Computer Simulation Study of Slipper Lubrication in Hydraulic Machines

Jordyn B. Miller, Wilkes University and Monika Ivantysynova, Purdue University

Hydraulic pumps and motors are vital components used in many applications today. Specifically, the axial piston pump is important because it is reliable, relatively compact, and has a high horsepower-to-weight ratio. These features make this type of pump very advantageous in hydraulic systems. Maintaining proper lubrication between surfaces in an axial pump, such as the slipper and swashplate, is imperative in order to have smooth operation of the system and prevent metal-to-metal contact. The aim of this research is to find the optimal slipper design and fluid film thickness to simultaneously maintain a balanced pressure and decrease power loss in the pump. Standard slipper designs are compared to multi-land designs through simulations. The simulations are run using the latest models developed by Schenk (2012). The geometry of the slipper along with input operating conditions calculate the gap height of the fluid film, as well as the pressures related to the interface. From this gap height, the efficiency of lubrication between the slipper and swashplate are determined. The results from the simulations are used to compare a design currently in use to both a standard and multi-land design. The simulation studies showed that a careful balance between pocket and orifice diameter is required to reduce leakage while minimizing friction.