VNIIMETMASH CONTINUES THE WORK
BEGUN BY A. I. TSELIKOV

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The name A. I. Tselikov occupies a special place on the list of names of the distinguished and honored scientists who laid the theoretical and practical foundations of metallurgical machine-building and thus enabled Russia to make great advances in Russian metallurgy and metalworking.

After graduating from Moscow Higher Technical School (MVTU) in 1928, A. I. Tselikov worked at the Izhevsk Metallurgical Plant and the Moscow factory Serp i Molot. Tselikov then became head of the Rolling and Drawing Department at MVTU.

With the creation of VNIImetmash – which incorporated the Perov Machine Plant – Tselikov’s idea of combining scientific research and design with the development of new experimental and commercial technologies sprang to life. Metallurgical plants have since been using the wide range of machines developed under his guidance or with his direct participation – high-capacity rolling mills, pipe mills, section mills, tube-welding mills, continuous casters, oxygen converters, vacuum-degassing units, caster/rolling complexes, etc.

In over a half century of creative activity, A. I. Tselikov published 36 monographs and more than 500 articles and was awarded more than 200 Author’s Certificates and patents.

The achievements of A. I. Tselikov have been well-recognized by the Federal Government: he twice received the title of the Hero of Socialist Labor, Order of Lenin, and Order of the Red Banner of Labor and he has been bestowed the Lenin Prize, State Prize, and the Prize of the Council of Ministers of the USSR.

At Tselikov’s initiative, VNIImetmash has created subdivisions to study and design machines for the entire metallurgical complex (coke-ovens, blast furnaces, and steelmaking furnaces). Among these machines are continuous casters, casting-rolling complexes, units for treating steel outside the furnace, equipment for the continuous “ore-steel” process, and rolling mills.

Working with machine plants, the institute has used the results of model studies and prototype testing to develop new designs of oxygen converters to replace existing converters. The new furnaces have been installed in Russian steelmaking shops and delivered to several foreign countries.

The new converters, with capacities in the range 50–370 tons, are being successfully used at the Novolipetsk, West Siberian, Azovstal’, Severstal’, Magnitogorsk, and Mechtel metallurgical combines and the Dnepropetrovsk Metallurgical Plant.

The first Russian-made 250-ton converter – a furnace which is bottom-blown with a gas–oxygen mixture and was designed by VNIImetmash – is still in use by the oxygen converter shop at the Dneprodzerzhinsk Metallurgical Combine. The institute was awarded the Prize of the Council of Ministers of the USSR for its work on developing oxygen converters.

To replace the existing scheme of transporting molten pig iron from blast furnaces to steelmaking shops, VNIImetmash designed mobile mixers with capacities of 150, 420, and 600 ton-f. The first twenty 150-ton-f mixers have been delivered to the West Siberian combine for transporting liquid pig iron along main rail lines to the Kuznetsk Metallurgical Plant. Mixers with a capacity of 600 ton-f are now being successfully used at Severstal’ and Magnitogorsk. The institute was awarded the Prize of the Council of Ministers of the USSR for its work on designing the mobile mixers.
The first Russian-made batch-type vacuum-degassing unit was designed by VNIIметмаш for 130-ton ladles at Mechel. The institute worked with the the Zhdanov Heavy Machinery Plant (part of the Azovmash Industrial Association) to create a batch vacuum-degassing unit for 350-ton ladles at the Azovstal’ Metallurgical Combine.

To expand production capabilities and make it possible to treat different grades of steel in one vacuum-degassing unit, VNIIметмаш designed a combination unit that can be operated by the batch and circulation vacuum-degassing schemes. One of these units is now successfully being used in the oxygen converter shop at the Magnitogorsk Metallurgical Combine.

VNIIметмаш has also developed and introduced units that allow steel to be finished in the ladle. Two such units are in use on 385-ton ladles at Magnitogorsk and one is in operation on 160-ton ladles at the Il’ich Metallurgical Combine, Mariupol. The units inject steel with powdered reagents, correct its chemical composition with cored and aluminum wire, and perform other functions.

VNIIметмаш designed and made the equipment of a ladle-furnace unit which is part of a complex that makes 100,000 tons of light sections a year. Following Tselikov’s proposal, researchers at VNIIметмаш developed the experimental “Оre-Steel” unit. The unit has a productivity of 10 tons/h, and the production components were made by TsNIIchermet (Central Scientific Research Institute of Ferrous Metallurgy). The new process is based on the following principles:

• processing of oxidized iron-ore pellets, including pellets made from relatively low-grade ores;
• the use of power-plant grades of coal as reducing and heat-transfer agents;
• high intensity and continuity.

Numerous studies have been made of the continuous production of steel from pig iron, scrap, and oxidized iron-ore pellets. Proceeding on the basis of the positive experiences that have been had with the operation of Ore-Steel units, the Ministry of Metallurgy of the USSR decided to build a commercial unit at the Cherepovets Metallurgical Plant.

Prior to the 1960s, only vertical-type continuous casters were used in Russia and abroad. A. I. Tselikov proposed changing over to radial-type casters, which are smaller and have a higher productivity. To do this, in 1963 VNIIметмаш developed an experimental radial continuous caster for casting sections, and in 1964 the first commercial radial continuous caster for casting slabs was made for the Rustavi Metallurgical Plant. Using the work done on the experimental and commercial casters, the institute collaborated with South Ural Machinery Plant and the Ural Heavy Machinery Plant to design radial continuous casters for several Russian factories:

• a slab caster for the Novolipetsk Metallurgical Combine;
• radial bloom casters for the Uzbek Metallurgical Plant and the Oskol Electrometallurgical Combine;
• radial section casters for the Moldavian Metallurgical Plant, Amurстал’, Elektrostal’, the Leningrad Steel Mill, the Bhilai Metallurgical Plant, a metallurgical plant in Pernicke (Bulgaria), and other facilities.

The institute was awarded the State Prize of the USSR for its work on radial continuous casters.

Horizontal continuous casters have several advantages over other types of continuous casters: the metal meniscus is brought out into the mold; horizontal casters can produce quality castings of semifinished light sections; horizontal casters are shorter and contain less metal.

At the initiative of A. I. Tselikov, VNIIметмаш developed several experimental and commercial models of machines designed to make semifinished products of steel and nonferrous metals. Horizontal continuous casters for casting semifinished sections of nonferrous metals were installed at the Kharkov Aluminum-Bronze Alloys Plant, the Proletarskii plant (in St. Petersburg), and the State Bearing Factory (in Vologda). The institute was awarded the Prize of the Council of Ministers of the USSR for its work on developing horizontal continuous casters for producing semifinished sections.

VNIIметмаш designed several horizontal continuous casters to make semifinished steel sections: a commercial model for the Karaganda Metallurgical Combine, designed to make 160 × 160 mm billets (the steel is cast from 120-ton ladles); an experimental-commercial caster for the Kramatorsk Metallurgical Plant, designed to make 145 × 145 mm semifinished products (the steel is cast from 60-ton ladles); a horizontal continuous caster for the Mitsuhima plant (of the Okura company in Japan), designed so that the semifinished product is withdrawn from two sides.

A. I. Tselikov believed that the future growth of metallurgy should proceed along the path of combining the continuous casting of semifinished products and their rolling into finished products into a single production cycle. This task was