PRODUCTION OF CORD STEEL AT THE MAGNITOGORSK METALLURGICAL COMBINE

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Studies of the wire rod currently being made at the MMK revealed the presence of nondeformable nonmetallic inclusions as large as 52 µm. The rod was also found to contain aluminates with an Al₂O₃ content greater than 50% and particle sizes greater than 5 µm (6 and 8 µm). Such rod does not meet the requirements established for metal cord. A collaboration with specialists at the company Kordinvest made it possible to determine the requirements that must be met when cord steel is deoxidized with ferroalloys and other materials. In terms of the purity of these materials, the main restrictions are on the allowable concentrations of S, P, Al, and Ti and the gases N and H. A new technology has been developed for making cord steel and treating it outside the furnace, and a trial batch of this steel was made and cast on a continuous section caster in an “open” stream. The company Uralkord has used a trial batch of cord-grade wire rod to make metal cord 15L24. The cord meets all the existing specifications.

Obtaining metal products that meet customers’ requirements and scaling the production process so as to also meet the market demand are currently key problems that need to be given high priority.

One such product is steel for making metal cord. Steels suited for this application are traditionally classified as “clean” steels: steels whose production requires the use of state-of-the-art steelmaking practices. The growth of the automobile industry is also driving increases in the volume of production of metal cord, which makes it very important to improve the technology used for obtaining cord-grade steel.

Steel suited for the production of metal cord has the following characteristics [1, 2]:
• a stable and very narrow range of chemical composition;
• low contents of harmful impurities (chromium, copper, arsenic, molybdenum, nickel, and tin);
• an absence of aluminum and titanium;
• a very high degree of purity with respect to the content of harmful impurities (sulfur, phosphorus), nonmetallic inclusions (NI), and gases (oxygen, nitrogen, and hydrogen);
• the presence of residual NI that are easily deformed during hot rolling and drawing of the wire to the minimum dimensions.

Specimens of wire rod were studied by a method developed by the company Pirelli. The method entails determining the number, composition, and size of the NI and plotting the results on a triangular diagram (Fig. 1). The specimens deemed unsatisfactory are those that contain nondeformable NI larger than 15 µm and 5-µm aluminates containing more than 50% Al₂O₃ (region C of the triangle).

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Use of the Pirelli method to study wire-rod specimens by the existing technology at the Metalltest Testing Center of the Central Research Institute of Metallurgy (TsNIIChermet) yielded unsatisfactory results: nondeformable NI as large as 52 µm were found along with 6- and 8-µm aluminates containing more than 50% Al₂O₃.

Working with specialists from the company Kordinvest to develop technical measures for preventing the contamination of steel by NI and removing existing NI from steel, we established requirements for the ferroalloys and materials used to deoxidize steel. The main limitations on material purity in these requirements reduce to regulation of the content of the

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**Fig. 1.** Distribution of the composition of nonmetallic inclusions in wire rod made by the existing technology.

**Fig. 2.** Distribution of the composition of nonmetallic inclusions in wire rod made by the experimental technology.