections exist between the structure of the equipment which is produced, on the one hand, and the amount of need for it, the degeree of its use, and the level of its economic effectiveness, on the other. The insufficiently rational structure of the implements of labor being used in the economy is substantially increasing the need for equipment, and leading to a lowering of the level of its use and a relative lowering of the branch and national economic effectiveness of machinery and equipment.

The degree of the satisfaction of the need for various types of equipment sometimes differs to the extent of several times. The calculation of equipment needs is a "bottleneck" in the system of economic planning calculations. The branch scientific research institutes frequently calculate only future needs, and, moreover, in a quite enlarged manner, without defining sufficiently refined technological and type-size structures of machines and without a scientific validation of the need for replacement or export. The so-called "requisitioned need," that is, the amount of consumer's requisitions, as is known, differs from real need, since it is determined without regard to reserves for improving the use of the existing pool, is frequently deliberately distorted or is distorted as the result of a lack of the necessary information, and includes not only actual, but also "prestige," or imaginary needs.

Consideration should be given to the experience of the Ministry of Tractor and Agricultural Machine Building which in recent years has been introducing a system of planning needs for agricultural equipment, giving individual production associations and enterprises plans for the satisfaction of the need for concrete machines. The fulfillment of assignments for the satisfaction of needs is becoming one of the most important indicators being used in evaluating the work and, consequently, also in the stimulation of the enterprises and associations of the ministry. The experience of the Ministry of Tractor and

Agricultural Machine Building in the field of planning needs deserves, in our view, further improvement and detailization, and also dissemination to other branches.

The practical realization of a special-purpose programmed approach to planning the structure of the production of the implements of labor is only possible on condition that this structure is formed on the basis of the following: (a) progressive branch and functional systems of machines which are developed for the medium- and long-term future; (b) overall programs for the development of individual types of equipment which are called for by machinery systems or subsystems; (c) interbranch special-purpose overall programs for the reequipping of material and non-material production. In addition, the machinery systems define the types, nomenclature and overall nature of the equipment; the programs for the development of individual types of equipment determine the scientific and technological principles, the schedules for the creation, mastery, and replacement of the machinery models (which are a part of the system), the amount of need, and the necessary resources. The reequipment programs which embrace the entire complex of goals and measures which are necessary for the accomplishment of a large interbranch socio-economic task will become the basis for determining the proportions (between the types of equipment necessary for this) and the conditions and schedules of satisfying needs.

Theoretical development work in the field of machinery systems is clearly lagging behind practice. In the literature machinery systems continue frequently to be understood as individual complexes, lines, or installations, and a clear definition and analysis is not given of the hierarchical structure of a branch machinery system which consists of subsystems and complexes and which embraces the entire aggregate of the processes of production and management in a branch, including not only the basic processes, but also auxiliary ones.

An analysis has shown the advisability of developing both branch and functional machinery systems and has made it possible to substantially expand and deepen our ideas about these systems. The possibility and advisability of transforming machinery systems into overall programs for the development of the corresponding types of equipment and of combining their development with scientific research and experimental designing work plans for the creation of equipment, with a determination of the need for overall machines, of the amount of expenditures, and of the effect of their mastery.

In 1977 the "KOMPLEKS" Scientific Production Association of the Ministry of Tractor and Agricultural Machine Building developed a system of machines for the automation and mechanization of loading and unloading and transportation and warehouse work (LUTW).[7] But this functional machinery system was constructed according to the principle of supplying mechanization equipment to the standard technological processes, schemes, and freight flows of the plants of only a single subbranch -- tractor and agricultural machine building -- although many solutions which are in the machinery system which was developed by the "KOMPLEKS" could find an application not only in tractor and agricultural machine building, but also in other branches of machine building.

This would necessitate the coordination of development work which is made difficult by a lack of an agency which is responsible for a single technical policy in machine building, and also by the lack of a branch which concentrates the production of hoisting and transportation equipment and of a scientific and technical center which carries out the direction of the development of equipment and technology for LUTW. The unification of the production of hoisting and transportation equipment which is dispersed among many ministries into a single branch is essential, in our opinion, not only for the development of an interbranch machinery system for LUTW, but also in order to study needs, to determine the rational structure of equipment stipulated by the system, to coordinate the creation, production, and introduction of the equipment, and to pursue a single technical policy in the field of the mechanization of LUTW.

