RESEARCH ON THE OPERATION OF LUBRICATION SYSTEM SEALS THE FRONT OF FOOD MACHINERY AND CAVITATION IMPLICATIONS

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Abstract

Cavitations is a complex physical process that occurs in a stream of liquid in the high speeds and low pressures and changes in the dynamic process is characterized by generating and subsidence quantities (goals) filled with gas vapor stream of liquid. It is therefore a liquid boiling under a vacuum produced by an excess of fluid current speed.

Key words: cavitations, lubrication system seals, food machinery,

INTRODUCTION

In food machinery, cavitations is a complex physical process that occurs in a stream of liquid in the high speeds and low pressures and changes in the dynamic process is characterized by generating and subsidence quantities (goals) filled with gas vapor stream of liquid . It is therefore a liquid boiling under a vacuum produced by an excess of fluid current speed.

There are two types of cavitations:

- Cavitations gas release and dissolution occurs when gas dissolved in liquid
- Cavitations vapor, when evaporation and recondensation occurs when sudden vapor liquid vapor pressure and temperature specific.

The front seal is usually gas cavitations. Liquids with high dissolved free gas (eg CO2 in water) are prone to cavitations. Microscopic bubbles (cavitations nucleus) are the mass of the liquid to initiate cavitations disintegrates if they return to the pressure, but not disappear, become smaller and split compression. Triggering cavitations under reduced pressure may be caused by:

- Changing the flow rate
- Due to oscillation components

Cavitations occurs through the following phases:

Gas absorption is the phenomenon by which gases and vapors forming phase "absorbed" penetrate the mass diffusion of a liquid - absorbing "- the area of separation between two phases. The phenomenon occurs if the concentration of gaseous components absorbed phase is higher than the equilibrium corresponding to the absorbing phase is in contact with the pressure and temperature.

MATERIAL AND METHOD

Cavitations occurs through the following phases:

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Physical absorption occurs only if the gas dissolved in the liquid.

Chemoabsorption occurs if the process is accompanied by a chemical reaction between the absorbed and absorbing. Absorption increases with increasing pressure.

Solubility coefficient is the ratio of dissolved gas volume and the volume of liquid absorbent.

Coefficient of solubility in water (20°C m^3gaz/m3 water atmospheric pressure)

Solubility coefficient = constant at t = constant. Each gas behaves as if being alone.

Gas release (desorption) is the inverse absorption of dissolved gases in solution that is passing gas. (Anton, I, 1979) Release phase occurs when the concentration of dissolved state absorbed is greater than the corresponding equilibrium concentration of the respective pressure and temperature. Desorption increases with decreasing pressure. (Chioreanu N, 2006, Georgescu, Al, 1987, Cornea C 1991).

Cavitations, as shown is a complex phenomenon consisting of gas release due to lower pressure and its recondensation in an area of higher pressure. If certain portions of a moving fluid pressure (p) decreases the vapor pressure (pv) temperature (T) vaporization occurs accompanied by the release of dissolved gases. (Cunningham, F. 1974, Demian T. 1982, Gelubev, G.A 1976,). The diagram (POS) in Fig.1 is represented carrying cavitations.

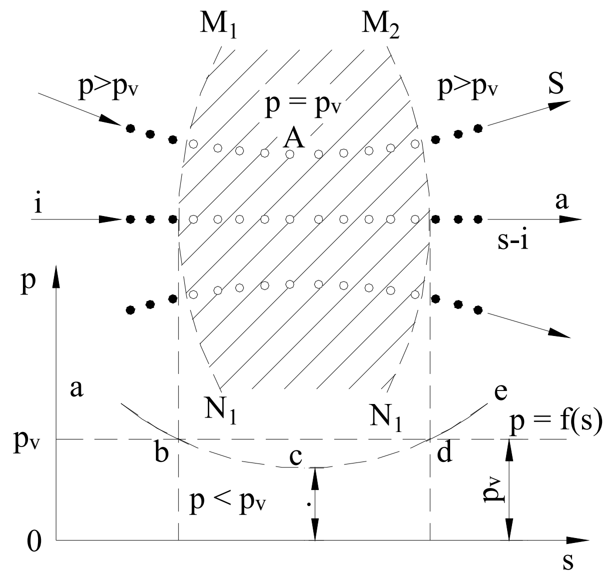

Fig.1. Explanatory diagram cavitation

It is considered a stream of fluid whose pressure varies according to curve a, b, c, d, e.

elementary volumes of water-moving purposes arrows at the border crossing M1N1 vapor and gas bubbles. So in the (A) have a biphasic system.

