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DEVELOPMENT OF SOVIET QUALITY METALLURGY

/Numbers in parentheses refer to appended list of sources./

Prewar Growth

At the beginning of the First Five-Year Plan (1927-28), the USSR produced 90,000 tons of quality rolled metal, constituting 2.6 percent of the total rolled metal output. In this period, quality rolled metal was produced primarily from carbon steel, alloy steel still being imported for the most part. In 1929-30, the import of quality steels was 21.5 percent of total consumption. At the same time, 62 percent of automobile and tractor steel was imported, and such steels as stainless, heat-resistant, and ball bearing were practically all imported.

By 1935, the output of quality steel of the "Elektrostal'" Plant was as high as 120,000 tons per year. In 1925, "Elektrostal'" produced 27 grades of quality steel, for the most part tool steel; in 1931; it produced 59 grades; and in 1934, 100 grades, including stainless, ball bearing, structural, and magnet. An additional 94 grades of steel were produced here experimentally.

The output of quality rolled metal in the USSR from 1930 to 1940 increased more than 13 times and the percentage of quality rolled metal, despite the sharp increase in output of rolled metal as a whole, increased from 5.2 to 24.4.

The old Verkh-Isetskiy Plant, once a producer of roofing tin, pickled iron, and a small quantity of dynamo iron, during the First Five-Year Plan considerably increased its output of dynamo steel and organized production of transformer steel. The plant has also successfully fulfilled orders for electrical engineering steel.

In 1929, the Stalingrad "Krasnyy Oktyabr'" Plant was designated the main metallurgical base for the Stalingrad Tractor Plant. By 1934, almost all steel smelted by the plant was quality, with commercial grades constituting less than 0.5 percent. Output of rolled products from alloy steel increased from 5.1 percent in 1930 to 35.3 percent in 1934, and the plant was transformed into the largest supplier of quality and high-quality steel for the automobile, aviation, and other branches of industry.

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By 1933, the percentage of quality steel in the output of the open-hearth shop of the "Serp i molot" Plant was 94.7, and of quality grades of wire in the steel-wire shop, 99 percent.

Prior to 1930, the Serov Metallurgical Plant produced rails and rolled sections. In 1930 it was converted to output of quality steels. From 1930 to 1933, output of quality rolled carbon steel increased from 13,000 to 68,400 tons. The plant since then has adopted production of a large volume of calibrated steel and the smelting and rolling of a number of grades of alloy steel.

"Dneprospetsstal'" since its inception has become one of the largest centers for production of rolled, forge, and calibrated electric steel, and also produces carbon and alloy tool steels. "Zaporozhstal'" until the war produced high-quality hot-rolled and cold-rolled sheet for the automobile, aviation, and other branches of industry.

In 1937, the USSR smelted 860,000 tons of electric steel, 4.8 percent of the total quantity of all steel smelted. In 1940, the percentage of alloy rolled metal in total rolled metal production was 6.3.(1)

Wartime Adjustments

The changes made during the war and the demands of wartime production led to a great increase in the output of quality rolled metal, particularly alloy rolled metal. In 1943, the share of quality rolled metal in total rolled-metal output was 62.2 percent, as compared with 22.4 percent in 1940; and the share of alloy rolled metal in total rolled metal production was 20.6 percent, as compared with 6.3 percent in 1940. Despite the losses of plants producing quality metal, the production of quality rolled metal, particularly that of alloy steel, was considerably higher in 1943 than in any prewar year.

Among the technical achievements made during the war is the work on converting the smelting of a number of grades of high-alloy steel from electric furnaces to basic open-hearth furnaces. After the evacuation of the "Dneprospetsstal'" and "Elektrostal'" plants, both of which smelted high-alloy electric steel, it was necessary to organized production of this steel in basic open hearths. A special technology for the steel-smelting process and subsequent conversions was developed, and it was decided to produce an open-hearth steel with the technical specifications of electric steel, in order not to decrease the quality of the finished products. The Zlatoust Plant and the Plant imeni Serov played particularly important roles in this work. The rich experience in the production, control, and utilization of high-quality basic open-hearth steel showed that with strict observance of necessary technology, this open-hearth steel answered the technical specifications for electric steel, although it was not quite up to the latter in certain respects.

Particular difficulties were encountered in the adoption of basic open-hearth smelting of the most needed high-alloy structural steels, especially grades 18KhNM (V) A and 25KhNM(V)A. These difficulties were overcome, and it was possible to start regular smelting of the metal, which was only slightly inferior to electric-smelted steel (chiefly in the resiliency in cross-section tests), and was satisfactory used in production of the most demanding types of products.