In addition to such equipment of interbranch application as machinery for hoisting and transportation and warehouse operations, engines, devices, and control equipment are among the most important functional machinery systems which have to be developed in the first place. In developing branch machinery systems the above equipment of general use should be borrowed from functional machinery systems. The combination of a system of machinery with calculation needs, resources calculations, and a plan of measures for the realization of this system turns it into an overall program for the development of a given type of equipment. Along with these kinds of programs, as has already been noted, interbranch overall reequipment programs have to be the basis for the formation of the structure of equipment.

In the light of the numerous and discordant opinions which have been expressed in the literature about the classification, character, and content of special-purpose overall programs (scientific and technical, production-technical, socio-economic, regional, and others), it is important to define the place and character of the above programs in the overall system of special-purpose programmed planning. In summarizing the results of the discussion on an acceleration of scientific and technological progress and on increasing its effectiveness, Corresponding Member of the USSR Academy of Sciences L. Gatovskiy proposed carrying out a gradual transition from scientific and technological programs which are limited to scientific research and experimental designing work and the production of the first series of new equipment to single scientific-production programs which also include series production and the use of this equipment.[8] The programs for the development of individual types of equipment, in our view, can be regarded as a variety of overall special-purpose production and technical programs, since reequipment programs are, at the same time, socio-economic programs.

Each reequipment program has to define a broad (within the limits of the formulated program goal) range of tasks of a technical and organizational character, and, in particular, the creation or expansion of capacities for the production of the equipment stipulated by the machinery system; an improvement in the structure of the equipment pool; a renewal and modernization of the equipment at operating enterprises; and the realization of measures for mechanization and automation, for an economy of resources, for increasing the social and economic effectiveness of equipment, and for creating the organizational conditions for the realization of the program. However, it would not be useful to include scientific research on the creation of fundamentally new types of equipment in the reequipment programs. The schedules and results of such research can not be precisely predicted before-hand. Therefore, they have to be included in the scientific and technical programs, and not in the production-technical and socio-economic programs.

There are sharp differences in the approaches to the composition of the elements of the economy and to the selection of the problems and goals which can be embraced by a single overall program; in other words, to the dimensions of programs. Some writers, for example, Yu. A. Zykov and T. L. Svetlova narrowed the dimensions and goals of the programs, proposing that individual programs be developed for the creation of new equipment, for the introduction into production of finished development work, for raising the technical level of production, and so forth.[9] Interconnected goals are broken up here among different programs. Other writers regard it as advisable to develop large national economic programs which embrace an extremely wide range of diverse problems, for example, planning programs of the type of "The Reequipping of the Economy,"[10] although the problem of reequipping includes such an enormously large number of global and local goals and aspects that an attempt to unite them into a single program is doomed to failure in advance. However, neither narrow nor expanded approaches to the selection of the problems and goals respond to the practical tasks of developing overall programs, particularly, reequipment programs.

The organization of the development of each of the reequipment programs and of the control over their realization should be entrusted to an agency which has been given the necessary authority. The development of programs for reequipping are directly connected with an improvement of the management of scientific and technological progress.

A further development of the production of and of the pool of the implements of labor, an improvement of their structure, and a rise in their efficiency requires, in our view, the development and realization of major overall national economic programs which have to embrace all of the levels of the economic system -- from the economy to the enterprise. The transformation and development of the equipment of production which ensures a substantial increase in its economic and social efficiency is the overall goal of all of the overall technical and economic programs. At the same time, every reequipment program has its own special direction. Among these programs, we have the following.

An Overall Mechanization Program.

It has to provide for supplying machinery and mechanisms to the basic part of the work which is performed manually. For a substantial (1.5-2 times) decrease in the share of workers engaged in manual labor, for the elimination of heavy and harmful labor, for an increase in the continuousness of production on the basis of overall supplies of machinery, mechanisms, and mechanized tools for basic and auxiliary operations, and for the creation of new and an expansion of production of existing machinery, mechanisms, tools, and rigging. Simultaneously with the preparation of this program, it is necessary to begin the development of mechanization level norms for the various types of operations. Technical plans and the actual achievements of the most advanced productions of each branch could be put at the basis of these norms. With these norms available, the object of planning should become the mechanization level indicator, including a decrease in the share of people employed in manual and, especially, hard manual labor. This will be a powerful impulse to accelerating the process of mechanization.

