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CHEMICAL INDUSTRY AND MACHINERY

ECONOMIC EVALUATION OF NEW EQUIPMENT DISCUSSED

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 77 pp 83-88

[Article by M. Vasil'yev; B. Pashko; and G. Dashevskaya: "The Evaluation of the Economic Efficiency of New Equipment"]

[Text] The Report of the CPSU Central Committee to the 25th Party Congress notes the large role played by the chemical industry in the development of the country's national economy, and in the increased efficiency of national production. The rapid rates of the development of the sector necessary for the solution of the problems posed for it are possible only on the basis of fundamental qualitative changes in its technical level and accelerated assimilation of the achievements of science and technology in production.

The bases of the effect of scientific and technical progress on physical production are laid at the stage of drafting the current and long-range plans for the development of the sectors of the national economy. The methodology and practical work in planning should ensure the comprehensive nature of the approach to compiling the plan and should be based on the need for coordination of its individual sections for substantiation of the possible paths of technical and economic development of the production potential.

The plan for the development of science and technology includes two stages of a continuous process of ensuring scientific-technical progress, unified in their ultimate goal, but differing in nature and in the periods for affecting the sector's economic indicators. The first of them encompasses the planning of scientific guarantee of technical progress in the sector, and the second determines the rise in the technical-economic level of production through assimilating the output of new types of products, introducing advanced technology and advanced industrial processes and control systems.

The economic tasks of the planning for assimilating the achievements of science and technology in production include:

Economic substantiation of the measures of the plan;

Consolidated evaluation of the economic results;

The nature of the effect of the planned measures on the change in the basic general sectorial economic indicators for the planned period;

Formation of a system of indicators to determine the technical-economic level of production and the goods produced and its evaluation in the dynamics by years of the planned period.

The plan for the development of science and technology solves these problems in stages in which the charts of the technical level of new types of products and industrial processes are compiled; preparation of consolidated data on the economic efficiency of introducing advanced industrial processes, mechanization and automation of the production processes; estimate of the basic indicators of the technical-economic level of production and the goods produced.

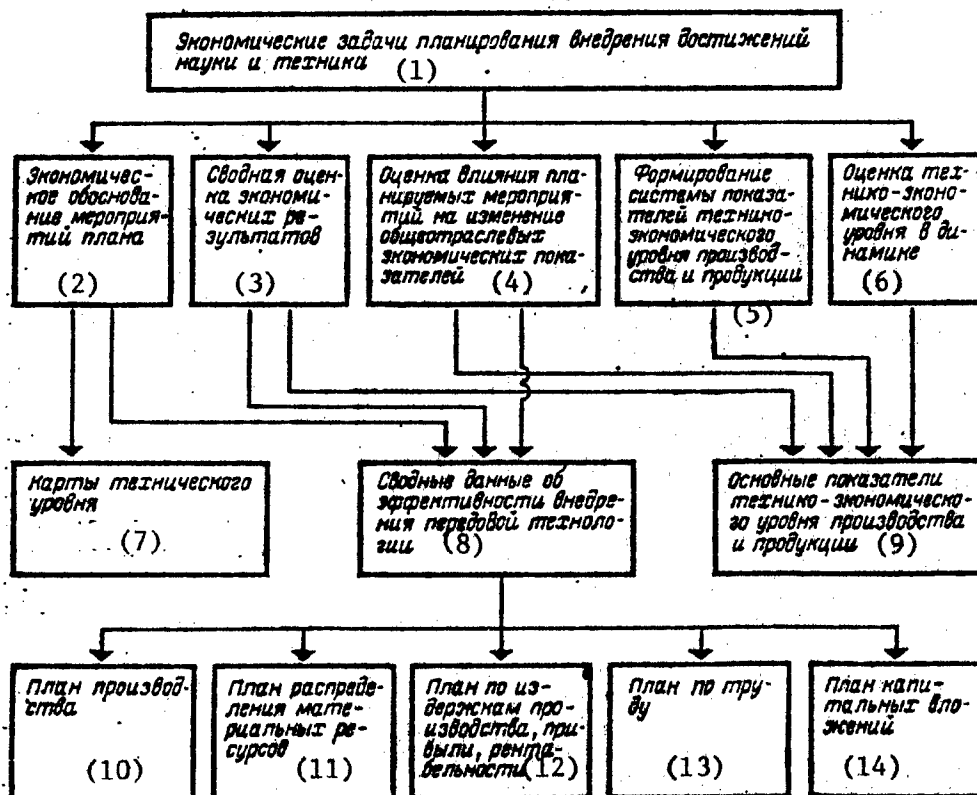
The diagram presented below illustrates the interrelations occurring during the solution of the problems listed, as well as during coordination of the plan for the development of science and technology with other sections of the sectorial plan.

The requirement for maximal intensification of national production on the basis of scientific and technical progress is realized by means of a system of methods of economic substantiation and selection of variants for solving the problems of technical development of the sector in the planned period. These variants are formed on the basis of the technical potential achieved, and the qualitative characteristics of the scientific projects in progress, the results of which may be assimilated within the planned period, and the existing resources and limitations.

The use of methods of economic optimization of the plan variants when determining the development of science and technology is regulated by the Methodological Instructions for the Drafting of State Plans for the Development of the USSR National Economy. As has been shown by practical work in the chemical industry in compiling yearly and five-year plans, there must be a further improvement in the existing methodological documents for the coordination of the plan for the development of science and technology with other divisions of the plans by indicators that have an interrelated target direction.

The economic potential of scientific-technical progress is realized in physical production during a certain period of time, including the assimilation of its results at the first enterprise and their dissemination to other production facilities of the sector. In accordance with this, the following industrial processes are taken into consideration in the planning: new, that is, being developed for the first time in the USSR; advanced (meeting

the highest technical level of the existing production facilities, but put into effect for the first time before the beginning of the planned period); improved processes.



Key:

1. Economic tasks of planning the assimilation of achievements of science and technology
2. Economic substantiation of the measures of the plan
3. Consolidated evaluation of economic results
4. Evaluation of the effect of the planned measures on the change in general sectorial economic indicators
5. Formation of a system of indicators of the technical-economic level of production and products
6. Evaluation of the technical-economic level in dynamics
7. Charts of the technical level
8. Consolidated data on efficiency of assimilating advanced technology
9. Basic indicators of technical-economic level of production and products
10. Production plan
11. Plan for distribution of physical resources
12. Plan for production costs, profits, profitability
13. Labor plan
14. Capital investment plan

An evaluation of the degree of innovation of the newly designed industrial processes and their economic substantiation are given in the charts of the technical level on the basis of a system of indicators characteristic of a specific industrial process and evaluated in comparison with the best foreign analogues. In this case there is an examination of the technical characteristics, for example, the unit capacities of the industrial lines (installations, units), the length of the industrial cycle, the structural features of the equipment, its basic parameters, metal-intensiveness, the need for production areas, and the degree of mechanization and automation of the process. At the same time there is an evaluation of the indicators of the product quality (brand assortment, physical-mechanical properties, useful materials content, etc.), and an estimation of the anticipated economic indicators (production cost, capital investments, consumption norms of the basic types of raw material, materials and power). This system also includes such indicators as the economic effect, determined in comparison with the existing domestic production of analogous purpose. Here two different base variants are actually used, and the economic effect should be identical to the efficiency estimated in the consolidated data from assimilating the advanced industrial process, mechanization and automation of the production processes.

Determined in the preparation of these data are: for the economic substantiation of the expediency of introducing the measures under discussion in the plan for assimilating new equipment--the repayment period of the capital investments and the conditional-yearly economic effect, on the basis of the planned production cost and capacity; for coordination with the plans: for the production costs, profit and profitability--the planned reduction in the production cost, and for labor--the relative reduction in the number of workers, with the plan for distribution of physical resources --the saving in physical resources, with the plan for capital investments--the volume of input for introduction of the measure.

When estimating the economic effect for substantiation of the industrial process planned for assimilation, the base should be, in our opinion, a process, analogous in purpose, of the preceding technical level (that is, the level of equipment being replaced). To be emphasized here is the contrast between this formulation and others, determining the base variant as the "equipment being replaced" and as "the best existing equipment for an analogous purpose." The first of them does not provide a solution to the problem posed from the standpoint of national economic interests, since with it, the economic effect may be the result of a low technical level of the base equipment. The inadequate clarity of the second formulation becomes obvious when one attempts to estimate the economic effect from introducing advanced industrial processes (in the higher determination given for them), since in this case the best equipment existing in the sector for an analogous purpose is the same as that being evaluated, slated for further distribution.