Under wartime economic conditions, particularly great importance was given to the decrease in consumption of alloys in smelting open-hearth steel. Alloy waste products began to be used in open-hearth charges. The technology for smelting chrome-bearing charges in high-alumina slags was developed and made possible the use of up to 80 percent chromium of the charge. Metals with smaller scarce alloy content were successfully used in place of certain high-alloy steels. In the Postwar Five-Year Plan period, production of low-alloy open-hearth steels will have an important place. These steels will have high durability and corrosion resistance and will be smelted from naturally alloyed pig iron. Smelting of a number of high-alloy steels and highly siliceous transformer iron with low watt losses well begin in open-hearth furnaces.(1)

Role of Eastern Plants

In October 1941, output of quality rolled metal at eastern plants was more than twice the output in these same plants in June 1941; in absolute volume, it almost reached the entire prewar production of the USSR, while in 1944, it exceeded it 3.7 times. As a result, the proportion of quality rolled metal output at eastern plants in 1944 was 66 percent, as compared with 26 percent in 1940, and at the Magnitogorsk and Kuznetsk combines, 71-73 percent, as compared with 10-12 percent in 1940.

The Kuznetsk and Magnitogorsk combines played a particularly great role during the war in output of quality steels. Before the war, both combines produced common grades of steel primarily and were equipped for this purpose alone In 2-3 months, both combines were reconstructed for production of armor plate, with a radical change in the technology used by special armor plate plants. In addition to armor plate, they started smelting a number of the more important grades of alloy steels in the large open-hearth furnaces.

In 1944 the production of steel pipe in the East increased more than four times in comparison with prewar putput. In 1945, smelting of pig iron and steel and production of rolled products at eastern plants increased more than 1½ times in comparison with prewar output as the result to a considerable extent, of improved utilization of existing equipment.

With the German occupation of the South in 1941, the Zaporozh'ye Plant, largest of the ferroalloy plants, which produced ferrochrome and ferrosilicon, stopped operation. Production of ferromanganese had also been concentrated in blast furnaces of the southern plants which used Chiatura and Nikopol' manganese ores. The blast-furnace workers of the Plant imeni Serov were the first in the history of metallurgy to start smelting ferrochrome in blast furnaces; this process was soon adopted at the Nizhniy Tagil Plant. Blast-furnace workers at the Magnitogorsk Combine started smelting ferromanganese from local Ural manganese ores in the combine's large blast furnaces. The rapid completion of the Kuznetsk and Aktyubinsk ferroalloy plants ensured the flow of ferroalloys throughout the war years.

The supply of manganese ore to eastern plants was of extreme importance. A number of local deposits were prospected, new mines built, and smelting of ferromanganese from the relatively lean ores of the East were all realized in a short time. During the war, output of manganese ore in the East increased three times.

Collection and reprocessing of ferrous scrap was of great aid to metallurgy during the war. In 1944, procurement of metal scrap (including captured) was 91 percent of the prewar level. Eight new plants for reprocessing oversize scrap were built, making it possible by 1944 to decrease the consumption of fresh pig iron in smelting steel to 546 kilograms per ton as compared with 620 in 1940, and to increase the consumption of metallic additives to 198 kilograms per ton of converter pig iron, as compared with 124 kilograms per ton in 1940.

In 1950, eastern plants will be producing 44 percent of the pig iron (instead of 29 percent as in 1940), 51 percent of the steel (instead of 34 percent), and 51 percent of rolled metal (instead of 33 percent).(1)

Postwar Prospects

With the conversion to peacetime economy, the absolute consumption and percentage of quality steel in total production decreased, since reconstruction necessitated large quantities of common grades of steel. At the same time, the assortment of grades of quality steel and rolled metal had to be expanded considerably. At present, Soviet metallurgy produces nearly 400 grades of quality and high-quality metal.(1)

To provide the necessary increase in output of the automobile industry, shipbuilding, electric-machine building, and instrument building, quality metallurgy must by the end of the Five-Year Plan increase the output of pig iron 315 percent over 1945, steel 266 percent, and rolled metal 237 percent.

