Validity of the modified Reynolds equation for incompressible active lubrication

The modified Reynolds equation for active lubrication has been the cornerstone around which the theoretical investigations regarding actively lubricated bearings have evolved over the years. Introduced originally in 1994, it enables to calculate in a simplified manner the bearing pressure field as a function of servovalve controlled pressurized oil injection. This article deals with a preliminary critical review of the simplificatory assumptions that are introduced into the modified Reynolds equation in order to model the phenomena taking place in the interface between the injection nozzle and the bearing clearance. The analysis is performed by means of direct comparison of the results of the modified Reynolds equation model versus benchmark CFD calculations, applied to a geometry representative of the system analyzed. The results show that the modified Reynolds equation mathematical simplicity comes at the cost of reduced accuracy regarding the description of the oil velocity field in the vicinities of the injection nozzle. On the other hand, the modified Reynolds equation results provide sufficient accuracy regarding global magnitudes, such as resulting loads and injected flows, which are essential for designing and operating bearings featuring the active lubrication system.

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