USING ULTRASONICS TO INTENSIFY METAL BOILING IN CONTINUOUS CASTING MACHINE MOLDS

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The Central Scientific-Research Institute of Ferrous Metallurgy has collaborated with the Novo-Lipetsk Metallurgical Plant in studying the effect of ultrasonics on intensification of metal boiling in continuous casting machine molds.

Intensifying mixtures or blowing the metal stream with oxygen are used to regulate the depth of occurrence of honeycomb blowholes in rimmed steel ingots, especially when casting speed is increased and particularly when the carbon content is more than 0.13%. In these circumstances, however, the nonmetallic inclusions content of the steel often increases and the honeycomb blowholes occur at insufficient depth.

Steels St 2kp–St 4kp were made in 150-ton oxygen converters and cast into slabs of (240×1070)-(240×1850) mm cross section. One strand of metal was subjected to ultrasonic treatment, the other was cast using the existing technology.

The use of ultrasonics altered the nature and intensity of the boil in the steel. The intensity of the boil in metal from the heats studied when various methods of casting were used is given below, in scale points:

Without treatment	2.0-2.5
Existing technology	2.5-3.0
Ultrasonic treatment	3.0-3.5

The more intensive boil when the metal is exposed to ultrasonics is due to the breakdown of the oxide film on the surface of the molten metal and the resultant increase in the speed of oxygen diffusion. It is known that ultrasonics help to ionize oxygen and consequently to intensify its oxidizing action, and the diffusion effect is caused by a reduction in boundary-layer thickness due to the vibrational velocity of the gas stream.

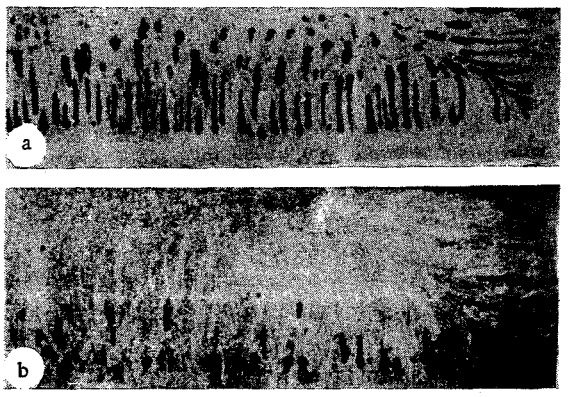

Fig. 1. Macrostructure of cast metal from the same heat, with ultrasonic treatment (a) and with the usual production technology (b); oxygen consumption 16 m^3/h.

Slag on the metal surface in the mold is reduced by ultrasonic treatment, disappearing almost completely in individual cases; the remaining slag is in the molten state. When the metal was blown with oxygen using a special pipe in the mold, there was often a considerable amount of slag on the surface of the metal. Observations showed that in casting using the existing technology and using ultrasonics, slag appeared on the surface of the metal in the mold in 68% and 27% of the heats respectively.

The higher rate of metal boiling when rimmed steel was exposed to ultrasonics led to a reduction in

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