A Production And Management Automation Program.

It covers the wide introduction of automated management systems, the fullest automation of the basic technological processes in mass and large-series productions, equiping series, and small-series productions with automatic equipment with digital programmed controls, the extensive introduction of industrial robots, and a substantial expansion of the production of automatic equipment, computers, devices, and other automation equipment. It is important to provide in the automation program not only for an increase in production, an expansion of the automated equipment pool, and a substantial increase in the share of the output produced at it, but also for measures to raise the level of the use and the degree of the efficiency of automated equipment and to prepare its sphere of application.

Especial attention should be given to the development of a program for improving the quality and efficiency of equipment. It should, in our view, provide for the solution of both economic problems (a relative decrease in capital and operating expenditures per unit of capacity productivity, or other useful properties of machines) and social problems. Of great importance for increasing economic efficiency is an improvement of the quality of equipment, its reliability, service life, serviceability, and various use properties.

Ensuring complete safety for the service personnel and for the inhabitants of a given area, the facilitation of servicing, and an improvement of the ergonomic and esthetic characteristics of equipment, which should save people from work under harmful health conditions resulting from temperatures, noise, vibration, dust, gas, from excessive efforts from working with heavy manual tools, and so forth. This program also has to provide for the development of the production of environmental protection equipment -- for the treatment of water and air, the destruction or utilization of household and production wastes, and so forth. It is very important to ensure an organic unity between economic and social aspects of the programs.

The modern level of world economic development is making it necessary to develop a special program for the development of equipment for the purpose of economizing raw materials, fuel, and energy and to create a closed waste-free production technology. We believe it is advisable to distinguish three subprograms which would embrace measures for the development of equipment which ensures an economy of raw materials, fuel and energy: (a) during the process of their extraction, transportation, and concentration; (b) in the sphere of the processing and use of primary and secondary raw materials, materials, fuel and energy; (c) in the sphere of the production and operation of machinery and equipment.

An increase in the efficiency of machine building production depends to an enormous extent upon the development and realization of a program for the further development of the specialization of machine building production. It should include measures on production concentration for technologically homogeneous output in a small number of branches of machine building and at the minimum necessary number of enterprises in each branch; for a substantial rise in the level of standardization and unification; for the transformation of inter-branch productions into a large branch which will provide machine building with billets, parts, and units of general machine building use in economically rational amounts; for the development of technological and functional specialization (including the provision of various services to equipment consumers); and for an outstripping growth of the specialized production of tools and rigging and also of repair work.

The above-enumerated programs should be developed simultaneously for all of the branches of material and non-material production and embrace the long-term perspective with a breakdown into two or three large stages. The five programs in their aggregate, it seems to us, will make it possible to cover the most important tasks in improving the structure of the implements of labor and increasing the efficiency of machine building itself.

The first stage in the development of any program is an analysis of the current state of a given problem and of the possible directions of solving it which follow from the achievements of scientific and technological progress. The second stage is the development of a tree or pyramid of goals. The overall goal here which is formulated in the name of the program comprises, as it were, the apex of the pyramid, while lower are the floors on which increasingly partial goals of first, second, and third importance are located. Goals of a third or fourth order may be regarded as concrete measures or local complexes of measures (research, development, the creation of individual productions, and others). In a number of cases it is possible to break complex programs down into subprograms.

After the development of a system of goals and a list of measures, the stages of their realization have to be set forth and calculations have to be performed for all types of resources, and also for effect. Depending upon the relationships between possible and needed resources corrections are made in the distribution of goals and measures by stages. Finally, careful thought has to be given to the forms of organizing and managing the realization of the program. The effect of the program includes both the sum of the effects of the individual measures and the effects of structural changes resulting from its realization. Thus, the specialization of the production of products of general machine building use will produce an effect not only through decreasing the expenditures for their production, but also through the utilization for the production of other output of the released capacities of many machine building plants.

