CAVITATION IN A WAVY MECHANICAL SEAL

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KEYWORDS
Hydrodynamic Lubrication; Modelling in Tribology; Surface Topography, Mechanical Seal

ABSTRACT
Mechanical seals are sealing devices for rotating shafts. They are composed of two flat annular rings whose contacting surfaces ensure the fluid sealing. These surfaces, even with a good surface finish, always exhibit some residual surface waviness of typical amplitude of 1 micron [1]. The circumferential height variations due to these defects promots hydrodynamic pressure generation in the interface as well as cavitation in diverging areas. Payvar and Salant [2] proposed a well-known model for this type of problem. They highlighted the impact of the rotating speed on the extent of the cavitation zone in steady-state operation. However, in real configurations, both seal faces are wavy leading to a transient problem. In the present work, the behavior of a mechanical seal with two wavy surfaces is studied.

The cavitation model used in this paper was presented by Brunetière [3]. The transient lubrication model was developed by Cochain [4] and is based on the finite element method. The configuration of the problem is described in Table 1. Each seal ring has two waves of amplitude w_r, for the rotor and w_s for the stator. The resulting transient film thickness h is

$$h = h_0 + w_r \sin(2\theta + 2\omega t) - w_s \sin(2\theta)$$

θ is the angular position and ω the rotating speed. h_0 is the central film thickness. It is recomputed at each time step to ensure the axial forces balance.

Table 1 Configuration of the problem

Parameter	Value
Outer, inner radii	14.62 and 11.14 mm
Waviness w_r, w_s	0.5 and 1 µm
Outer, inner press.	1 and 0.1 MPa
Duty parameter G	$\frac{\mu\omega}{2\pi B \Delta p} = 6.3 \times 10^{-7}$

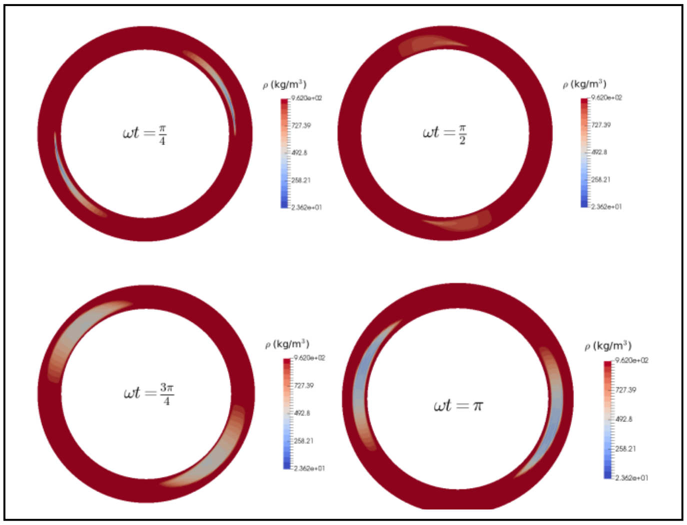

Fig.1 Fluid density of the film at different times

Figure 1 presents density distribution within the contact at different times. The cavitation zones extent and location change with time due to the evolution of the film thickness. The cavitation is due to the hydrodynamic effect promoted by the height variation and to the squeeze effect due to the change of h_0 with time.

ACKNOWLEDGMENTS
A part of this work was supported by the open-Lab Lerded between the Cetim and the Institut Pprime.

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