- M2N2 border cavitations bubbles disappear quickly passing gas in the p> p_v by recondensation. Due to desorption in the (A) pressure can not fall below the vapor pressure, so the actual pressure curve is a, b, d, c.
- M2N2 border recondensation local produce enormous overpressure (thousands of bars) noise and disturbance resulting in cavitations wear.

assumptions cavitations. (Shigley, J,1992, Demian, Tr,1982).

Mechanical hypothesis - Destruction due to high local pressure and surface impact.

Chemical hypothesis - the destruction of metal by applying chemical effect: water vapor released shall freedom pure oxygen which attacks the metal.

Thermodynamic hypothesis attributes the effect of cavitations results in recondensation overheating.

The electric hypothesis explains the phenomenon by potential difference between gas and liquid bubbles. (Chioreanu N, 2006, Georgescu, Al, 1987, Cornea C 1991)

In conclusion, cavitations is the sum assumptions.

RESULTS AND DISSCUSIONS

Cavitations as a phenomenon of wear in front seals, because small study of this phenomenon occurs more frequently in recent years in operation these seals. A series of damage caused by cavitations were attributed to causes: thermal, local overpressure, etc.

There are two aspects of cavitations in front seals;

- Cavitations erosion damage to that effect is due to mechanical action of the jet overpressure.
- Corrosion of chemical corrosion and cavitations including mechanical and chemical corrosion.

Reducing the pressure required to trigger cavitations may be caused by:

- Changing the flow velocity
- Due to oscillation components.

Cavity produced by the flow velocity increases and pressure decreases when the pressure increases when the speed decreases It is favored by the geometry interface sealing rings: undulations, grooves, (working on the interface) that produce sudden pressure changes.

If the oscillations produced cavitations, the liquid adjacent components oscillate at high frequency is alternately compressed and relaxed. For example the front mounted unbalanced seals at a certain speed, the pressure difference is enough gas release takes place before the critical speed occurs when detachment interface. Bubbles will form and break at the same place that the cavitations zone Compression depends on the state bubble fluid flow near solid surfaces, the mechanism presented in the figure

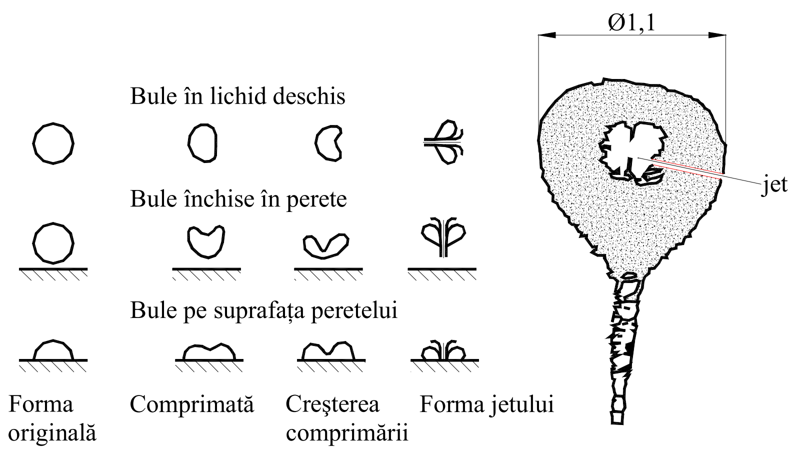

Fig.2. Forms bubbles tablets

Bubbles tend to split tablets suddenly – micro jet dissolution with the formation of size 10% of the initial bubble diameter is accompanied by crackling and creates smaller bubbles micro jet low energy. Micro jet will have a speed of 100-200 m / s and a pressure of GPa order. The high pressure impact erosion of jet impact, drills and solid surface pressures lower impact shattered granular surface structure. The cavitations corrosion layer is affected first creating cavitations erosion conditions (Zeus, D, 1974, Hritescu C. 1989).

