
Analysis of carbon brush seals with long bristles

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Résumé

The present work introduces the analysis of a dynamic seal (a brush seal) employed in rotating machinery to limit gas leakage between high and low-pressure zones. The seal is comprised of a carbon brush consisting of closely serrated, long bristles of small diameter. The bristles free length exceeds the radial clearance between the rotor and the stator of the device in which the seal is installed. The brush flexes in the axial direction along the rotor and fills the radial rotor-stator clearance. Thus, a porous barrier is formed, impeding the flow of leakage.

Theoretical estimation of the leakage flow rate is particularly challenging due to the complexity of the seal properties characterization, in particular its porosity and permeability. The brush behavior do not only depends on the density defined as the number of bristles per circumferential length, but also on its deformation. This is accounted for by considering the bristles as beams that undergo large deformations. Contact interactions occur between the bristles and the rotor, as well as between the bristles themselves. Bristles experience deformations not only due to contacts but also due to fluid forces acting upon them. By achieving a state of equilibrium between the flow forces and the deformed brush structure, a constant permeability is then established.

(attached.file)

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