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Studies the Heat Exchange Process during Iron Ladle Transportation

This work is the study of heat exchange process during iron ladle transportation in conditions of Dnieper Metallurgical Plant. Ladle with iron is transported by railway from the blast furnace to the steelmaking plant and returns empty.

Plant workers made around the clock observation of ladle rotation at the plant to determine the time of actual ladle rotation, identify "bottlenecks" in all phases of transportation.

The average ladle turnover time was 295 minutes. Name of operation: ladles transportation to blast furnaces – 99 minutes; waiting for hot metal running – 15 minutes; running and pouring of pig iron – 58 minutes; taking away of ladles from a blast furnace – 4 minutes, transportation of ladles with hot metal to scale – 30 minutes, weighing ladles with hot metal – 3 minutes, transportation of ladles to pouring bay – 14 minutes, pour hot metal from ladles – 31 minutes, waiting for cleaning of empty ladles – 2 minutes, transportation of ladles to scale – 5 minutes, weighing ladles – 3 minutes, transportation ladles to cleaning bay – 19 minutes, cleaning ladles – 12 minutes.

One of the key parameters is the temperature of the iron which should be controlled during the technological operations with iron ladle. Temperature of iron reduces when it moves between bays. This fact influences the additional costs for heating iron in a mixer and the final cost of the end cast iron. Cooling of iron is due to heat loss through the side of the bucket, the bottoms, and the radiation from the surface of the pig iron mirror.

The purpose of the research is to determine heat loss, as well as temperature changes of pig iron and ladle during their movement for further prediction of heat loss and to develop measures for reducing loss of melt heat.

Among these measures can be introduction of heat insulation mixes during technological operations to reduce heat radiation from the exposed surface of the melt in the ladle; use of new thermal insulation materials; optimizing the shape of ladle; screening.

For the calculation of the heat exchange processes of the melt cooling in iron ladle, the following data are used: geometric dimensions of ladle; mass of the melt; initial temperature of the melt; temperature of environment; thickness and number of fire brick layers, thermo-physical properties of the melt and lining materials.