The coordination of the consolidated data on the efficiency of assimilating advanced industrial processes, mechanization and automation of the production processes with other divisions of the plan is the least developed of all the economic problems under discussion in planning the assimilation of new equipment.

The consolidated estimate of the reduction in input per ruble of commodity output according to the basic technical-economic factors (the division of the plan, "Production Costs, Profit, Profitability") use the data on the reduction in production cost by virtue of introducing the new, advanced production process, mechanization and automation of the production processes. The existing methodological documents do not give a clear answer to the problem as to whether in this case one should consider the saving only from the measures (new) introduced for the first time or the total reduction in the production cost, also brought about by advanced industrial processes and measures for the organizational and technical plans of the enterprises.

The over-all saving is taken into consideration in practice in the plan for the production costs. In the chemical industry, the division into new and improved industrial processes is in many cases quite conditional, and therefore the saving from improving the equipment and the industrial process proves to be partially taken into consideration in these consolidated data on the efficiency (prepared in the plan for the development of science and technology). At the same time, the saving from improving the equipment and industrial process used is added in this plan toward the reduction in the production cost.

In the Methodological Instructions, in the section on "Production Costs, Profit and Profitability" there is a condition in accordance with which, in estimating the saving obtained as the result of raising the technical level, no allowance is made for the newly-introduced production facilities. The assimilation of advanced industrial processes in the chemical industry is, as a rule, however, precisely the introduction of new enterprises and production facilities.

It is obviously expedient to determine the reduction in the production cost by assimilation of advanced technology in the following way: if the goods produced are new for the enterprise (the object being put into production) --as compared with the average sectorial production cost of the given item; if the item has been previously produced at the enterprise (the object being put into production)--as compared with the level of its production cost in the base period.

In the first case the saving cannot be taken into consideration in the plan for the enterprise, but is actually developed in the sector. Difficulties of a methodological nature, involved in ensuring the coordination of the consolidated data on the introduction of the advanced industrial process, mechanization and automation of the production processes with the plan for

distributing the physical resources, essentially are analogous to the difficulties arising in determining the reduction in production cost from this factor, when the implementation of the corresponding planned measures necessitates the introduction of new production capacities. The economic results of introducing the advanced industrial process, mechanization and automation of the production processes with the plan for work are coordinated by estimating the relative reduction in the number of workers and the result of introducing the measures for this direction of technical progress.

National economic planning uses a unified classification of the factors of the growth of labor productivity, and is less detailed for the group, "Raising the Technical Level of Production," than for the same factor when estimating the production cost. In preparing the consolidated data on the economic efficiency of introducing advanced technology, mechanization and automation of the production processes, however, the structure of the measures to evaluate the saving from reducing the production cost and the relative reduction in the staff, is naturally identical. Consequently, the same indicators (with respect to the measures encompassed) are given differing content in the sections of the plan with respect to work and the production costs. For example, in the plan for reduction of the production cost, the saving stemming from improving the equipment and industrial process used is added to the saving from introducing the advanced technology. At the same time, in the plan for work, the relative reduction in the number of workers resulting from the introduction of the advanced technology (estimated for the same measures) also includes its improvement, since it is not singled out here as an individual factor.

A generalizing evaluation of the efficiency of assimilating the achievements of science and technology in physical production is obtained when the basic indicators of the technical-economic level of production and the goods produced are planned. In this case the consolidated evaluation of the economic results of scientific-technical progress are ensured; the effect of the planned measures on the change in the general-sectorial economic indicators is ensured; the system of indicators is formed and the technical-economic level of production and goods produced in the dynamics is evaluated.

The level of the technical development is reflected in the indicators that characterize the structure and quality of the goods produced, the state of the technical base, the materials-intensiveness of production, the rise in labor productivity, the volume of production using advanced industrial processes and advanced equipment.

The anticipated results of assimilating the achievements of science and technology in production are characterized by their economic efficiency and are realized in the reduction of the production cost of the commodity items in the planned period and the rise in labor productivity.

The most important indicators of the technical level are: a rise in the quality of the goods produced, which is planned on the basis of their certification; assimilation of new products; the degree of their innovation.

The existing system of planning the development of science and technology specifies the singling out in the plan, at the national economic level, of the proportion of goods with the State Seal of Quality in the total volume of goods produced in value terms and according to the number of items. The expediency of estimating according to the number of items is doubtful. When a similar product is put out at several enterprises and only certain types of it have the Seal of Quality, a duplicate counting is possible.

The plan for the development of science and technology, in addition, gives the indicators for mechanization and automation of production that characterize the expansion of the physical basis of eliminating heavy and unskilled manual labor.

The dynamics of the number of workers performing their work by a fully mechanized method, as well as the reduction in the number of workers engaged in manual labor are determined from the corresponding indicators.

Assimilating advanced technology in production, using units with a higher unit capacity, by reducing the need for basic workers, results at the same time in a rise in the number of highly skilled repairmen, fitters and adjusters included in the category of auxiliary workers. By bringing about an increase in the proportion of manual labor, this tendency promotes a rise in the reliability of the equipment used in a number of important factors in the growth of labor productivity in the sector with the implementation of measures ensuring an increase in technical progress. On the basis of the role of the adjusters for the basic equipment and the control systems for the industrial processes in ensuring normal functioning of modern, highly automated production, in our opinion, it would be more correct to include them in the category of basic workers.

Including in the plan goals of raising the technical level of production is now specified for the first time in the practical work of planning the results of scientific-technical progress. The indicators determining them reflect the qualitative and structural changes in the goods produced, the level of the sector's technical base, the materials-intensiveness of production and labor productivity. In the chemical industry they characterize the increase in the production of concentrated and combined fertilizers, thermoplastics, synthetic fibers, the average content of nutrients in mineral fertilizers, the production of chemical products at units with a large unit capacity, etc.

From this one can obviously see the urgency of coordinating the planned level of these indicators with the production plan. It is evidently expedient in the plan for the development of science and technology to determine only the proportion of the goods produced by using the most advanced technology and industrial processes, and the real indicators characterizing the corresponding production volume should not be included in this section of the plan.

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ELECTRONICS AND PRECISION EQUIPMENT

ELECTRIC CABLES. PROTECTIVE COVERINGS

Moscow GOSUDARSTVENNYY STANDART SOYUZA SSR, GOST 7066-62, 1964, pp 0001-0007

[Text] The present standard extends to protective coverings of electric cables, intended for protection of cable sheaths from mechanical damage and corrosion.

I. Types

1. Types of protective coverings should correspond to those indicated in Table 1.

TABLE 1

1 Виды брони	2 Наружный покров		5 Без наружного покрова		
	3 нормальный	4 негорючий			
	6 Подушка				
	3 нормальная	7 усиленная	3 нормальная	3 нормальная	7 усиленная
8 Типы покрытий					
9 Стальная лента . . .	B	Bv	Bn	BG	BGv
10 Плоская стальная оцинкованная проволока	P	Pv	Pn	PG	PGv
11 Круглая стальная оцинкованная проволока	K	Kv	—	—	—

Key: 1, Type of armor; 2, Outer cover; 3, Normal; 4, Nonflammable; 5, No outer cover; 6, Cushion; 7, Reinforced; 8, Types of coverings; 9, Steel strip; 10, Flat steel galvanized wire; 11, Circular steel galvanized wire

2. The utilization of types of coverings should correspond to Table 2.

TABLE 2

1 Преимущественная область прокладки кабелей	2 Кабель, не подвергающийся значительным растягивающим усилиям		3 Кабель, подвергающийся значительным растягивающим усилиям			
	4 Оболочка кабелей					
	5 свинцовая	6 алюминисвая	7 неметаллическая	5 свинцовая	6 алюминисвая	7 неметаллическая
	8 Типы покровов					
9 В земле . . .	В	В _А	В	Р	Р _А	Р
10 Внутри помещений, в каналах и туннелях . . .	ВГ	ВГ _А	ВГ	РГ	РГ _А	РГ
11 В земле в особо агрессивных условиях и в местах, где оболочка подвергается коррозии блуждающими токами	В _В	В _В	В	Р _В	Р _В	Р
12 Внутри помещений, в каналах и туннелях в особо агрессивных условиях	ВГ _В	ВГ _В	ВГ	РГ _В	РГ _В	РГ
13 В шахтах и пожароопасных помещениях	В _П	—	—	Р _П	—	—
14 Под водой	—	—	—	К	—	—
15 Под водой в особо агрессивных условиях	—	—	—	К _В	—	—

Key: 1, Primary area in which cables are laid; 2, Cable not subjected to significant tensile forces; 3, Cable subjected to significant tensile forces; 4, Cable sheath; 5, Lead; 6, Aluminum; 7, Nonmetallic; 8, Types of covering; 9, In earth; 10, In buildings, canals and tunnels; 11, In earth in particularly corrosive environments in areas where the cable is subjected to corrosion due to stray currents; 12, Within buildings, canals and tunnels in particularly corrosive environments; 13, In mines and buildings with danger of fire; 14, Under water; 15, Under water with particularly corrosive environments.

