DESIGN AND ANALYSIS OF A HYDRAULICALLY CONTROLLED MECHANICAL SEAL FOR NUCLEAR APPLICATIONS

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EHL; Modelling in tribology; Fluid lubrication; Seals

ABSTRACT

Nuclear reactor coolant pump (RCP) multi-stage seals occasionally exhibit excessive leakage or, less frequently, insufficient leakage from the first stage. To mitigate such problems, it would be desirable to employ a seal in which the leakage could be controlled manually or by an automatic control system.

In the present study the operation of such a seal, to replace the first stage mechanical seal in conventional RCP seal systems is simulated. To vary the leakage, the geometry of the non-rotating seal face is varied. Two options are considered: i. a carbon graphite face with multiple internal cavities containing hydraulic fluid at controlled variable pressures, and ii. a stainless-steel face with a single internal cavity containing hydraulic fluid at a controlled variable pressure. These options are simulated with a soft elastohydrodynamic analysis consisting of a Reynolds equation solver coupled with a finite element deformation analysis.
The results show that both of these options yield sufficiently large control ranges, as shown below. In addition, it is apparent that this conceptual design could be applied to any controlled leakage seal where predictable control of leakage is desired.

Fig. 1 Leakage rate vs. cavity pressure, multi cavity carbon graphite face.

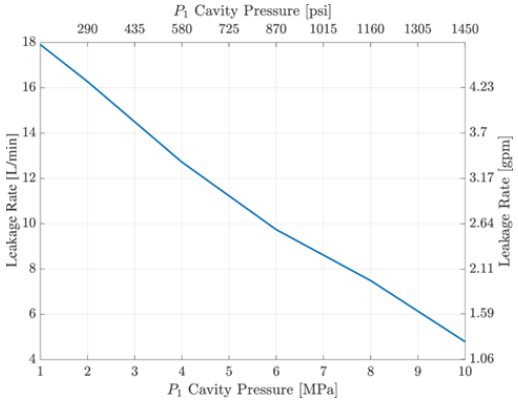
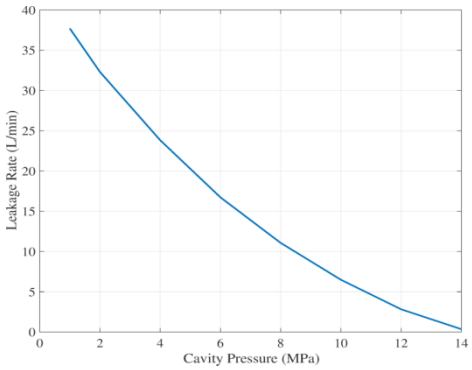


Fig. 2 Leakage rate vs. cavity pressure, single cavity stainless steel face.



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