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NUMERICAL SIMULATION OF FLOW IN A HYDROCYCLONE

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***Abstract*— A new method is presented to predict the localization of an air core, which is usually found on the internal flow of hydrocyclones. The control and stability of the air core affect the flow split between the products of a hydrocyclone. The flow split is one of the least understood aspects of the hydrocyclone operation. This split is greatly influenced by the air core radius, so an understanding of the air core behavior would enhance the prediction of the flow split. The liquid-air interface is characterized by means of the Young-Laplace jump condition. A steady flow of Newtonian fluid is being considered. It was developed a model considering the air core as having a cylindrical shape. This model that we are presenting considers a radius as optimum, when the final expression for the jump condition of the interface liquid - air is minimum. With the velocity field obtained for an optimal air core radius, we can trace the trajectories of the solid particles, thus, it is possible to simulate the performance of the hydrocyclone. The velocity field, the flow split and the selectivity curve obtained are compared to experimental results. Good concordance is achieved.**

***Keywords*— Hydrocyclone, Air core, Turbulence, Free surface.**

I. INTRODUCTION

Hydrocyclones are used extensively to separate and classify solid particles in the mineral processing industry. A strong rotational movement takes place inside the equipment by means of the tangential feeding of fluid and solid particles, because of this field, the solid particles suspended in the fluid tend to move towards the walls. Besides, by the high tangential velocity of the fluid in the central part of the device, the pressure decreases to values smaller than the atmospheric pressure. A low pressure region is created causing the formation of an air core about the central line. In spite of the simplicity of the geometry and operation of a hydrocyclone,it is extremely complex to explain with details the mechanisms of the dynamics of fluids. The difficulty of finding the actual flow of the hydrocyclones makes it necessary to specify the shape and localization of the air core surface.In the usual models of flows in a hydrocyclone, the interface that bounds the air core is modeled as a fixed cylindrical surface, that simplifies the problem greatly. This approximation avoids the necessity of calculating an unknown boundary that modifies the domain, where the field equations must be solved. Nevertheless, such simplification can produce bad results.

Barrientos *et al.* (1993) presented a theoretical model to calculate the air core considering that the liquid-air interface is of the Young-Laplace type. In this model, we must know the radial velocity gradient and the pressure jumps on the interface to calculate the air core. Steffens *et al.* (1993), analyzed experimentally the relation between the air core diameter and the drop of pressure in a single outlet cylindrical vortex chamber in a wide range of operating conditions. They obtained those relationships based on simple models and empirical correlations for the fluid flow. Dyakowski and Williams (1995) showed a model to calculate the flow splits using, as a boundary condition on the interface liquid-air, the same proposal used by Barrientos *et al.* (1993). In a first stage, without the air core, the interface location and shape are marked out by spots in which the pressure is the same as the atmospheric pressure. Davidson (1995) analyzed the air core diameter using a simple model for the fluid flow. He considered a non-viscous fluid in each outlet where a factor modifies the flow considering the viscous effects. In each pressure drop it is considered the principle that the air core diameter is adapted to the largest flux. The resulting expression is iteratively applied during the calculation of the flow in the hydrocyclone and the computational grid is adjusted in each iter-