

Continuous casting (CSC) is currently the leading method of producing steel ingots. In this process, molten steel from a ladle is supplied to a tundish, and then - by submerged entry nozzle - to a water-cooled mold. The quality and structure of semi-finished steel product depends strongly on proper operation of the mold. The great complexity of physical and chemical phenomena occurring in continuous steel casting mold (such as mass and heat transport, fluid flow structure of liquid steel, growth and agglomeration of nonmetallic inclusions, the behavior of the inert gas bubbles and the formation of the slag layer covering the molten metal) affects, that carrying research spanning across all the phenomena occurring in the mold during its work is very difficult or even impossible.

Around the world, a group of scientists conduct intensive studies, both basic and applied, to examine the processes in the continuous steel casting mold. Extensive work related primarily to study of liquid steel hydrodynamic structure and solidification process. Within the project it was decided to focus on analysis of the interfacial boundary of the molten steel and slag in the mold because, as is apparent from review of the literature, this issue is still poorly understood. It is assumed that the planned study will have a form of basic research and allows to find the theoretical dependencies affecting the behavior of the liquid steel layer under the conditions of continuous steel casting process. It was assumed, that research will take the form of numerical simulations using specialized computer program and experiments carried out using a physical model of the actual device (using the criteria of similarity it is possible to simulate the behavior of the molten steel and molten slag in the mold using water and oil).

The first stage of the research will rely on conducting a series of laboratory experiments using a water model of mold. The impact of technological parameters (submergence depth of submerged entry nozzle, casting speed, thickness of slag layer), geometry of submerged entry nozzle and physico-chemical properties of the lighter phase on the movement of oil layer reflecting liquid slag will be described. Next, critical conditions, leading to instability of interfacial boundary and the occurrence of phenomenon of lighter phase droplets entrainment will be determined.

The next stage of the project involves verification of used in the preliminary study multiphase model, based on the comparison of experimental results with the results of numerical simulations. This will allow the selection of the optimum calculation parameters in such a way as to allow to maximize the accuracy of reflecting the movement of the liquid steel and slag in the mold, using only computer simulations.

The final stage of the project will rely on development of a new-design submerged entry nozzle. The main objective will be to achieve as high as possible casting speed, maintaining safe conditions to minimize the risk of entrainment liquid slag droplets into the steel bath.

Although the research planned under the project have nature of basic research (because explain the mechanism of the formation of two liquid phases in the continuous steel casting mold), in the future they may be a basis for the applied research aimed at optimizing the continuous steel casting process.