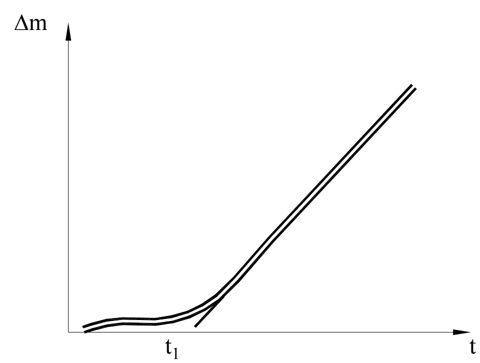

Fig. 3. Cavitations resulting in material by time

In both forms there is first an incubation period (t1) fig.3 then there is a large accelerated aging with loss of material and surface damage.

Sealed environment influence

The gas content is higher (high pressure) with the cavitations intensity is low (impact pressure) but increases susceptibility to cavitations. Sealed environment also influences the viscosity of cavitations, such as decreases the viscosity more than the phenomenon of degassing is facilitated (or degassing easier) and therefore cavitations effect is greater (Hutte, 1995, I Iorga et al, 1972, Mayer,E 1972). For example, cold water is more inclined to produce cavitations than hot water or hydrocarbons.

Pressures and low speeds cavitations bubble occurs sporadically. Pressure and high speed cavitations is formed nests that adhere to surfaces in layers creating cavitations in shock (current).

Advantageous properties for the material to resist cavitations are:

- hardness
- modulus of elasticity
- resistance to breaking
- tenacity
- deformability
- corrosion properties
- microstructure.

The most important is the microstructure of inclusions such as soft, grainy structure that decreases more resistance to cavitations. For this reason, ceramic materials are prone cavitations due to porosity.

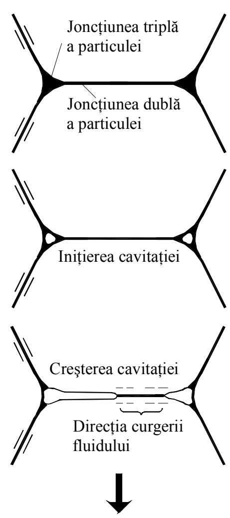

Fig. 4. The mechanism of cavitations damage in the ceramic surfaces

Figure 4 reveals the mechanism of cavitations damage by:
a. The structure of dual and triple junction granulated
b. Initiation of cavitations in the triple junction
c. Extension of cavitations through cracks in the double junction dislocation followed by the number of grain microstructure.

CONCLUSIONS

Damage caused by cavitations in front seals are:

- The interface sealing rings
- On the outside due to working
- Wear by cavitations rate is several times higher than the wear of friction.
- Cavitations erosion is triggered by the porosity in the interface, combined structure material (water, carbonated graphite, v = 4.5 m / s)
- Pitting around a jet drive channel
- Pitting the sleeve around a hollow head.
- Lubrication groove pitting in the interface.

Measures to prevent cavitations

a. Prevention of cavitations by flow:

- Optimizing flow by avoiding discontinuities (edges, grooves, holes, pockets of susceptible environments cavitations)

b. Prevention of cavitations in ceramics by: decreasing the porosity and higher sides processed

c. Prevention of cavity oscillation is caused by the requirement for processing and assembling, increased stiffness elastic closure system and pressure seal its touch (Cristea V. 1973).

Cavitations stage (stage, phase, period, phase) can be determined by "the number of cavities".

Keeping a constant speed, we have, according to boot: (Cristea V. 1973)

- Early cavitations:

$$\sigma_i = (p - p_i) \Big/ \frac{1}{2} \rho \cdot v^2$$

- Extinction coefficient cavitations

$$\sigma_d = (p - p_d) \Big/ \frac{1}{2} \rho \cdot v^2$$

- Limit value coefficient of the cavity

$$\sigma_l = (p - p_v) \Big/ \frac{1}{2} \rho \cdot v^2$$

$$\sigma_d \angle \sigma_l \angle \sigma_i$$

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