The largest of the new projects of quality metallurgy is the Chelyabinsk Metallurgical Plant. In 1950, when its construction will be completed, it will have four coke batteries, three blast furnaces, two open-hearth shops with 13 furnaces, two electric-smelting shops with ten large electric furnaces, two blooming mills, a group of bar and section mills, heat-treatment shop, and a large refractories shop. The ore base of the plant will be Bakal ore, which will be treated in an ore-treatment combine now under construction. The Bakal ores will be dried in reverberatory furnaces. Two new sintering lines will be built, and productivity of the two existing lines will be increased. Flue dust will be used in the sinter plant. Siderites will be mined and prepared for sintering and for smelting in the crude stage, the possibility of which will be tested by experiments.

The work of rebuilding "Zaporozhstal'" should in particular be speeded up since it will be the chief supplier of high-quality sheet for the automobile industry. In 1946, the "Krasnyy Oktyabr'" Plant had already achieved more than half its prewar productivity, and complete restoration is expected next year. The Stalino and "Dneprospetsstal'" plants are also under reconstruction in the South. For the remaining plants of "Glavspetsstal'," the following major projects are listed: completion of construction of open-hearth shop No 2 at the Zlatoust Plant, construction of a concentration plant, scrap-sorting base, and coke battery at the Plant imeni Serov, and completion of the sheet-rolling mill at the Asha Plant.

An important measure for saving large quantities of liquid fuel is conversion of the open-hearth and soaking furnaces of the "Krasnyy Oktyabr'" Plant to Archadinskiy natural gas.

The electrode industry must increase the quality of electrodes, consumption of which is excessively great at present. Electric metallurgy is supplying the most important high-alloy steels for all branches of industry, particularly defense, and therefore should not have to depend on imports of electrodes. To improve the technology of smelting the more important grades of steel, work is being advanced on the use of diffusion deoxidation and special deoxidizers, including silicocalcium, silicozircon, and others.

In the new Five-Year Plan, quality metallurgy plants must start production of a large number of new types of products, in particular coal-rolled lacquered plate and cold-rolled transformer iron. The automobile industry has presented the industry with the complex task of organizing production of automobile sheet up to 2,000 millimeters wide with a good finished surface designed for extremely deep drawing. Output of highly durable steel conveyer bands will also be organized on a mass-production scale. Production of burnished and polished steel (silver steel), particularly that with high precision for the clock and medical industries, is being considerably expanded. Special precision equipment will therefore have to be supplied to shops producing polished steel.

Production of special precision alloys of the Permalloy type, including Perminvar, Elinvar, Kovar, etc., will be organized.(2) At present, the USSR has a widely developing production of various types of precision alloys, particularly in the following institutions and plants: Central Institute of Ferrous Metallurgy, Scientific Research Institute of the Electric Industry, in the Ministry of Aviation Industry and the communications equipment industry, and at the "Elektrostal'," Verkh-Isetskiy, and "Serp i molot" Plants, Plant imeni Molotov (Leningrad), and Kol'chuginskiy Plant imeni Ordzhonikidze. However, this industry is still not meeting all demands. In the near future, construction will begin on new bases for production of such alloys, primarily in the Ministry of Ferrous Metallurgy and in the Ministry of the Electric Industry.(1)

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Smelting of tool, stainless, and heat-resistant steels and also high alloy alloys for special purposes will be much expanded. Production of pure alloys and ferroalloys will be expanded for this purpose. Output of metallic chrome, tungsten, molybdenum, ferroniobium, electrolytic manganese, metallic silicon, and highly pure nickel of the Mondovskiy type will be particularly stressed.(2)

Prospects for development of the comparatively new Soviet industry producing spring steel strip and plant springs are tremendous, since in the immediate future, it must completely satisfy the requirements of domestic plants for various types of plant springs for clocks and similar mechanisms. The government has given the task of starting spring production on first-class equipment to a number of plants, and this task is being met successfully. During 1946-47, the spring shop of the Plant imeni Molotov started output of a number of springs for clock plants, in particular 0.12 x 1.5-, 0.21x1.5-, and 0.18 x 1.35-millimeter springs. (3)

The Min'yar Plant, Chelyabinsk Oblast, produces cold-rolled bands of various sizes form iron-chrome-aluminum alloys No 1 and 2, developed by I. I Kornilov. These alloys are distinguished by their high electrical resistance and heat resistance and are used in the form of bands and wire for heating elements in electric furnaces. By their physical properties, they can substitute for nickel-chrome alloys which have a high content of scarce nickel.(4)

SOURCES

1. Stal', Vol VII, No 11, Nov 47

2. Stal', Vol VII, No 2, Feb 47

3. Stal', Vol VIII, No 4, Apr 48

4. Stal', Vol VII, No 8, Aug 47

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