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Effect of Discharge Pressure Conditions on Flow Characteristics in Axial Piston Pump

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Abstract : In many kinds of industries which usually need a large amount of power, an axial piston pump has been widely used as a main power source of a hydraulic system. The axial piston pump is a type of positive displacement pump that has several pistons in a circular array within a cylinder block. As the cylinder block and pistons start to rotate, since the exposed ends of the pistons are constrained to follow the surface of the swashed plate, the pistons are driven to reciprocate axially and then a hydraulic power is produced. In the present study, a numerical simulation which has three dimensional full model of the axial piston pump was carried out using a commercial CFD code (Ansys CFX 14.5). In order to take into consideration motion of compression and extension by the reciprocating pistons, the moving boundary conditions were applied as a function of the rotation angle to that region. In addition, this pump using hydraulic oil as working fluid is intentionally designed as a small amount of oil leaks out in order to lubricate moving parts. Since leakage could directly affect the pump efficiency, evaluation of effect of oil-leakage is very important. In order to predict the effect of the oil leakage on the pump efficiency, we considered the leakage between piston-shoe and swash-plate by modeling cylindrical shaped-feature at the end of the cylinder. In order to validate the numerical method used in this study, the numerical results of the flow rate at the discharge port are compared with the experimental data, and good agreement between them was shown. Using the validated numerical method, the effect of the discharge pressure was also investigated. The result of the present study can be useful information of small axial piston pump used in many different manufacturing industries. Acknowledgement: This research was financially supported by the “Next-generation construction machinery component specialization complex development program” through the Ministry of Trade, Industry and Energy (MOTIE) and Korea Institute for Advancement of Technology (KIAT).

Keywords : axial piston pump, CFD, discharge pressure, hydraulic system, moving boundary condition, oil leaks
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