The necessity for creating overall reequipping programs has become so acute that the practice of their composition in individual branches and economic regions has in recent years outstripping methodological developments on this matter. In particular, of great interest is the experience of the Institute of Economics of the Urals Scientific Center of the USSR Academy of Sciences which together with the Council for the Overall Planning of Economic Development of Sverdlovskaya Oblast is directing the development and helping to carry out a number of special-purpose overall programs which combine features of scientific and technical, production-technical, and socio-economic programs. Among them are such relatively partial programs as the creation of individual machinery complexes for metallurgical production and also such an all-embracing program as "An Overall Program for an Accelerated Rise in Labor Productivity in Industry, Construction, and Transportation and for the Rational Use of the Labor Resources of Sverdlovskaya Oblast During the Tenth Five-Year Plan and for the Years 1981-1985." The latter includes measures for the reequipping of enterprises, improving the skills of workers, improving working and living conditions, increasing the creative activities of workers, and so forth.

As practice has shown, in the realization of regional programs it is necessary to overcome difficulties which are connected with the allocation of necessary resources, with departmental barriers, and with obtaining help from central management agencies, enterprises, and partner-organizations. These difficulties, and also a certain heterogeneity and diversity in the approach to the composition of programs can, in our view, be overcome if the regional programs for reequipping become a part of all-union programs the list of which, along with the methodological regulations, has to be approved by Gosplan USSR and the State Committee for Science and Engineering USSR.

One of the most difficult problems in shifting to special-purpose programmed planning in general and of equipment production in particular consists of the methods of "building in" overall special-programs into national economic plans. It is precisely the difficulties of reflecting the programs in the already approved economic development programs that becomes an obstacle to the realization of the measures stipulated by the programs. These difficulties can be overcome if the development of the programs precedes the approval of the plan. The development of the proposed programs must, in our view, be begun in the nearest future so as to take account of their basic content when the following long-term program is composed.

The tasks of improving the structure of the implements of labor and accelerating its adaptation to the demands of the scientific and technological revolution and to socio-economic tasks is making it necessary to increase the dynamism of the branch and organizational structures of machine building. Due to the lack of an appropriate subbranch there has still been no development of the production of highly effective means of industrial transportation on air pillows. It has long been a necessity to create a specialized production association for the production of overall equipment for cable roads, high-vacuum apparatus, heat-insulation and heat-using apparatus, and others. During the current five-year plan the series production of industrial manipulators (robots) is being organized. Apparently, it would be good to begin the formation of the appropriate subbranch. This measure, in our view, has long been necessary. The creation of an independent subbranch (if only a large production association) for the production of industrial robots could accelerate the organization of their series production and further technological progress in this field.

The production of the above and certain other types of new equipment is dispersed among many departments and not a single one of them bears full responsibility for developing this equipment and supplying the economy with it and, for this reason, for many long years the production capacities which are necessary for this do not develop. The process of changing the branch and intrabranch structures of machine building is contradictory. The organizational formation of the production of individual types of output into independent branches or subbranches is usually carried out when this production has already reached substantial proportions, possesses definite individualized production capacities, and has a scientific research and planning and designing base. In other words, organizational formation is given to an already developed production. It is important and essential, in our view, to organize independent scientific-production associations which are specialized in the creation of individual types of promising new output.

Thus, the inclusion in our economic development plans of assignments for a well-directed change in the branch, functional, technological, age, and type-size structures of the implements of labor; the transformation of assignments to satisfy needs for concrete types of machinery into the basis for planning the production of equipment and into an important criterion for stimulating machine building enterprises; the development of branch and functional machinery systems and also of interbranch overall programs for reequipping as bases for planning national economic needs and the structure of equipment, and, finally, an increase in the dynamism of the structure of machine building, an acceleration of the creation of independent branches, subbranches, and productions for the production of new types of equipment and output of interbranch use -- these are measures which, in our opinion, are essential for overcoming disproportions in the structure in the implements of labor and for increasing the effectiveness of the equipment pool.

