EXPERIMENTAL INVESTIGATION OF DOWNWARD GAS-LIQUID FLOW IN A VERTICAL PIPE

Renato Santulli, Italy
Supervisors : M.L.Riethmuller & Ph.Planquart

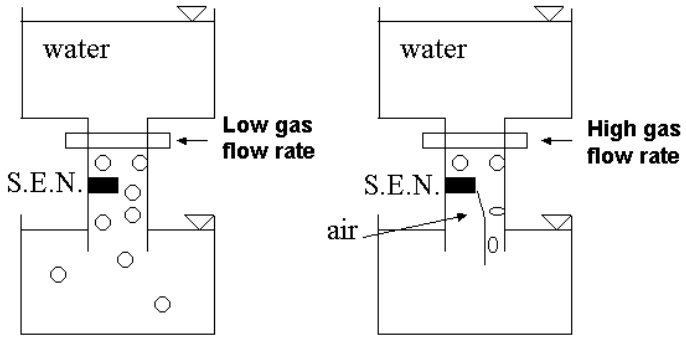
The continuous casting and the shell casting are the most common ways to produce small and medium size ingots. This Diploma Course Project is directed towards the first of these two methods. The research field is the Two-Phase flow inside the Submerged Entry Nozzle (S.E.N.) of the Caster. Diphasic flow is originated by the injection of Argon into the molten steel.

Different ratio between the gas flow rate and steel flow rate induces different regimes in this nozzle. The purpose is to understand and predict the best condition for the Continuous Casting Process. Downward two Phase flow is first studied through a literature survey on Downward cocurrent Two-phase flow.

A fluid-dynamic similitude has been adopted to study the entire process. The two-phase flow is first studied performing volumetric void fraction measurements in an existing scale facility at VKI, then doing measurements of volumetric and local void fraction in a new scaled down facility, built ex-novo. Particular attention was used to highlight the existence of phenomena inside the S.E.N such as transition from bubbly flow to stratified flow and hysteresis behavior. The main reason of building a new facility is to investigate the effects produced by the scaling factor and to perform local void fraction measurements. The comparison between the two model tests shows good agreement, confirming the hypothesis that the Froude Number plays the most important role in the problem. Therefore, useful information for the real case could be extracted.

An optical measurement chain has been assembled to perform local void fraction measurements and a simple optical probe has been built and used. Experiments inside the S.E.N of the new facility were done to reconstruct the local void fraction profile in different casting conditions and to characterize the flow structure. This optical probe was also compared with a commercially available one, recently purchased by the Institute.

The results obtained have shown the different local void fraction profiles between bubbly regime and stratified regime. The type of flow has been characterized for these two regimes computing the size of the structures flowing inside the S.E.N. .



Bubbly regime

Stratified regime