Assessment of the cavitational behaviour induced by a symmetrical suction elbow in a centrifugal pump impeller

S Muntean[1,2], **I Rus**[2], **I A Draghici**[3]

[1] Romanian Academy – Timisoara Branch, Bv. Mihai Viteazu, 24, Ro-300223, Timisoara, Romania
[2] University Politehnica Timisoara, P-ta Victoriei 2A, Ro-300006, Timisoara, Romania
[3] AQUATIM S.A., Str. Gheorghe Lazar 11A, Ro-300081, Timisoara, Romania

E-mail: sebastian.muntean@upt.ro

Abstract. The study presents a methodology for evaluating the cavitational behaviour of a centrifugal pump with a symmetric suction elbow. Extensive experimental investigations on the cavitation behaviour of the centrifugal pump equipped with SSE are carried out. The pump cavitation curve $\eta(\sigma)$ is determined based on experimental data. The values associated with the Thoma numbers zero (σ_0), one (σ_1) and three (σ_3) to identify the cavitation regimes corresponding to the operating point are determined. Two-phase flow numerical simulations are conducted for six Thoma numbers considering the numerical setup correlated with the experimental framework. The vapour cavity developed on the impeller blades are visualized for each Thoma number based on the numerical investigations. The development of the vapour cavity on the impeller blades is different from one blade to another due to the flow non-uniformity induced by the SSE. The growth and collapse of the cavitation cavity during a full rotation of the pump impeller leads to faster degradation of the impeller integrity. Further investigations will focus on evaluating the evolution of vapour volume.

1. Introduction

The storage pumps are key elements in the energy market that allow the decoupling of energy consumption from energy production [1]. The degradation of the integrity of storage pumps due to the cavitation erosion occurred in their operation is a major concern for any beneficiary. The special configuration of storage pumps with one or more stages require a good distribution of the flow delivered by the suction elbow to ensure an improved suction behaviour of the impeller or the first impeller [2]. Several investigations have been conducted to assess the behaviour of the storage pumps with different geometrical configurations of the suction elbows [3-6].

The aim of the study is to assess the cavitation behaviour induced by SSE on the pump impeller. The test rig and experimental investigations conducted to assess the cavitational behaviour of the pump together with a SSE are presented in Section 2. The numerical setup (computational domain, boundary conditions, cavitation model, and so on) that is cut from the experimental framework including the centrifugal pump with all parts from the suction pipe to the discharge pipe is detailed in Section 3. The numerical results obtained using two-phase flow numerical simulations for six values of Thoma number are plotted on the pump cavitation curve in Section 4. The vapour cavity