Liquid Metal Experiments for the Visualisation of the Two-phase flow in a Continuous Casting Model

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The quality of continuous casted steel is significantly affected by the flow pattern in the mould and the SEN. The flow in continuous casting machines is often a two-phase one, because argon bubbles are injected into the melt to avoid clogging inside the casting nozzle. Dependent on process parameters, like the liquid and the gas flow rate, such two-phase flows could become rather complex. Obviously, the actual two-phase flow regimes in the SEN are difficult to predict, but, have a distinct influence on the flow pattern and upcoming instabilities in the mould.

We present an experimental study concerned with the two-phase flow in a mockup of the continuous casting process of steel. A specific experimental facility was designed and constructed at HZDR for visualizing two-phase flows in the mould and the SEN by means of X-ray radioscopy: the X-LIMMCAST (X-ray LIquid Metal Model of continuous CASTing). This setup utilizes the low melting, eutectic alloy GaInSn as model liquid. The argon gas is injected through the tip of the stopper rod into the liquid metal flow. The system operates continuously under isothermal conditions. First results about the two-phase flow will be presented here accompanied by statistical analysis on the argon bubbles and a discussion of the advantages and limitations of the X-ray method.

The position of the X-ray observation window can be changed, which allows the inspection of regions around the gas injection point at the tip of the stopper rod or the development of the bubbly flow in the mould. The X-ray images reveal complex flow situations, for instance, argon bubbles might be attracted by the wall of the SEN near the inlet forming huge bubbles there. Smaller bubbles are generated at the bottom of the SEN, where high shear flows exist. The bubbles in the mould are entrapped by the liquid metal jet. Bubble coalescence can be observed between the bubbles circulating within the flow rolls below the jet. The tendency to rise towards the mould level increases with growing bubble size.

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