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Rozprawa doktorska

„Modeling of the physicochemical phenomena in the bubble refining of liquid aluminum”.

Abstract

Liquid aluminum for casting and alloying must meet strict requirements for the presence of gaseous contaminants (hydrogen), metals and non-metallic inclusions. As refining with an inert gas is one of the basic contaminant removal procedures, therefore the use of a comprehensive analysis of the barbotage refining process, based on theoretical knowledge as well as mathematical, physical and numerical modeling to improve the conditions for the impurities removal from liquid metal is purposeful. The present work is an attempt at applying this solution to binding components and stages of inert gas refining, i.e. modeling phenomena related to the inert gas bubbles generation, breakup and flow, as well as their contribution to the removal of hydrogen and non-metallic inclusions by turbulent collisions. For this purpose, rotor heads were designed and their suitability tested on a water model of a barbotage refining unit. Then, the results of the physical modeling were compared with the results of numerical modeling, so that on this basis the optimal head model could be determined and such process parameters as inert gas flow rate and head speed selected. An equally important issue solved in this work is the modeling of non-metallic inclusions removal to slag formed through the introduction of refining materials. For this purpose, a computer program was developed and, basing on the physicochemical parameters of the slag, used for analyzing the behavior of selected inclusions at the interfacial boundary, depending on the applied slag-forming refiner..