Abstract

Despite their well known superior load and stiffness characteristics, the widespread use of porous bearings in preference to other bearing types has been hampered by difficulties in controlling the permeability of the porous material during manufacture and machining. In addition, instability caused by the additional volume of lubricant trapped amongst the pores poses a problem. Recent research in Japan and at the Technical University of Munich in Germany suggested the use of a two-layered porous bearing as a solution to the problem. This bearing uses a core of coarse grain, highly permeable substrate as structural support, which is topped by a thin surface layer with high restriction to fluid flow. The stability is, thus, enhanced.

The steady state and dynamic characteristics of externally pressurized two-layered porous journal bearings using both oil and gas as lubricant have been studied. Effects of various design parameters on the stability of these bearings are also investigated.

With the usual assumptions of viscous and laminar flow, the pressure distribution in the clearance space is obtained by simultaneous solution of continuity equations in the two porous layers (obtained from Darcy's law) and modified Reynolds equation satisfying the appropriate boundary conditions.

Both linear and non-linear analyses are carried out to study the stability of a rigid rotor supported on two hydrostatic two-layered porous journal bearings. In linearized perturbation technique, stiffness and damping coefficients evaluated from perturbed pressures are used to determine the threshold of instability from the equations of motion under different operating conditions. In the non-linear transient analysis locus of the journal centre is found from the solution of time dependent Reynolds equation and equations of motion marching with time. Journal centre trajectories thus obtained are used to find the status (stable or unstable) of the system.

It has been observed that two-layered porous journal bearings using both oil and gas as lubricant give higher stability as compared to conventional (single-layered) porous journal bearings.