Note. The type of protective covering is called for in the standards or technical conditions for cable products approved according to law.

II. Technical Requirements

3. The normal external covering should consist of the following concentric layers in sequence:

- a) Bitumen or bitumen composition;
- b) Saturated cable thread or glass thread of stable fiber;
- c) Bitumen or bitumen composition;
- d) Covering preventing contact between turns of cable.

4. The nonflammable external covering should consist of the following concentric layers in sequence:

- a) A nonflammable composition;
- b) Glass thread of staple fiber;
- c) Nonflammable composition;
- d) Covering preventing contact between turns of cable.

5. The steel strip of coverings type BG and BGv should have a zinc or bitumen coating preliminarily applied to prevent corrosion.

6. The normal cushion should consist of several sequentially applied concentric layers:

- a) Bitumen or bitumen composition;
- b) Strip of reinforced bitumen-saturated paper or saturated cable paper;
- c) Bitumen or bitumen composition;
- d) Saturated cable thread;
- e) Bitumen or bitumen composition.

For cables in plastic sheaths, the cushion should be manufactured without applying the first and second layers of bitumen or bitumen composition.

7. For power cables made up of individually lead sheathed cores wound with fabric strips or saturated cable thread, the cushion should consist of the following concentric layers applied in sequence:

- a) Bitumen or bitumen composition;
- b) Saturated cable thread;

c) Bitumen or bitumen composition.

8. The reinforced cushion should consist of the following concentric layers, applied in sequence:

a) Bitumen composition;

b) Two strips of polyvinylchloride plastic;

c) One strip of reinforced bitumen-saturated paper or saturated cable paper;

d) Bitumen composition;

e) Saturated cable thread;

f) Bitumen composition.

9. Cushions of all types of coverings with steel strip armor may utilize strips of reinforced bitumen-saturated paper or saturated cable paper in place of the cable thread.

10. Bitumens or bitumen compositions used for the manufacture of normal cushions should have a softening point of no less than 45 C, while the bitumen composition used for reinforced cushions (MB-90) must have a softening point of at least 65 C.

Bitumens or bitumen compositions used for the manufacture of normal external coverings should have a softening point of at least 45 C for coverings of types B, P and K and at least 65 C for coverings of types Bv, Pv and Kv.

For communication cables with cordel-styroflex insulation, coverings type Bv, Pv and Kv may utilize bitumen or bitumen composition with softening points of no less than 45 C.

11. The radial thickness of elements of protective coverings should be as indicated in Table 3.

12. Armor consisting of steel strips 0.3 mm thick may be replaced with armor consisting of galvanized steel wire 1.4-1.8 mm in diameter.

Armor consisting of galvanized flat steel wire 1.5-1.7 mm in diameter may be replaced by armor consisting of galvanized circular steel wire 1.4-4 mm in diameter.

13. Armor consisting of two steel strips should be applied so that the outer strip covers the gaps between turns of the inner strip.

14. Armor consisting of flat steel galvanized wire without an other protective covering should consist of at least two steel wires 1.4-1.8 mm in

TABLE 3

mm

7 Диаметры кабеля поверх оболочки	2 Радиальная толщина элементов защитных покрытов							15 наружного покрова
	3 подушки под броню				4 брони			
	5 из стальных лент		6 из стальных оцинкованных проволок		7 из двух сталь- ных лент*	8 из стальных оцинкованных проволок		
	9 Подушка					13 плоских	14 круглых	
	10 нор- маль- ная	11 усилен- ная	10 нор- маль- ная	11 усилен- ная				
12 не менее								
16 До 13					0,3	—	—	
13 - 37	1,5	2	2	2,5	0,5	1,5	4	2
37 - 50					0,5	1,7	4-6	
17 Св. 50					0,8	1,7	6	

Key: 1, Cable diameter outside sheath; 2, Radial thickness of elements of protective coverings; 3, Cushion beneath armor; 4, Armor; 5, Of steel strip; 6, Of steel galvanized wire; 7, Of two steel strips; 8, Of steel galvanized wire; 9, Cushion; 10, Normal; 11, Reinforced; 12, At least; 13, Flat; 14, Circular; 15, Outer cover; 16, Up to; 17, Over

*Thickness of each strip.

diameter at intervals no more than six times the diameter of the cable.

15. Strips of polyvinylchloride plastic should be applied with a positive overlap of at least 20%.

16. Cable thread and cable paper should be preliminarily saturated with a rot-proofing composition containing copper naphthanate. The content of copper naphthanate in the saturated thread and paper should be at least 4% of the weight of the thread and paper.

17. Bitumen and nonflammable compositions in coverings types B, Bn, P, Pn and K should not flow at a temperature of 45 C.

The bitumen composition in coverings types Bv, Pv, Kv, as well as coverings of types BG and BGv should not flow at a temperature of 50 C.

18. The outer covering should be cold resistant. The bitumen and nonflammable composition should not chip away from the outer covering of the cable when struck at a temperature of -40 C.

19. The outer coverings of types Bn and Pn should be nonflammable.

20. Materials used for the manufacture of protective coverings should correspond to the following standards:

- a) Cable thread -- GOST 905-41;
- b) Steel strip -- GOST 3559-47;
- c) Galvanized steel wire -- GOST 1526-42;
- d) Bitumen types BN-III-U and BN-III -- GOST 1544-52;
- e) Bitumen type BN-V -- GOST 6617-56;
- f) Copper naphthanate -- GOST 9549-60;
- g) Cable paper -- GOST 645-59;
- h) Polyvinylchloride plastic, bitumen composition MB-90, nonflammable composition, glass thread of staple fiber, reinforced bitumen-saturated paper and galvanized steel strip -- the technical conditions established by law.

21. The supplying enterprise must guarantee that the protective coverings of cables meet all the requirements of the present standard.

III. Test Methods

22. Testing for agreement with the requirements of paragraphs 3-8, 11, 13-15 for all cable coverings.

23. Testing for agreement with the requirements of paragraphs 16-19 should be performed by the supplier using cable specimens taken from production runs in sufficient quantity and at sufficiently frequent intervals to guarantee agreement of protective covering with all requirements of the present standard.

Reports of tests performed by the supplier should be presented to the consumer on demand.

24. The test methods indicated below should be used by the consumer for quality control of cable protective coverings.

25. Testing of the application of the armor (paragraph 13) should be performed by bending the cable at a distance of 1 m from the end of the cable around a cylinder with a diameter equal to 15 times the diameter of the cable. The outer strip of armor should continue to cover the gaps between turns of the lower strip when thus tested.

26. Determination of the content of copper naphthanate in cable thread (paragraph 16) should be performed by the following method.

The cable thread, removed from the cable, is cut into small parts and two charges of 5 g each are taken. One charge is placed in a porcelain crucible with a capacity of 40-50 ml, then slowly burned in a muffle furnace, then heated for 20-30 minutes more.

The residue in the crucible is dissolved with heating in 10 ml of nitric acid (1:1), transferred to a 200-300 ml beaker, an additional 10 ml of nitric acid (1:1) are added and the mixture is boiled until the copper oxide dissolves completely. The solution is diluted with water, filtered, washed 6-8 times with distilled water, acidified with nitric acid and the content of copper is determined by electrolysis.

The other charge of cable thread is extracted with benzene or chloroform in an extraction apparatus for 8-12 hr until the bitumen composition is completely eliminated, then dried and weighed.

The content of copper naphthanate (X) in percent is defined by the formula:

$$X = \frac{a \cdot 100 \cdot 12}{b \cdot k},$$

where:

a is the weight of copper on the electrode, g;

12 is the conversion factor to copper naphthanate;

b is the charge of cable thread taken for determination of copper, g;

k is the ratio of the weight of extracted thread to the weight of the initial charge.

The content of copper naphthanate in cable paper should be determined after preliminary saturation with the rot-proofing composition and should be guaranteed by the cable supplier.

27. Tests for flowing of bitumen and nonflammable compositions (paragraph 17) should be performed using a cable specimen 200-250 mm in length.

