THE FIRST-BORN OF DOMESTIC CONVERTER STEELMAKING

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The converter process is now the leading steelmaking process in the world: of the 779.9 million tons of steel that is produced, 541 million tons — nearly 70% — comes from converters (basic oxygen furnaces); altogether, there are 257 converter shops in operation, with 652 converters ranging in capacity from 50 to 400 tons.

On April 22, 1936, Soviet engineer N. I. Mozgovoi became the first steelmaker ever to blow molten pig iron with gaseous oxygen. This marked the beginning of a radically new method of steel production — the oxygen-converter method. Subsequent research by a group of scientists at TsNIchremet (Central Scientific Research Institute of Metallurgy) under the leadership of Academician I. P. Bardin and close collaboration with the production staff at the Dnepropetrovsk Metallurgical Plant resulted in the creation and successful introduction of the nation's first commercial converter-steelmaking technology at Dnepropetrovsk in 1956.

The plant decided to introduce the new technology in its open-hearth shop. To do this, the existing OH shop was rebuilt according to a "Ukrgipromez" design: three 16.8-m³ converters with oxygen lances were installed, a charging yard with equipment to feed charge materials into the furnaces was built, and a gas-cleaning system and other facilities were constructed. On September 21, 1956, a crew headed by K. P. Kravtsov tapped the first heat from a converter top-blown with oxygen. This was thus the date on which a new era in steelmaking began in the country. In a relatively short time, converter technology would make it possible to increase the production of quality steel and allow rapid development of the main sectors of the national economy.


The first commercial heats in the converters were made by a technology, developed at TsNIchremet, that basically consisted of the following steps. Molten pig iron was poured into a 16.8-m³ converter. The amount of hot metal charged was 20.5-21.0 tons, and its composition was as follows: 0.6-0.7% silicon, 1.2-1.4% manganese, 0.08-0.09% phosphorus, 0.06-0.07% sulfur. Oxygen of 98.0-98.5% purity was then delivered to the furnace through a single-channel water-cooled lance with a cylindrical nozzle 42 mm in diameter. Flow rate was a constant 60 m³/min ton. Oxygen pressure was 0.7-0.9 MPa (7-9 atm). The position of the lance was changed during the blow to induce slag formation.

The first batch of lime and iron ore was introduced simultaneously with "ignition" of the process (ore of grade 21, with a maximum SiO₂ content of 21.5%, was used exclusively). Incompletely burned material and kiln lime accounted for 30-40% of this material. The second batch of ore and the remaining lime were added five or six minutes into blow, after the...
primary slag had been removed. An addition of 200 kg of bauxite was made simultaneously to improve slag formation. The last (third) batch of ore was added in the ninth or tenth minute of the blow. Removal of the primary slag was an essential step in the process. Total lime consumption was about 100 kg/ton steel and should have ensured a basicity of 2.5 in the final slag. Iron ore consumption reached 40 kg/ton steel. The excess heat generated was compensated for by supplying water with the oxygen at a rate of 200-400 liters per heat.

At the time, steelmakers did not know how to end the blow at the specified carbon content. A manual stopwatch was the main aid available to the melter foreman. The distributors did not even have such simple devices as timers or a meter to monitor total oxygen consumption. While the operators of modern converter shops have computers at their disposal, 40 years ago the main piece of equipment used by a distributor was the lever that controlled the hydraulic drive of the converter rotation mechanism.

In the first days of operation of the shop, the new technology was used mainly to make rimming steel 0-3kp. This steel was sometimes so overheated and so overoxidized (with a carbon content of 0.05-0.07%) that casters had difficulty "holding" the steel in the ingot molds and obtaining ingots that were suitable for rolling. As a result, the percentage of rolled products that was rejected reached 3.5% during the first months, while the consumption of molten pig iron climbed to 1144 kg/ton. Only in 1957 was the shop able to master the production of rimming steels SV-08 and SV-08A for electrodes, steel "T" for telegraph wire, low-alloy steel 25G2S for reinforcing bar, and steels st3sp and st5sp for crane runways.

The reconstruction of the shop initially led to a reduction in productivity: due to some non-optimal planning decisions, various pieces of equipment could not be used during this period. The long idlings of shop equipment also adversely affected the life of the linings of the converters (reducing it to 27-49 heats). The downtime eventually reached 22% of the nominal operating time.

Working quickly under difficult conditions while the shop was kept in operation, the production staff managed to modernize individual components of the charge system, the lances, cooling-water jackets, gas-cleaning system, and other equipment. The low durability of the converter linings, composed of chrome-magnesite and magnesite bricks made by the Satkinsk Refractories Plant, made it necessary to find new, more efficient refractories. The best material available to the Dnepropetrovsk facility turned out to be magnesite-chromite brick. The technology for making these products was successfully introduced in the refractories shop through the diligent efforts of S. B. Gobelets, head of the refractories section of the central laboratory at Dnepropetrovsk. Use of the technology to make the new bricks increased the life of the linings to 110 heats, which for the conditions existing at the time ensured continuous operation of the shop with the two converters then in operation (the third converter was either being relined or held in reserve).

A redesign of the trunnion ring and shell of the converters and an increase in shell diameter from 3 to 3.5 m (with an accompanying increase in the volume of the furnace to 20 m³) made it possible to change over to operation with a charge of