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# Analysis of lubricating characteristics of valve plate pair of a piston pump

Zhaoqiang Wang[1]*, Shan Hu[1], Hong Ji[2], Zhen Wang[1], Xintian Liu[1]

(1. Automotive Engineering College, Shanghai University of Engineering Science Shanghai, 201620, China, wangzhaoqiang_2008@126.com, 15317652575@163.com, wangzhenhello@126.com, xintianster@gmail.com

[2]School of Fluid Power and Control Engineering, Lanzhou University of Technology, Lanzhou, 730050, China, jihong@lut.cn

**Abstract**

The wedge-shaped oil film thickness, pressure and temperature distribution of the valve plate pair of an axial piston pump were investigated using finite difference and relaxation iterative methods and lubrication characteristics for different working conditions and tilt and non-tilt states of the cylinder block were analysed for comparison. The oil film thickness changed when the cylinder block was tilted relative to the valve plate and produced hydrodynamic effects, increasing the carrying capacity. The structural parameter of the valve plate pair influenced lubrication characteristics. The temperature of the oil film increased and the temperature field was unevenly distributed owing to frictional power–related changes to heat energy. The simulated temperature and friction coefficient showed good agreement with measured values.

**Keywords:** Valve plate pair, friction, hydrodynamic, temperature

## Nomenclature

| Symbol | Name | Symbol | Name |
|---|---|---|---|
| $h$ | Thickness of oil film ($m$). | $P$ | Lubricant pressure ($Pa$). |
| $h_0$ | Initial oil film thickness ($0.0325\cdot 10^{-3}m$). | $\eta$ | Viscosity of lubricating oil ($Pa\cdot s$). |
| $h_1$ | Minimum oil film thickness ($m$). | $\eta_0$ | Initial viscosity of oil film ($\eta_0$=0.036572$Pa\cdot s$). |
| $h_2$ | Maximum oil film thickness ($m$). | $\theta$ | Circumferential angle at a point (º). |
| $R$ | Radius of one point on the oil film ($m$). | $\omega$ | Cylinder block speed (3000$rpm$). |
| $R_1$ | Inner diameter of interior sealing belt (0.0298$m$). | $\varphi$ | Cylinder block tilt angle (0.0004º) |
| $R_2$ | Outside diameter of interior sealing belt ($m$). | $H$ | Width of the sealing belt (0.0121$m$). |
| $R_3$ | Inner diameter of outer sealing belt ($m$). | $F$ | Carrying capacity ($N$). |
| $R_4$ | Outside diameter of outer sealing belt (0.0419$m$). | $T$ | Offset load torque ($N\cdot m$). |
| $w$ | Average stiffness of oil film($N/m$). | $F_f$ | Friction force ($N$). |
| $M_f$ | Friction torque ($N/m$). | $f$ | Friction coefficient. |
| $\rho$ | Lubricating oil density. | $C_\rho$ | Specific heat of lubricating oil: ($C_\rho$=870J/kg/k). |

[1]Corresponding author: Vehicle Engineering Automotive Engineering College, Shanghai University of Engineering Science, e-mail: wangzhaoqiang_2008@126.com