The cable specimen, with the ends covered with rubber tape, is placed in the horizontal position in a thermostat for 4 hours at the temperature required (45 or 50 C). The bitumen or nonflammable composition should not leak out under these conditions.

28. Cold resistance testing (paragraph 18) should be performed by holding cable specimens 200-250 mm in length in a cold chamber at -40 C for 2 hours. Then, at the same temperature, the cable specimen is struck three times with a weight of 3 kg dropped freely from a height of 20 cm. The bitumen or nonflammable composition should not chip off under these conditions.

29. Nonflammability testing (paragraph 19) should be performed on a specimen of cable 350-500 mm in length, held in the vertical position. The cable specimen is held in the flame of a soldering torch for 10 minutes. After removal from the flame, the covering should not burn.

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CSO: 8344/1657 B

PAPER FOR POWER CABLE INSULATION

Moscow GOSUDARSTVENNYY STANDART SOYUZA SSR, GOST 645-67 in Russian 1967 pp 0001-0010

[Text] The present standard covers paper designed for insulation of power cables and associated equipment.

1. Types and Dimensions

1.1. Paper should be manufactured in the following types, as shown in Table 1.

TABLE 1

1 Марки	2 Наименование и характеристика	3 Рекомендуемая область применения
K-080; K-120; K-170	4 Кабельная обыкновенная	10 Для изоляции силовых кабелей напряжением до 35 кВ включительно
KM-120; KM-170	5 Кабельная многослойная (четырёхслойная)	
KV-030; KV-045; KV-080; KV-120; KV-170; KV-240	6 Кабельная высоковольтная	11 Для изоляции силовых кабелей напряжением 35 кВ и выше
KVM-015; KVM-020; KVM-030; KVM-045; KVM-080; KVM-120	7 Кабельная высоковольтная уплотнённая	
KVM-080; KVM-120; KVM-170; KVM-240	8 Кабельная высоковольтная многослойная	12 Для изоляции силовых кабелей напряжением 110 кВ и выше
KVM-080; KVM-120	9 Кабельная высоковольтная многослойная уплотнённая	

Key: 1, Type; 2, Nomenclature and characteristics; 3, Recommended area of application; 4, Ordinary cable; 5, Multilayer cable (four-layer); 6, High-voltage cable; 7, High-voltage compacted cable; 8, High-voltage multilayer cable; 9, High-voltage multilayer compacted cable; 10, For insulation of power cables up to 35 kV; 11, For insulation of power cables 35 kV and higher; 12, For insulation of power cables 110 kV and higher

1.2. The paper should be produced in rolls. The widths of the rolls are as follows:

For paper 0.015-0.045 mm thick -- 350 mm;

For paper 0.080-0.240 mm thick -- 500, 650 and 750 mm.

Permissible deviations of the width of rolls ± 3 mm.

Upon agreement, paper can be manufactured in rolls of other widths.

2. Technical Requirements

2.1. Paper of types K, KM, KV, KVM should be produced with machine smoothness, of types KVU and KVMU -- with calendared smoothness.

2.2. The technical indicators of paper of types K, KM, KV and KVU should agree with the norms shown in Table 2.

2.3. The technical indicators of type KVM and KVMU paper should meet the norms indicated in Table 3.

2.4. The light transmittance of the paper should be smooth.

2.5. Cutting of the edges of the paper should be clean and smooth, without tearing or raggedness.

2.6. The surface of the paper must have no folds, sagging or strips or spots of various origins.

Note. There can be up to 6 spots of fiber origin measuring not more than 10 mm^2 each per roll of paper.

2.7. The presence of carbon, metallic and mineral inclusions, as well as tears or holes visible to the naked eye is not permitted.

2.8. The color of type KM, KV, KVU, KVM and KVMU paper should be the color of the natural fiber, of type K -- of the natural fiber, red, green and blue. The color of the paper should be stable when exposed to water or mineral oil.

2.9. The number of permissible tears or rips per roll is:

For paper 0.045-0.240 mm thick -- not over 2,

For paper 0.015-0.30 mm thick -- not over 4.

Up to 10% of the rolls in a batch can have one extra tear or hole.

2.10. The type and color of paper, width of the roll should be indicated in the order.

Key to Table 2. a, Indicators; b, Types; c, Test method; 1, Composition as fiber, %: Cellulose, wood sulfate type, GOST 5186-59; Cellulose, sulfate type, for multilayer cable paper, GOST 12454-67; 2, Thickness in mm; Permissible variations, mm; 2a, GOST 7514-55 and paragraph 3.3 of the present standard; 3, Volumetric weight, g/cm^3 ; Permissible variations, g/cm^3 ; 4, Tensile strength, at least: In longitudinal direction; In transverse direction; 5, Elongation in % at least: In longitudinal direction; In transverse direction; 6, Tear resistance in the transverse direction in g, at least; 6a, GOST 7497-55 and paragraph 3.4 of the present standard; 7, Air permeability, ml/min , not over; 8, Moisture content, %; 9, Ash content, %, not over; 10, pH of aqueous extract; 11, Content of iron as Fe, %, not over; 12, Dielectric loss angle tangent at 100 C, not over: Dry paper; Oil-soaked paper; 12a, GOST 6433-65 and paragraph 3.5 of the present standard; 13, Conductivity of aqueous extract at 25 C in $\text{ohm}^{-1}\cdot\text{cm}^{-1}$, not over; 13a, GOST 8552-57 and paragraph 3.6 of the present standard

2.11. The finished product should be subjected to quality control testing by the manufacturer. The manufacturer should guarantee that all paper produced meets the requirements of the present standard and each batch of paper should be shipped with documents of the established form attesting to its quality.

3. Test Methods

3.1. Consumer quality testing of paper, as well as checking of agreement of packaging and labeling with the requirements of the present standard should follow the rules for sampling and preparation of specimens for testing of GOST 8047-64 and the test methods indicated in Tables 2 and 3, with the following additional information.

3.2. Paper specimens should be conditioned for at least 18 hours before determination of physical and mechanical indicators.

3.3. In determining the thickness of the paper from 0.015 to 0.030 mm inclusively, the paper should be folded in five layers.

3.4. To determine the resistance of the paper to tearing in the transverse direction, specimens are cut in which the long side corresponds to the longitudinal direction.

3.5. To determine the dielectric loss angle tangent, flat electrodes of stainless steel should be used, with the following dimensions:

Measurement electrode -- diameter 50 ± 0.2 mm;

High-voltage electrode -- inside diameter 100 ± 0.5 mm;

Retaining circular electrode -- width at least 4 mm.

TABLE 3

а Показатели	б Марки						с Методы испытаний
	КММ-080	КММ-120	КММ-170	КММ-240	КММ-080	КММ-120	
1. Состав по волокну в %: целлюлоза сульфатная марки ЭИ-2 по ГОСТ 5186-59	100	100	100	100	100	100	ГОСТ 7500-65
2. Толщина в мм Допускаемые отклонения в мм	0,080 ±0,005	0,120 ±0,007	0,170 ±0,010	0,240 ±0,015	0,080 ±0,005	0,120 ±0,007	2а ГОСТ 7514-55 и п. 3.3 настоящего стандарта
3. Объемный вес в г/см ³ Допускаемые отклонения в г/см ³	0,76 ±0,06	0,76 ±0,06	0,76 ±0,06	0,76 ±0,06	1,10 ±0,05	1,10 ±0,05	ГОСТ 7514-55
4. Разрывное усилие в кгс, не менее: в продольном направлении в поперечном направлении	8,5 4,0	14,5 6,5	19,0 8,5	23,0 10,5	13,0 5,5	18,0 8,5	ГОСТ 7497-55
5. Удлинение в %, не ме- нее: в продольном направлении в поперечном направлении	3,3 10,5	3,3 10,5	3,3 10,5	3,3 10,5	3,0 10,5	3,0 10,5	ГОСТ 7497-55
6. Сопротивление раздира- нию в поперечном направле- нии в гс, не менее	70	150	240	300	100	170	6а ГОСТ 7497-55 и п. 3.4 настояще- го стандарта
7. Воздухопроницаемость в мл/мин, не более	25	25	20	10	6	6	ГОСТ 7582-55
8. Влажность в %	7 ⁺¹ ₋₂	7 ⁺¹ ₋₂	7 ⁺¹ ₋₂	7 ⁺¹ ₋₂	7 ⁺¹ ₋₂	7 ⁺¹ ₋₂	ГОСТ 8428-57
9. Зольность в %, не более	0,3	0,3	0,3	0,3	0,3	0,3	ГОСТ 7629-66
10. pH водной вытяжки	6,5-8,0	6,5-8,0	6,5-8,0	6,5-8,0	6,5-8,0	6,5-8,0	ГОСТ 8540-57
11. Содержание натрия в мг/кг, не более	40	40	40	40	40	40	ГОСТ 10638-63
12. Тангенс угла диэлек- трических потерь при 100°С, не более: сухой бумаги бумаги, пропитанной мас- лом	0,0023 0,0030	0,0023 0,0030	0,0023 0,0030	0,0023 0,0030	0,0024 0,0032	0,0024 0,0032	2а ГОСТ 6433-65 и п. 3.5 настояще- го стандарта
13. Удельная электропро- водность водной вытяжки при 25°С в ом ⁻¹ ·см ⁻¹ , не более	2,0·10 ⁻⁵	2,0·10 ⁻⁵	2,0·10 ⁻⁵	2,0·10 ⁻⁵	2,0·10 ⁻⁵	2,0·10 ⁻⁵	3а ГОСТ 8552-57 и п. 3.6 настояще- го стандарта