FOOTNOTES

1. In 1965 there were around 6,000 automatic lines in industry, while in 1977 there were more than 20,500 of them. The share of automatic equipment has reached the level of almost 6 percent of the value of machinery and equipment. In industry approximately 10 percent of total industrial production personnel is engaged in servicing mechanized flow and automatic lines. Automated and overall mechanized (on the whole, or for basic production) enterprizes at which 11 percent of our industrial production personnel is employed produced 19 percent of our industrial output.

2. Thus, according to the data of a statistical survey, in 1976 within the output of a number of machine building ministries the proportion of products which had been put into production not more than five years ago was 1.3 times less than in 1967, while the proportion of products which had been in production for more than ten years increased by 1.6 times. In 1976 the profitability of output in its first year of mastery was almost 1.5 times less than the average profitability of all products. The essential differences in the machinery-labor ratios in the branches are connected, above all, with the special character of the labor processes and of the technology of each branch. However, the lagging of a number of branches (construction, agriculture, the distribution sphere, and, especially the non-production sphere) behind industry with respect to the machinery-labor ratio is also explained by the insufficient development of a number of branches of machine building and the not always justified distribution of expenditures among types of equipment for research and development.

3. The existing differences in the machinery-labor ratio in the branches is connected above all with the special character of the labor processes and technology of each branch. However, the lagging of a number of branches (construction, agriculture, the distribution sphere, and, especially, the non-production sphere) behind industry in the machinery-labor level is also explained by the insufficient development of a number of branches of machine building and by a not always justified distribution of expenditures between types of equipment for research and development.

4. For example, the elimination of disproportions between the amount of tractors and working machines in agriculture is an important task. From 1958 through 1970 the tractor pool in the country's sovkhozes increased by four times, while machinery and implements increased by 3.8 times. On the average, in the kolkhozes and sovkhozes for every 100 rubles of value of tractors in 1970 there were 138 rubles of agricultural machinery and implements, while the practice of advanced farms shows that this ratio should be 100:200 or 100:300 (EKONOMIKA SEL'SKOVO KHOZYAYSTVA, No. 7, 1971, p. 7). In recent years there has been no material change in this proportion.

5. For example, in the structure of the implements of labor for machine building disproportions have not been overcome between equipment for the various technological processing sections -- the production of billets, machining, assembling, metal covers, and products quality control. Overcoming the lagging in supplying machine building with modern equipment for casting, assembling, and quality control -- this, in our opinion, is the general direction for changing the technological structure for machine building equipment.

6. In construction, for example, as a result of discrepancies in the type-size structure of the pool of excavators, bulldozers, scrapers, and other construction machinery, expenditures for equipment are increasing in the structure of machinery intensive operations, the cost of operations is increasing, and some of them have to be performed manually. In agriculture due to the lack of mini-tractors and motorized cultivators with a capacity of 5-10 horsepower, many types of operations in vegetable growing, orchard work, pea growing, and on subsidiary plots, and in mountainous areas, and so forth, are performed manually or with the use of substantially less maneuverable and more powerful and expensive tractors of the ordinary type.

7. The system includes 45 technological complexes of equipment, including 15 complexes for the mechanization and automation of warehouses, 21 complexes for the mechanization of interoperation movements and machining shops, 6 complexes for intraplant and 2 for interplant movement of freight, and 1 complex for the mechanization and processing of metal waste products. The expected economic effect from the introduction of the system in tractor and agricultural machine building has been computed at more than 120 billion rubles.

8. L. Gatovskiy, "An Acceleration of Scientific and Technological Progress and an Increase in its Effectiveness," VOPROSY EKONOMIKI, No. 6, 1978, p. 116.

9. Yu. A. Zykov and T. L. Svetlova, "Overall Programs of Scientific and Technological Progress," IZDATEL'STVO "Nauka," 1977, p. 81.

10. B. G. Saltykov and V. L. Tambovdsev, "On the Selection of Problems for Programming,": in the collection "Special-Purpose Program Methods in Planning -- Theses of the Reports of the All-Union Conference on Special-Purpose Program Methods in Planning and Management in the Light of the Decisions of the 25th Congress of the CPSU," Moscow, 1977, pp 155, 157.

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