INFLUENCE OF MHD PLASMA ACTIONS IN CASTING MAGNETODYNAMIC INSTALLATION ON HOMOGENEITY OF LIQUID ALUMINIUM ALLOYS AND THEIR PROPERTIES IN SOLID STATE

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When studying the liquid state of the metallic systems, many researches prove that preparation of alloys (for example, on aluminium base) goes with the formation of micro-inhomogeneities in the melt. They are caused by metallurgical heredity of charge. At solidifying of alloys, such micro-inhomogeneities provoke substantial declining of structure and properties. Therefore, it is necessary to provide destruction of such formations. For decision of this problem, a new method of complex treatment of aluminium melts has been developed. It is based on combination of homogenizing influence on liquid metal both electromagnetic and high-power plasma effects. Plasma action is concentrated in the local area of aluminium melt being found into macrovolume of liquid metal. At that, liquid aluminium alloy is contained in a bath of specialized magnetodynamic installation (MDI). The melt is heated by induction currents and thermostated at a set temperature (no more than 800 ^{0}C). Such temperature is substantially lower than the temperature of transition of melt from the metastable micro-inhomogeneity state to micro-homogeneity equilibrium state. So, as a result, two areas of thermal and forced actions are formed in liquid metal: 1) via submerged plasmatron in the melt volume; 2) via crossed electromagnetic fields in a region of direct MHD action on the melt.

The feature of the first area consists is the following. At the nozzle exit section of the submerged plasmatron, the temperature of liquid alloy can be ca. 3000-5000 ^{0}C (it is substantially more than the average temperature of the melt). It causes a considerable temperature gradient. There is evaporation of alloy components in this area, and then, as moving off the area of plasma stream action, there is condensation of components. So, it is a specific type of thermal-time processing, combining alternation of evaporation and condensation. At that, there is realized the thermal destruction of microgroups of clusters with negative hereditary structure.

To provide the processing of all melt volume in the MDI by direct action of plasma, it is used the frequent moving of liquid aluminium alloy under the action of electromagnetic forces generated in the second above-mentioned processing area. That is the feature of the MDI.

Liquid metal in its working area is processed by electromagnetic actions: alternating electric current with density to 20×10^6 A/m^2; alternating magnetic field by induction to 0.3 T (it is created on the definite area of the induction channel, the so called working area of MDU). As a result of superposition of current and field, it is generated volume electromagnetic force (to 60×10^5 N/m3). It provides melt motion. Also, because of MHD-effects there are vortexes originated. Due to frequent passing of the melt through the working area, the indicated factors substantially affect the thermal and forced processing of liquid metal. As result, complex MHD-plasma action on liquid metal realizes disintegration existed regions of micro-inhomogeneities. So, at relatively low overheating of all aluminium melt volume in MDI, this melt repeatedly moves through the local area of the plasma heating (to 5000 ^{0}C) and at one time processed by power MHD and hydrodynamic actions. It causes disintegration regions of microinhomogeneities, removes negative metallurgical heredity, and promotes liquid alloy homogeneity. As result, it is achieved the improvement of structure and rise of properties of solid alloys and castings.