Key: a, Indicators; b, Types; c, Test methods; 1, Fiber composition, %: Sulfate cellulose type EI-2, GOST 5186-59; 2, Thickness, mm; Permissible variations, mm; 2a, GOST 7514-55 and paragraph 3.3 of the present standard; 3, Volumetric weight, g/cm³; Permissible variations, g/cm³; 4, Tearing strength, kg, at least: In longitudinal direction; In transverse direction; 5, Elongation in %, at least: In longitudinal direction; In transverse direction; 6, Puncture resistance in transverse direction in g, at least; 6a, GOST 7497-55 and paragraph 3.4 of the present standard; 7, Air permeability in ml/min, not over; 8, Moisture content, %; 9, Ash content, %, not over; 10, pH of aqueous extract; 11, Content of sodium in mg/kg, not over; 12, Dielectric loss angle tangent at 100 C, not over: Dry paper; Oil-soaked paper; 12a, GOST 6433-65 and paragraph 3.5 of the present standard; 13, Conductivity of aqueous extract at 25 C in ohm⁻¹·cm⁻¹, not over; 13a, GOST 8552-57 and paragraph 3.6 of the present standard. Note. Sodium content indicator optional until 1 July 1969.

The pressure on the measurement and retaining electrodes should be 150-300 g/cm².

Determination should be performed using several layers of paper with a total thickness of 0.24-0.35 mm.

The dimensions of specimens should correspond to the dimensions of the high-voltage electrode.

Immediately before measurement, the paper should be dried at 100-110 C for 1.5 hr (no vacuum), then for 8 hours at a residual pressure of 1-2 mmHg.

When the paper is tested in the saturated state, specimens which have been dried as indicated above should be saturated with type S-220 oil, GOST 8463-57, preliminarily dried, with dielectric strength at least 180 kV/cm.

When specimens are saturated, they should be held at an oil temperature 100 ± 5 C with a residual pressure of 1-2 mmHg for 1-1.5 hr.

The dielectric loss angle tangent should be measured at 100 ± 5 C with an electric field voltage in the specimens of 1.5 kV/mm. Paper soaked with oil is tested in the same oil. Specimens should be held before measurement 100 ± 5 C for at least 30 minutes.

The test result used is the least value of three measurements.

3.6. To determine the conductivity of an aqueous extract, 5 g of air-dry paper are cut into pieces of 10 x 10 mm, placed in a conical flask of quartz glass and covered with 250 ml of freshly distilled water.

4. Packaging, Marking, Transportation and Storage

4.1. Packaging and marking of the paper should be according to GOST 1641-64, with the following additions:

a) Diameter of rolls:

Paper thickness 0.015-0.020 mm -- not over 300 mm;

Paper thickness 0.030-0.045 mm -- at least 350 mm;

Paper thickness 0.080-0.240 mm -- 450-800 mm;

b) Paper should be glued to the core;

c) Holes or tears should be marked with a colored paper warning signal visible from the end of the roll or a colored pencil;

d) Rolls of paper types KVM, KVMU, KV and KVU of all thicknesses should be wrapped in two layers of waxed paper according to GOST 9569-65 or in a two-layer water-proof bag according to GOST 8828-61, the weight of which should fall within the general norm for consumption of wrapping paper -- 1.2% of the weight of the roll.

At each end of a packaged roll of paper of the types mentioned, two circles of wax paper or a two-layer water-proof bag should be included.

4.2. The paper should be stored in closed areas, protected from precipitation and soil moisture.

4.3. The paper should be transported in closed, clean vehicles in packages.

4.4. It is forbidden to drop paper rolls at storage areas or during transportation.

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POLYSTYRENE FILAMENTS

Moscow GOSUDARSTVENNYY STANDART SOYUZA SSR, GOST 12851-67, 1967, pp 0001-0005

[Text] This standard covers polystyrene filaments used for insulation of cables. The filaments are manufactured of a mixture of block and high-impact polystyrene.

1. Technical Requirements

1.1. Polystyrene filaments should meet the requirements and norms indicated in the table below as to physical-mechanical and electrical properties.

1.2. Each coil must carry not over 5 lengths of filament of diameter 0.4 and 0.65 mm, not over 3 lengths of filament diameter 0.8 and 1.1 mm. Lengths of filament should be connected together. The point of connection should be covered with paper.

1.3. The color and diameter of the filament is established by the consumer as the filament is ordered.

1.4. The finished product should be subjected to quality control testing by the supplier. The supplier must guarantee that all polystyrene filament manufactured meets the requirements of the present standard.

2. Test Methods

2.1. The rules for sampling and test methods indicated below should be used by the consumer to test the quality of polystyrene filaments, as well as the agreement of containers, packaging and marking with the requirements of the present standard.

2.2. A batch is considered to be a quantity of polystyrene filament of homogeneous quality indicators, but not over 2 tons, simultaneously delivered and accompanied by one quality control test document.

2.3. A batch of filament may contain various quantities of filaments of each color, depending on the conditions of the order.

а	Показатели	б Нормы для сортов		е Методы испытаний
		с 1-го	д 2-го	
1.	Внешний вид	1а Нити должны быть неокрашенными или окрашенными в красный, желтый, зеленый и фиолетовый цвета. Не допускаются посторонние включения и механические повреждения		1б Визуально
2.	Диаметр в мм	0,4±0,02 0,65±0,02 0,8±0,02 1,1±0,06	0,4±0,03 0,65±0,03 0,8±0,03 1,1±0,07	2а По п. 2.7
3.	Длина отдельных концов в м, не менее	500	500	
4.	Предел прочности при растяжении в кг/см ² , не менее:			4а По п. 2.8
	нитей диаметром 0,4 мм	650	600	
	" " 0,65 мм	700	650	
	" " 0,8 мм	690	680	
	" " 1,1 мм	710	690	
5.	Относительное удлинение при разрыве в %:			5а По п. 2.8
	нитей диаметром 0,4; 0,65 мм	5—35	5—45	
	" " 0,8 мм	15—35	10—45	
	" " 1,1 мм	5—25	5—30	
6.	Гибкость нитей диаметром 0,4; 0,65; 0,8 мм	6а Должны выдерживать испытание по п. 2.9.		
	" " 1,1 мм	6б Не определяется		
7.	Тангенс угла диэлектрических потерь при частоте 10 ⁶ гц, не более	0,0003	0,0004	7а По п. 2.10
8.	Диэлектрическая проницаемость при частоте 10 ⁶ гц, не более	2,6	2,7	8а По п. 2.10

Key: a, Indicators; b, Norms for type; c, 1; d, 2; e, Test method; 1, External appearance; 1a, Filaments should be uncolored or colored red, yellow, green and violet. Foreign inclusions and mechanical damage are not permitted; 1b, Visual; 2, Diameter, mm; 2a, Paragraph 2.7; 3, Length of individual filaments in m, at least; 4, Tensile strength, kg/cm², at least: Filaments diameter; 4a, Paragraph 2.8; 5, Relative elongation at rupture, %; Filaments diameter; 5a, Paragraph 2.8; 6, Flexibility of filaments diameter 0.4, 0.65, 0.8 mm; 6a, Should withstand testing as indicated in paragraph 2.9; 6b, Not determined; 7, Dielectric loss angle tangent at 10⁶ Hz, not over; 7a, Paragraph 2.10; 8, Dielectric permeability at 10⁶ Hz, not over; 8a, Paragraph 1.10. Note. One variation from nominal dimensions of ±0.04 mm diameter permitted for each 1000 m of coiled filament of type 2.

