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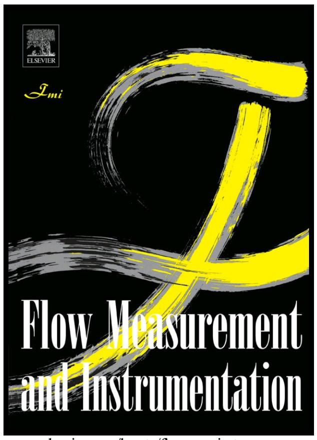

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INCOMPRESSIBLE PULSATING FLOW FOR LOW REYNOLDS NUMBERS IN ORIFICE PLATES

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ABSTRACT

A flow with periodic variations is known as pulsating flow. A particularly important consequence of these flows occurs in the presence of orifice plates, which are devices related to the determination of discharge in pipes. Based on an experimental methodology, this work presents a study on the effects of pulsation variations and temporal inertia on the discharge coefficient. The work includes situations beyond those contained in the standards, particularly for liquid flow in small diameter pipes with low Reynolds numbers. The experiments were conducted on a flow bench, capable of producing pulsating flows inside pipes. For the experimental study of the transient flow, the propagation of a known flow fluctuation was related to a pressure fluctuation, allowing the dynamic calibration of the measuring system. The value of the dynamic discharge coefficient was determined, as well as comparing the coefficients of static discharge and quasi-steady. The results showed that the inertial effects significantly affect the value of the discharge coefficient of the orifice plate, reducing the discharge values.

Key-words: Orifice plate, pulsating flow, dynamic discharge coefficient.

1. INTRODUCTION

Pulsating flows occur in compressible and in incompressible flows, in one or two states or even in multiple states. Among the engineering applications , the main flows of interest are those in natural gas and petrochemical pipes, admission and discharge pipes of reciprocating or rotary compressors, pumps, internal combustion engines, and particularly in hydraulic and pneumatic systems, where there is a need to measure discharges to determine the dynamic characteristics of elements such as servomechanisms (FRAWLEY; GRACE, 2011). Certain forms of pulsating flow are favourable such as those that increase combustion efficiency in combustion chambers. Others are harmful, such as the pulsation associated with the increase of compressor instability, leading to an increase in noise levels.

Research dating from the 1920s describes the difficulties of observing the behaviour of pulsating flows and accurately measuring. Since this decade, several efforts have been made to predict and prevent pulsating flows (METWALLY, 2009). During this period, the works were limited to reporting the problem, studying the nature