СЕКЦІЯ 5. МОДЕЛЮВАННЯ РОБОЧИХ ПРОЦЕСІВ В ТЕПЛОТЕХНОЛОГІЧНОМУ, ЕНЕРГЕТИЧНОМУ ОБЛАДНАННІ ТА ПРОБЛЕМИ ЕНЕРГОЗБЕРЕЖЕННЯ

EXPERIMENTAL INVESTIGATION OF DROPLET FLOW STRUCTURE WHEN DISPERSING WATER BY WATER-AND-AIR FLAT SPRAY NOZZLES

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Flat spray nozzles have a wide range of applications due to their technical and operational characteristics. In particular, at metallurgical enterprises, the supply of water for ingots secondary cooling in continuous casting machines is carried out using flat spray nozzles. In this case, there are certain difficulties in using these nozzles, since high heat exchange rate and a significant distribution inhomogeneity of heat transfer coefficients in the spray zone. This leads to significant temperature fluctuations and can contribute to cracking on the ingot surface. To decrease the intensity of local heat removal unambiguously means to decrease liquid spray rate for a cooled high-temperature surface. At the same time, it is necessary to provide a large spray zone with a small drop liquid specific flow rate and to maintain the operational reliability of the nozzles. The technical solution of this problem is possible using water-air flat nozzles. A single water-air flat nozzle was investigated experimentally. In an internally mixing nozzle pressurized air is applied to a water jet resulting in a spray. At the outlet of the air nozzle the spray is spreading cone-shaped.

The objective of the experiments was to determine the local specific water flow rate of the drop flow. Geometrical dimensions of the nozzle were as follows: radius of the sphere inside the nozzle: 10 mm; dimensions of the major and minor axis of the nozzle outlet: 6.5×16.5 mm; the angle of the transverse channel: 30 °. Other nozzle geometrical as well as operating parameters varied within the following limits: diameter of the tube for supplying compressed air: 5–12 mm; immersion depth of the air nozzle: 10–60 mm; the air and water mass flow rates ratio: 3.2–21 %; nozzle water pressure: 0.1 MPa, water flow rate: 150 and 300 kg/h, compressed air pressure was up to 0.25 MPa.

The results showed that water-air dispersion leads to a tenfold decrease in water flow rate and liquid spray rate, while the nozzle spray zone is doubled. Thus, by changing the ratio of air and water flow rates, it seems possible to effectively control heat removal by changing the liquid spray rate for the cooled surface.

It was also found that at low compressed air flow rate, a pulsating supply of a droplet flow to the cooled surface is observed, which, in turn, also contributes to a decrease in the intensity of heat removal.

But when using water-air spray nozzles, it is necessary to take into account both the additional complexity of the designed cooling system and the operating costs for compressed air using.