2.4. One percent of the coils in a batch are tested, but no less than five coils.

The tests for tensile strength, relative elongation at rupture, flexibility and filament diameter are performed on 20 m of each coil of the sample taken.

2.5. In each batch of filament, in order to test the dielectric loss angle tangent and dielectric permeability of the polystyrene used to manufacture the given batch of filament, the supplier must provide three discs 100 ± 2 mm in diameter and 2 ± 0.2 mm thick, manufactured as follows:

Pouring temperature, C	205-215
Holding time in press mold, s	12-20

The specimens should be placed in an envelope and sealed.

2.6. If unsatisfactory test results are achieved for any one of the quality control indicators, retesting of twice as many specimens taken from the same production batch should be performed. The results of the retesting are final.

2.7. Filament diameter is measured by micrometer (GOST 6507-60) with an accuracy of 0.01 mm. Specimens are measured at intervals of 4 m in two mutually perpendicular directions. The arithmetic mean of all measurements is taken as the result of the determination. None of the measurements of diameter may go beyond the limits of the established tolerances.

2.8. Determination of tensile strength and relative elongation at rupture is performed on any type of tensile testing machine allowing measurement of the load with an accuracy of at least $\pm 1\%$. The load scale is selected so that the measured force is between 20 and 90% of the scale limits. The machine must be applied with clamps which prevent slipping of specimens during the process of testing.

The distance between clamps should be 100 mm.

The test speed is 100 mm/min.

Five specimens from each coil of the sample taken are selected for testing.

2.8.1. The test result is the arithmetic mean determined for specimens which rupture in the gauge portion. None of the measured values of tensile strength or relative elongation at rupture should go beyond the limits of the norms indicated in paragraphs 4 and 5 of the table.

The tensile strength (σ_z), in kg/cm^2 , is calculated by the formula

$$\sigma_z = \frac{P}{S},$$

where P is the load causing failure of the specimen, kg;

S is the initial cross-sectional area of the specimen, cm².

The relative elongation at rupture (ϵ_z), in percent, is calculated by the formula:

$$\epsilon_z = \frac{l - l_0}{l_0} \cdot 100,$$

where l is the length of the gauge portion of the specimen at the moment of rupture, mm;

l_0 is the initial length of the gauge portion of the specimen, mm.

2.9. The flexibility of filaments is determined at room temperature, by winding the filament at the rate of 10 turns per second onto a rotating rod 30 cm in length with a diameter equal to 1 and 1/2 times the diameter of the filament. The filament is wound onto the rod so that the turns contact each other.

The filament should not break or crack when so wound.

Filaments are inspected without the use of magnifying devices.

2.10. The dielectric loss angle tangent and dielectric permeability at 10⁶ Hz are determined according to GOST 9141-65 on a type IPP-5 instrument (direct indicating loss meter) and a type KV-1 Q meter (for measurement of capacitance) on the discs, the dimensions and manufacturing procedure of which are indicated in paragraph 2.5.

The electrodes, 50 mm in diameter, made of annealed aluminum foil (GOST 618-62) or tin foil (GOST 1327-47), not more than 0.01 mm thick, are attached to the surface of the disc using condenser oil (GOST 5775-51) or condenser vaseline (GOST 5774-51).

3. Packaging, Marking and Storage

3.1. Polystyrene filaments are wound onto coils. The weight of a coil with filament should not exceed 5 kg. Upon agreement of both parties, filaments may be wound onto coils supplied by the consumer.

The coils of filament are packed in wooded boxes wrapped in paper.

3.2. A printed paper label is attached to each coil, indicating:

- a) Batch number;
- b) Date of manufacture;
- c) Nominal diameter and length of filament.

3.3. Each box of coils carries the following information:

- a) Name of product;
- b) Color and type;
- c) Date of manufacture;
- d) Batch number;
- e) Gross and net weights;
- f) The number of the present standard.

3.4. Each batch of polystyrene filament must be accompanied by a document reporting the results of tests or guarantee correspondence of the quality of the polystyrene filament to the requirements of the present standard.

The document should also contain:

- a) The name of the product;
- b) Color and type;
- c) Ordinal number of batch;
- d) Diameter of filament;
- e) Number of positions of the batch;
- f) Date of manufacture;
- g) Gross and net weights;
- h) The number of the present standard.

3.5. Polystyrene filaments should be stored in packaged form in a clean, dry, heated area.

The filaments should be placed on shelves at a distance of no less than 1 m from heating devices and protected from direct contact with sunlight.

The guaranteed storage life is one year.

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CSO: 8344/1657 C

METALWORKING EQUIPMENT

DEVELOPMENT OF THE METAL WORKING INDUSTRY

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 7, Jul 77 pp 133-138

[Article by I. Gerasimenko, chief specialist of the USSR Gosplan]

[Text] High rates of industrial development especially of machine building, in the Tenth Five-Year Plan period, (in 1976-1980 the output of machine building and metal working will increase 1.5 to 1.6 times) pose higher requirements before the metal working industry with respect to increasing the output of castings and forgings and improving their quality, as well as reducing further material and labor expenditures in production. At the same time, the standard of development of manufacturing castings and forgings, and their design and quality have great importance in accelerating the development of many industries of the national economy and reducing the amount of materials used in the products.

At present, the production of castings and forgings is concentrated in about 25,000 enterprises where basically they are made for "their own needs" and only an insignificant amount is sold outside in accordance with interindustrial cooperation. This situation is due to the fact that until very recently, as a rule, machine building plants of the comprehensive type and very few large specialized capacities for manufacturing castings and forgings for delivery to consumer plants were being created. This delayed the utilization of the advantages of technological specialization and was the reason for the low technical standard of production of castings and forgings. Although such sections and shops are now being modernized and reequipped, the problem of the further development and specialization of manufacturing castings and forgings remains very urgent.

It should be noted that the rate of increasing the production of castings and forgings frequently still does not correspond to the requirements of the development of individual sectors of machine building which handicaps the growth of output. In machining castings and forgings a considerable portion of the metal, more than 7 million tons, goes for shavings. This leads to inefficient expenditures of material labor and money resources of about 2 billion rubles per year in the country as a whole. Moreover, this involves the use of additional capacities and large capital investments.*

* PLANOVOYE KHOZYAYSTVO, 1972, No 11.

According to available data, a reduction in the volume of machining of castings by 1 percent reduces the manufacturing cost of the part by 2.7 percent. At the same time, the higher quality of the castings and forgings, the lower allowances for machining, as well as achieving stable values for the allowances makes it possible to achieve in large-series and mass production of parts comprehensive mechanization and automation of the manufacturing processes. It is well-known that the use of automatic machine tools and automatic lines require especially high precision castings and forgings because otherwise there originate frequent breakdowns in operation (breakage of tools, readjustment of machine tools, etc.), leading to unjustified idle times and a sharp reduction in the efficiency of automation. Therefore, the problem of raising the quality and accuracy of castings and forgings is urgent at present and will remain so in the future.

In recent years, a number of progressive methods for making precision castings and forgings was developed and assimilated. In foundry production, the following methods were applied most widely: chill casting, including that with thermal insulation facing; in shell molds, using smelted models; using gasified models made of block foam polystyrene; machine casting under pressure; electroslag casting; centrifugal casting, etc.; as well as using vacuum for making sand molds without adding binders. The latter method makes it possible to raise the accuracy of the castings, reduce allowances for machining, as well as achieve full automation of the molding and casting cycle. Moreover, it is possible to reduce the weight of the castings considerably and mechanize and automate technological processes comprehensively, reduce the labor-intensiveness of making ingots, and improve the sanitary-hygienic conditions of labor. Thus, by using the new method of chill casting with a thermally insulated shell makes it possible to make precision castings, frequently not requiring subsequent machining, reduce metal consumption by 10 to 20 percent, and, at the same time, raise the reliability and life of the parts.

The production of castings using a gasified model of foam polystyrene reduces labor intensiveness by 15 to 30 percent and simplifies considerably the process of molding the parts. The costs of basic and auxiliary materials are reduced.

Also promising is a method for obtaining high quality castings by electroslag remelting which makes it possible to make shaped castings of complex configurations such as crankshafts, housings for shut-off fixtures, cold rolling rollers, etc. In a number of cases, electroslag castings replace forging, providing a high quality of product.

The availability of the above-indicated methods makes it possible to select the most efficient process as applied to the conditions of production (individual, series, mass), types of casting requirements of the quality of castings, etc. However, so far, progressive casting methods are not distributed far enough, the problems of organizing new production are not fully solved, in particular, optimal capacities are not determined, as well as the efficient organization of comprehensive technological processes. As before, casting in sand molds is used (about 70 to 75 percent) with large allowances (up to 16mm).

