EFFECT OF SURFACE TENSION IN TWO-PHASE LUBRICATED CONTACTS

N. Brunetière [a*], A.S. Medjahed [b], A. Blouin [a], B. Pap [b]
*noel.brunetiere@univ-poitiers.fr
[a] Institut Pprime, CNRS, Université de Poitiers, ISAE ENSMA
11 bd Marie et Pierre Curie, 86360 Chasseneuil du Poitou, France
[b] Safran Transmission Systems,
18 Bd Louis Seguin, 92700 Colombes, France

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ABSTRACT
There are many examples where a gas can enter a lubricated contact leading to two-phase lubrication. For example, some mechanical seals are equipped with spiral grooves that pump low-pressure air to push back the high-pressure fluid to be sealed to avoid leakage. An example of air ingestion in this type of seal, where the stator has been replaced by a sapphire disk, is shown in Figure 1. The limit between the liquid and the air is materialized by the blue dashed line.

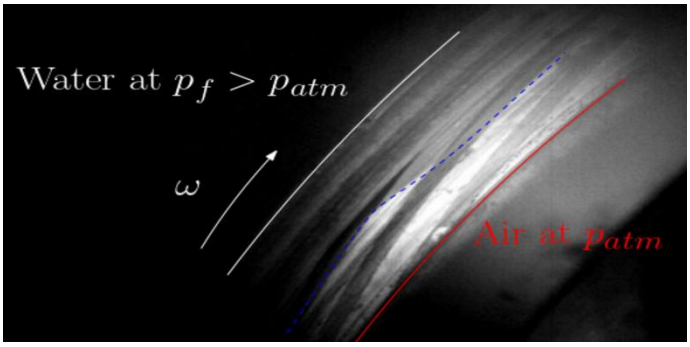

Fig.1 Air ingestion in a mechanical seal with spiral grooves [1]

A meniscus will form at the interface between the liquid and the gas. Due to the curvature R of the meniscus and the surface tension γ, a pressure difference will appear between the two phases. Using the configuration of Figure 2, the Laplace law gives:

$$p_2 - p_1 = \gamma \frac{cos\theta_1 + cos\theta_2}{h}$$

The pressure difference will increase when the surface distance h is decreased. For micrometric distance, the pressure difference can reach one MPa which is significant.

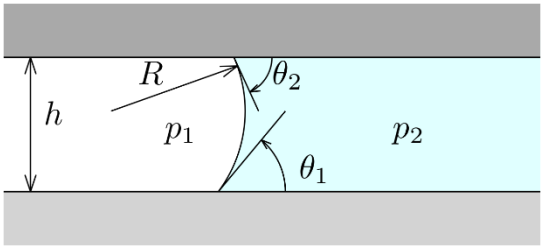

Fig.2 Liquid – gas interface between two surfaces

In a previous paper, the authors presented a numerical method based on the Reynolds equation coupled with a transport equation to analyze air ingestion and two-phase flow. In the present paper, the surface tension is considered using a continuous approach [3]

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