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Criterion Study of Fluid Transition Flow from Laminar to Turbulent of Hydrostatic Bearing

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Abstract. Based on the lubrication properties of the heavy-duty hydrostatic bearing, and use many oil pad circular guide hydrostatic bearing on the Heavy-duty CNC machine which is widely used as the research object. Under the condition of changing viscosity, establish the equation of lubricant viscosity-temperature, and calculate the fluid critical flow from laminar to turbulent from hydrostatic bearing gap. Use the finite volume method, based on the actual working condition of the factory. When the rotational speed is 6r/min, simulate the value of hydrostatic bearing inner flow field at different flow, verify the reliability of the calculation results. The results showed that, in this paper the transition critical inlet fluid flow from laminar flow to turbulent of the hydrostatic bearing is 22L/min. Through the above analysis and research, reveals the flow rule of the hydrostatic bearing oil film bearing gap, provides a theoretical basis for actual hydrostatic bearing for engineering structural optimization design.

Keywords: hydrostatic bearing, flow field, finite volume method, flow criterion

1 Introduction

Currently, scholars have studied on film lubrication performance to a certain degree. Scholars Sharma, Satish C. using the finite element method theoretically studied the performance of four containers hydrostatic tapered bearing system. Establish the bearing clearance space control flow lubrication Reynolds equation. Calculate the numerical values of different external load bearing static and dynamic performance. The simulation results show that the oil flow is also a greater impact on the capacity of the tapered bearing [1] .In 2012, Maher, Bilal M. A.studied on the Stokes movement of viscous fluid oil in the fluid hydrostatic bearing, which is elliptical outer boundary, and concentric circle inner boundary. Through analysis in the form of graphics, given a two-dimensional pressure distribution, and calculate the total thrust approximate estimates, derived the result consistent with the aforementioned theoretical results [2].

This paper summarizes the vertical lathe workbench at home and abroad and the performance of hydrostatic guide-ways, study for vertical lathe hydrostatic bearing,

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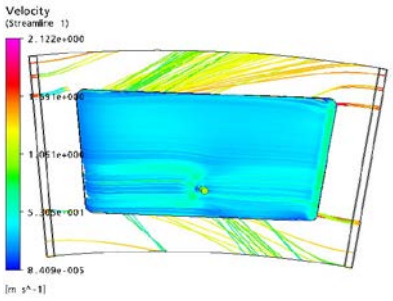

Fig.2. Streamlines of 12L/min inlet flow

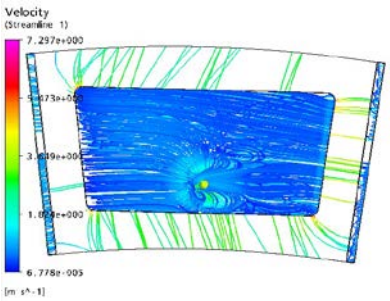

Fig.3. Streamlines of 36L/min inlet flow

It can be seen from figure 2, when the inlet flow is 12L/min, The flowing lines in oil chamber is very smooth, no flow lines and lines cross, no any swirl. We can determine the flow is a laminar flow. figure 3 shows that when the oil chamber inlet flow is 36L/min, there are lots of significant flow lines and lines cross in oil chamber and a large number of swirl. Its flow state is a typical turbulent flow.

4 Conclusion

Using the finite volume method for large size hydrostatic bearing gap fluid numerical analysis, reveals a gap of fluid flow state under different flow. Based on the flow chart simulated from CFX, when the workbench rotational speed is 6r/min constant, critical inlet flow is 22L/min, compare and analysis the results of numerical simulation and calculation data in table 1. Simulation flow chart and calculated values match, simulate realistic, true and reliable.

The numerical simulation result does not appear divergence phenomena, indicates that the equation using finite volume method is stable. At the same time, the flow distribution of interstitial fluid on hydrostatic guide accord with the practical, testify that the research method is credible.

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