Moreover, the utilization of comprehensive mechanization and automation is delayed by a considerable volume of individual and small-series production (65 to 70 percent).

With the rise in machine building production, new demands are being made on the quality of the castings as the requirements for them are increased. The prevalence of small foundry shops and sections (with an annual output of up to 5000 tons) cannot satisfy modern machine building. In this connection, there is the problem of concentrating and specializing foundry production in optimal volumes (25,000 to 30,000; 60,000 to 80,000; 90,000 to 100,000 ton) and its organization as applied to concrete requirements of each sector of the industry.

Along with this, there are a great number of uniform castings and castings of the same type used in many industries. Here it is possible to realize interindustrial specialization of manufacturing castings based on its efficient organization, mechanization and automation of processes, equipment and working positions. This would make it possible to raise the efficiency of production, reduce material expenditures and production costs.

The achievement of optimal specialization of enterprises requires solving a number of methodological and economic problems, in particular, the development of typical plans for plants and shops, taking into account the modern achievements of science and engineering, creating main enterprises that must finish up progressive technology using the latest high productivity equipment. It seems that for small-series production, it would be expedient to build foundry shops with capacities of 25,000 to 40,000 tons and 8000 to 15,000 tons for individual production and a limited number of types of castings, as well as castings for repair purposes.

The correct solution of these problems requires extensive analysis of the trends in the development of foundry production, the selection of areas of efficient utilization of each of the indicated methods of casting, the calculation of optimal capacities of shops and plants, and their efficient location in economic regions.

At the beginning of 1976, the production of castings was 42 percent of the total volume of production of unfinished work pieces including steel castings -- 9.7 percent, and nonferrous castings -- 1.9 percent. Calculations show that in many cases, it is expedient to replace steel castings by welded semi-finished work pieces. This simplifies the technology and eliminates the necessity of complex and expensive foundry equipment, saves a considerable amount of metal, improves labor conditions and reduces operating costs.

Essential changes must occur in foundry production in the very near future. First of all, the following must be done at a number of plants and shops being built and at existing enterprises: cold blast cupolas should be replaced by induction furnaces and the duplex process, in which a cupola plus an induction channel furnace or crucible furnace, is used more widely. The use of induction furnaces makes it possible to obtain high quality cast iron (with a high uniformity of the chemical composition of the metal), reduce the loss of metal by 1 to 1.5 percent as compared to 5 to 7 percent when smelting in cupolas, and make castings of any configuration.

It appears that in the future nuclear power will be used for smelting. In sections with harmful production conditions or where labor is especially difficult, people will be replaced by industrial robots, computers and other achievements of the scientific-engineering revolutions. Highly mechanized plants for manufacturing castings will appear (central foundries) where many operations will be performed in enclosed rooms, while the processes will be controlled by special panels.

In the Ninth Five-Year Plan period, the production of cast iron increased by 14.1 percent, steel castings -- by 23.3 percent, and nonferrous castings -- by 38.4 percent. As may be seen from the cited data, the production of nonferrous castings, mainly from light alloys, developed at an accelerated rate which facilitated a reduction in the weight of machines and products.

In the Tenth Five-Year Plan period, the rate of development of casting production, of cast iron in particular, especially of high quality cast iron ingots must increase because the quality casting requirements of machine building and other industries of the national economy increase constantly. A number of machine building sectors created large specialized capacities, as well as interindustrial plants (central foundries) equipped with modern foundry equipment, and mechanization and automation facilities.

Considerable changes are also occurring in forging-pressing production. From 1940 to 1972 inclusive, the pool of forging-pressing equipment increased from 199,000 to 845,000 units. At the same time, the efficiency of forging-pressing production increased, its organization improved, technology improved, and shops and sections were equipped with modern equipment. The wise use of new equipment facilitated a rise in the productivity of labor and a reduction in the amount of metal used in forgings.

The basic reserve for raising the productivity of labor further and saving materials is in making the shape and dimensions of the forgings as close as possible to the shape and dimensions of finished products in order to reduce machining. There are considerable reserves here.

A big achievement in forging-pressing production is closed impression die forging which makes it possible to reduce machining of parts and in some cases, eliminate it entirely. In closed impression die forging minor internal defects are eliminated, a better structure is provided and the

strength properties of the products are increased. Along with this, rolling, extruding and drop forging are used more and more, gradually displacing outdated methods such as, for example, hammer-smith forging.

Especially efficient is drop forging in crank presses and rolling metal. The first method was found to be especially advantageous in the mass production of such products as pinions, hobbing cutters, sprockets, drills, etc. The use of drop forging has increased, especially of high precision forgings. At the same time, there are beginning to be introduced more widely high productivity machines with programmed control and new methods of forging based on the principles of intensive plastic deformation (explosion forging, pulse forging, hydraulic extrusion and from liquid metal).

However, forging-pressing production is scattered at present among numerous plants, shops and sections. Their loading is extremely uneven and depends, to a considerable extent, on the list of the products being manufactured. In the total volume of metal working, 8 percent is drop forging, while about 2.1 percent are forgings from ingots; forgings from rolled stock, the production cost of which is 1.3 times higher than forgings from ingots, are used widely.

Domestic and foreign experience shows that high efficiency of production may be achieved by concentrating forging-pressing production at special plants and shops with a capacity of 60,000 to 150,000 tons annually. Thus, the Tokmakskiy Central Forging Association operates successfully and their experience may be used for further improvement in forging-pressing production.

Nevertheless, this manufacturing facility, in spite of a considerably high productivity, is rather expensive in a number of cases (especially in drop forging). Therefore, instead of manufacturing a number of inefficient kinds of forgings and stampings, it is expedient to manufacture welded structural metal from rolled stock, as well as welded-forged semifinished parts, and replace forgings by electroslag castings made by electroslag remelting.

Recently, forged-welded and stamped-welded semifinished parts, that are considerably less labor-intensive, are beginning to be used widely. Thus, by using welded-forged 2 x 2.6 meter cross section semifinished products for an experimental rotor for a 500 megawatt turbogenerator using electroslag welding, it was possible to build a turbine shaft successfully and save conditionally 20 million rubles.

To raise the standard of specialization of forging-pressing production, it is necessary to realize industrial and interindustrial cooperation in the production of forgings of the same type and, if necessary, limit the list of forgings and stampings for each plant, shop and section. This would create favorable conditions for using specialized equipment, achieve comprehensive mechanization and automation of manufacturing forgings, introduce the latest production technology and improve the productivity of labor.

In the Ninth Five-Year Plan period, the production of forgings from ingots increased by 17.7 percent and of stampings -- by 22.9 percent, which facilitated the creation of efficient, primarily welded structures and a reduction in their cost.

In the Tenth Five-Year Plan period, the volume of production of metal-cutting machine tools and forging-pressing machines will increase 1.5 to 1.6 times. In 1980, it is planned to increase the output of forging-pressing machines to 58,000 units. The accelerated development of production of forging-pressing machines, lines and sets of equipment will insure obtaining precision forgings.

In modern machine building as in the transport and construction industries, welded structures are used widely due to their high technical-economic indicators and due to the almost unlimited possibilities for creating various units and parts for modern machines, apparatus, equipment, etc. At the same time, the weight of the machines and products is reduced, metal is saved (about 10 to 25 percent) and the amount of labor is reduced.

Moreover, capital investments for creating capacities per ton output of welded parts are about 2.9 times lower than for steel castings, 4.7 times lower than for forgings from ingots and 6.3 times lower than for forgings from rolled stock.

Welded designs make up 48 percent of the total volume of the output of semifinished products. Recently, new in principle progressive methods for welding metals were created such as electroslag, electron beam, plasma beam, laser, induction, induction-press, thermal compression, cold, blast, friction, ultrasonic, magnetic-pulse, etc. This wide selection makes it possible to weld efficiently, taking into account the special features of the materials and requirements imposed on welded designs.

As various processes are developed for welding, gas and plasma cutting and hard-facing, as well as of various materials and equipment, a new direction was forming -- welding production, that now occupies a leading place in the production of semifinished parts. This was due to the reduction in capital investments necessary for creating production capacities, as well as the comparatively short times it took to assimilate them and insignificant current expenditures. As a result of this, favorable conditions were created for the accelerated development of welding manufacture, the replacement, in a number of cases, of steel castings and various forgings from ingots and rolled stock by welded forgings and casting by electroslag remelting.

