Wear of the materials of the hydraulic turbine cavitation

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Resumen

The consequences of the phenomenon of cavitation in a hydraulic machine are : Forming part load instabilities resulting from work with less than design flow , the formation of torches overload (flows greater than the design performance) , occurrence of noise and vibration, Reduced machine performance Hydraulic (drop in performance), reducing the reliability of the facilities, development of erosion , increase in maintenance costs (not only the talk associated with the substitution (s) affected parts cost , but the problems associated with stoppages production) sufficient to enpesar research processes that allow efientemente problematic measure wear , get started the search for materials or alloys , estableser patterns of electrical signals that establish a mathematical model and observe the variability in time and in this way may make choices that would reduce wear on hydraulic turbines

1. Cavitation

Cavitation is the formation and activity of bubbles (cavities) in liquids. The formation of precisely these cavities takes place when the pressure of fluid falls below the vapor pressure (Pv)

1.1. Occurrence of cavitation

It is well known that if the liquid pressure has dropped sufficiently, begin evaporate this is part of it will undergo a phase transformation, from liquid to gas. The pressure at which this phenomenon occurs is called pressure or saturation vapor pressure (Pv), a value that depends strongly on the temperature of the fluid, increasing rapidly with increasing temperature
Ultimately, the cavitation is produced by a local decrease in pressure below the saturation of the liquid that results in the formation of vapor or gas and in the Abrupt subsequent condensation. It involves nothing less than the boiling point of the liquid at room temperature led to very low pressures
The bubbles begin in the microcavities present in all liquids, precisely called germs or nuclei and within gas and steam coexist in stable equilibrium
Cavitation in hydraulic machines is the result of a reduction in fluid pressure when accelerating move along curved surfaces. The phase change will originate at the surface of the solid or in the fluid medium, where vaporization of nuclei detected
Cavitating flows or currents can erode solid bubbles to collapse following a further increase in pressure above the saturation pressure of the fluid (and provided that these bubbles are close enough surface areas: no collapse erosion is synonymous!) This is the fundamental reason that should be avoided as far as possible, the presence of cavitating flows in hydraulic machines

1.2. Cavitation in hydraulic machines

Cavitation is a phenomenon that should be considered in the design of a variety of machines on which no circulating fluid. Under certain conditions, cavitation may decrease power output and performance of the turbines, can also cause vibration, noise and erosion of nearby materials
The formation of cavitation and its consequences are based on many factors, such as the design and size of the machine, the specific speed or operating point, among others. The influence of these factors has been studied by many researchers in models of hydraulic machines in the laboratory (see eg Hammitt (1980), Laperrousaz et al. (1994) and Bourdon et al. (1994)), and conclude that it is not yet possible to predict the influence of these factors with satisfactory precision. It is necessary to further evaluate the cavitation existing data,

make comparisons with similar geometry units and units with different speeds. Evaluation should be assisted with studies using modeling and simulation to determine the possible site of occurrence of cavitation
From the point of view of use, if cavitation is inevitable, we must know whether a given machine design, with some restrictions, can operate within acceptable standards. Often, the operation with a cavitation is tolerated due to operational needs see figure:1 and 2

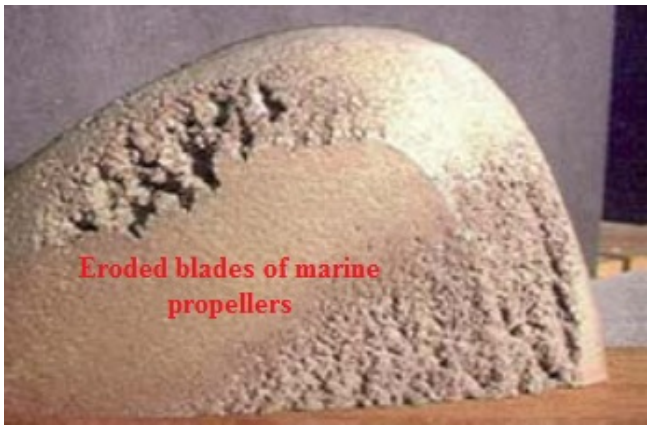

Figura 1: Eroded blades of marine propellers

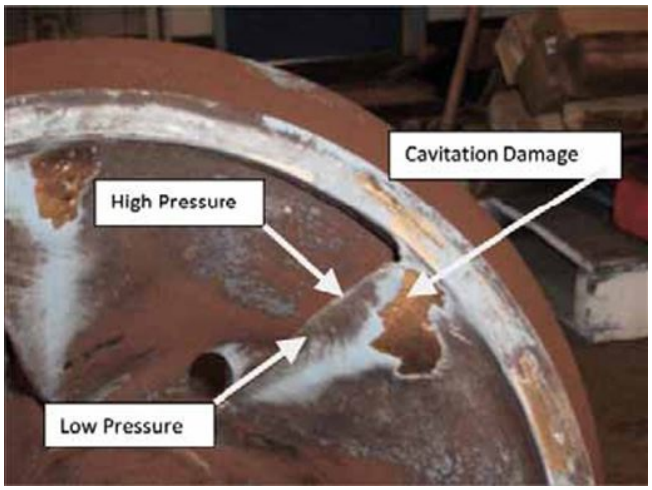

Figura 2: Damage an impeller

1.3. Cavitation depends σ

Acurdo to teaching Dr. Luo Xianwu is the cavitation bubble undoubtedly the most important dependent of σ. Usually appear in the upper surface of the blades, towards the outlet from the impeller and is influenced by the operating point of the machine

1.4. Cavitation does not depend on σ

Cavitation extrados input or suction side (inlet cavitation or Extrados leading edge cavitation), can produce deep erosions in a short period of exposure, as it is the most harmful form of cavitation in hydraulic machines. Used to occur when the turbine works with the biggest jumps Design Cavitation soffit inlet or pressure side (inlet Intrados cavitation). Same as above, but a result of working with low jumps. - Cavitation produced by vortices at partial load (Part-load vortices). Due to the characteristics of flow through the channels of the impeller when operating at very low loads. Is characterized by the appearance of parallel cavitating vortex inducing a strong three-dimensional spill impeller channels. The erosion hazard is low, producing noise (although less intense compared to cavitation soffit entry, pe)

1.5. Cavitation torch

Emergence of a cavitating vortex - called torch- in suction pipe when working at partial loads or Overload. This torch causes pressure oscillations which can lead to unwanted fluctuations of torque on the shaft of the turbine,accompanied by a remarkable level of vibration

2. conclusions

1. It is very important to analyze the phenomenon of cavitation in hydraulic turbines

2. According to the first exhibition of Dr. Luo Xianwu on the problems of cavitation in hydraulic machines takes arouses interest for future research in wear-mediated hydraulic machine having a time with the help of electronic signals observed reflective waves, generate patterns, compare and formulate mathematical models to predict and measure me efficient machine wear.

Referencias

[1] Lecture 1-2-3-4-5 Dr.Xianwu Luo