# INVESTIGATION OF THE ANNULAR FILM HYDRODYNAMICS OF A TAYLOR BUBBLE RISING IN A VERTICAL PIPE UNDER STAGNANT AND COCURRENT CONDITIONS

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Gas slug or Taylor bubble flow is a type of gas-liquid pipe flow characterized by the existence of large axisymmetric bullet-shaped bubbles that occupy almost the entire cross-section of the pipe. The wakes of these bubbles are known to enhance mixing and transfer processes and are used for this purpose in many different industrial applications. Between the gas slug interface and pipe wall, there is a thin film of liquid flowing downward as the gas slug rises in a vertical column. The objective of this study is to characterize the flow through this annular film for different viscosities using Particle Image Velocimetry (PIV). With this data, the influence of the annular film flow field can be found on the wake produced by the gas slug. The overall motivation of this work is to understand the phenomenon of coalescence where two bubbles combine together resulting in inefficiency of the gas slug to enhance mixing.

In order to conduct this study, improvements and modifications to an existing facility at VKI were made to better idealize the conditions under which the gas slugs are studied. Shadow imaging and PIV were used to characterize the bubble shape and the annular film flow fields. Also, the application of PIV to bubble flow was studied. Essentially, the bubble/liquid interface shows a mirage of PIV particles where there should only be the bubble. Studies were performed with a silicone model of the bubble with embedded particles to reproduce the problem. The results of the study show a reflection and refraction effect occurring on the bubble interface.

PIV measurements and shadow imaging techniques were applied for 4 different viscosities under stagnant pipe flow conditions and two different viscosities under cocurrent conditions. The first known shear stress measurements were made with the data acquired from the PIV. The results show increasing velocity magnitudes with decreasing viscosity values. Assumptions used in theoretical models of the flow field were also validated.