Thus, in 1971-1975 in the construction, road and municipal machine building industries, 20 installations for air-plasma cutting of rolled sheets were introduced in enterprises which made it possible to improve the quality of the cut and raise the speed of cutting 5 to 6 times. The pool of welding equipment grew considerably in the industry by introducing over 2000 units of various types of high productivity equipment. Besides, 20 shops and 220 sections were comprehensively mechanized and 135 flow-mechanized lines were started up in assembly-welding production.

Technical-economic indicators were raised considerably as a result of realizing organizational and technical measures. Thus, the output of a welder increased from 134 tons of welded structures compared to 115 tons in 1970, while the level of mechanization of welding increased to 64 percent as against 49 percent during the same period.

Such measures were also realized in other sectors of machine building which facilitated increasing the output, reducing the amount of materials used, and reducing labor and money expenditures. The wide use in the Soyuzsel'-khoztekhnika system of welding and hard-surfacing when repairing and restoring agricultural machines made it possible in 1975 to restore parts in the amount of 230 million rubles. A new method for manufacturing perforated welded beams is being introduced in construction and an installation was created for their manufacture. This raises the productivity by more than 3 times and saves 25 to 30 percent of metal. Moreover, the realization of other measures on creating efficient welded structures saved the national economy about 7 million rubles.

An important step in laying pipelines is the creation of a special design complex of equipment for contact butt welding of 1420mm diameter pipes with automatic testing of the quality of weld which makes it possible to raise considerably the rate and improve the quality of building pipeline mains (70 to 80 pipe joints can be welded in one shift). The output per worker increases 3 to 4 times and costs of manufacturing such an installation are repaid in one year.

All of this created new potential possibilities for economic growth in the Tenth Five-Year Plan period.

The data in the Table shows how the structure and relationship of the production of various kinds of semifinished parts has changed in 15 years (1960-1975).

During the indicated period, the production of welded structural metal increased considerably as a result of which they are now in the leading place. At the same time, the production of light alloy, especially aluminum, castings increased noticeably which is important for the amount of metal used in several kinds of products.

The rise in the output of welded structural metal was also observed during the Ninth Five-Year Plan period. Many industries of the economy changed over to welding rolled stock and pipes instead of using labor intensive and inefficient cast parts of machines and equipment, especially those made of cast steel; the use of efficient stamped-welded, cast-welded and forged-welded parts increased. At the same time, welded structures use more and more progressive materials such as: high strength steel, bent and light shapes of rolled stock, welded H-beams, thin-wall welded pipes, bimetals, etc. In 1975, welded units used the following: rolled stock from high strength steel -- 139,700 tons, rolled stock -- 889,300 tons and other efficient materials.

Table

Type of semifinished products	Design of semifinished products, % of the total			
	1960	1965	1970	1974
Welded structural metal	35.5	40.4	45.5	48.3
Drop forging	10.1	8.6	8.1	8.0
Forgings from ingots	2.5	2.4	2.2	2.1
Castings including	51.9	48.58	44.2	41.6
cast iron	-	36.2	32.7	30.1
steel	-	10.9	9.8	9.7
nonferrous	-	1.5	1.6	1.8

Along with that, hard-surfacing of working surfaces of machines, equipment and cutting tools increased to 42,400 tons of built-up metal in 1975, which also produced a considerable saving.

The summary of international forecasts "The World in the Year 2000" states that the technology of forging, including machine forging will be displaced by the improvement of the existing technology and the development of new welding technology, using powder metallurgy on industrial scales, as well as a continuous casting process, cold pressing and casting under pressure. Of course, this is only a forecast for the future, but it characterizes the trend of development in this area that has appeared in the technology of production. The forecast notes further that "Raising the efficiency of electrohydraulic, electromagnetic and other methods of stamping and welding makes it possible for stamped and welded shaped steel to compete with the traditional rolled stock. Also expected is "the advent of more significant and radical shifts in the technology of metal working of steel by pressure without producing chips."*

At present, about 140 methods for metal welding are used and automatic contact and arc welding of various products are used widely. By using groups of robots, full automation of the welding line of motor vehicle and other parts of units is achieved which makes it possible to free workers from monotonous and tiring operations.

It should be noted, however, that welding production is still scattered throughout many shops and sections, and are sometimes located in nonspecialized shops and even in the open. This leads to higher requirements in equipment, materials, fixtures, tools, production areas, scattering of money resources, reduction in quality and higher costs of products.

* Kh. Baynkhauser, E. Shmakke. "The World in the Year 2000." Summary of International forecasts, Moscow. PROGRESS, 1973.

Therefore, the problem of concentration and specialization of the manufacture of welded structures, units and parts must be the center of attention of each industry in order to achieve the best results in production. The electrical equipment industry must provide great help in solving this problem by creating automatic, semiautomatic and flow-mechanized lines for manufacturing welded units and products, as well as making various kinds of special electric welding equipment.

A considerable role in developing welding manufacture is played by machine tool building and tool building industries in creating automatic, semiautomatic and flow-mechanized lines for manufacturing the semifinished products used in welded structures, producing mechanization facilities and auxiliary welding equipment, as well as machine tools for welding by friction, and equipment for cold and press welding.

The specialization of the production of welded structures may be realized by building individual specialized plants (welding centers) with capacities of 50,000; 100,000; 150,000 and 200,000 tons, medium size and large size shops, in individual cases, groups of shops, as well as by expanding and modernizing existing shops. The most efficient is the specialization of welded structure production in accordance with established kinds of products, primarily in large-series and mass production, on the basis of mechanizing production processes, for example, in the motor vehicle and tractor industry; in the production of products and units for general machine building applications; and in several other industries where the production of similar types of products can be organized by using the modern achievements of science and engineering.

At the same time, along with taking into account the effect of the scientific-engineering revolution, it is necessary to consider the problems of specialization in operational practice. It is well known that in the process of its realization, new kinds and types of products originate (primarily individual or small-series), especially, in the starting period of their creation. This may lead to a considerable increase in the list of semifinished products and reflect negatively on the specialization level of a given kind of production. The determination of optimal sizes of enterprises is a very complex and responsible stage of planning.

Specialization of welded structure production may be realized in accordance with the kind of structures (machine building, construction, technological, welded fixtures, as well as in accordance with types of materials (structures made of stainless steels, aluminum alloys, etc.). The VNIIMETMASH [All-Union Scientific Research, Planning and Design Institute of Metallurgical Machinery] of the USSR Gosstandart developed technological classifications for welded structures in machine building, making it possible to classify welded units in accordance with design-technological criteria and established large-series and mass production of welded units instead of the existing individual or small-series production. Thus, the creation of specialized sections, shops and welding centers for the production of welded units and structures is an important factor in the development of the production of semifinished parts on the new technical basis.

The party and the government devote a great amount of attention to problems of developing specialization and organizing efficient cooperative supplies of semifinished metal parts, and building large enterprises for the production of products for general machine building applications.

Speaking at the 25th party congress, A. N. Kosygin, chairman of the USSR Council of Ministers, stressed that "In the Tenth Five-Year Plan period, there will be an increase in the rate of production of automated casting, forging-pressing machines, lines and sets of equipment for making high precision semifinished products. Production will be organized of equipment for making semifinished products using new and combined methods (such as electroslag casting, casting-stamping, stamping-welding, metal ceramics, etc.), making it possible to obtain semifinished products of complex shapes with dimensions close to those of the final products, which makes it possible to produce products practically without loss of metal."*

It may be seen from what is stated above that problems of the technical policy of semifinished product production acquire greater importance in providing accelerated development of machine building, metal working and raising the efficiency of production. Under conditions of intensive development of industry and transport, it is urgently required to create new, as well as to improve, existing processes for manufacturing semifinished products for the purpose of raising their quality, reliability and life, reducing labor-intensiveness and production cost. One of the most important directions in solving this problem is the concentration and specialization of the production of semifinished products, the use of progressive technology and modern high productivity types of equipment.

The scientifically substantiated development and efficient territorial disposition of industrial and interindustrial semifinished product manufacturing facilities requires, first of all, the realization of typicalization and standardization of basic types of semifinished products for mass and series production, and the determination of the economic regions where their production would be organized in the visible future. Moreover, in locating interindustrial production facilities, it is necessary to take into account how well machine building enterprises and group bases within the radius of reasonable transportation costs are provided with the necessary material, power and labor resources, and other factors affecting their efficiency. This will make it possible to determine the optimal capacity for producing semifinished parts and provide the greatest output at the lowest unit costs.

* "Materials of the 25th Party Congress." Moscow, Politizdat, 1976, p 138.

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