卢秀泉,马文星,李雪松,吴岳诗,许文.限矩型液力偶合器气-液两相环流特性仿真预测[J].农业工程学报,2014,30(9):27-34

限矩型液力偶合器气-液两相环流特性仿真预测

Simulation and prediction on fluid-gas circulation characteristics of torque limited hydrodynamic couplin

投稿时间： 2013-09-26 最后修改时间： 2014-02-28

中文关键词: 数值模拟 预测 模型 限矩型液力偶合器 气-液两相流 环流特性 流体体积法

英文关键词:numerical simulation forecasting model torque limited hydrodynamic coupling fluid-gas two-phase flow fluid-gas distribution volume of fluid

基金项目:国家"863"高科技资助项目（2007AA05Z256）、国家自然科学基金青年科学基金（51305156）。

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中文摘要:

限矩型液力偶合器始终工作在部分充液状态下，工作腔内部的工作液体做复杂的气-液两相螺旋环流运动。在不同的载荷工况下，工作液体气-液两相的具体分布形式环流形态很大程度上决定了偶合器的限矩特性。为了掌握限矩型偶合器内部的气-液两相环流特性，该文以YOXD200偶合器为分析模型，在建立全流道模型的基础上，滑移网格瞬态算法，两相流模型采用流体体积法VOF（volume of fluid）模型，对3种典型充液率下的环流形态进行CFD数值模拟分析。数值模拟结果很好地预测了在不同液率下，随载荷的增加，内部气-液两相流体由小环流向大环流运动的转化过程。该文为实现限矩型液力偶合器转矩跌落工况点的预测及过载能力的估算提供了数值计算方法和依据。

英文摘要:

Abstract: As the hydraulic transmission components, torque limited hydrodynamic coupling regards fluid as the transmission medium, and its gas-liquid two-phase fluid in the chamber works in a complex circulation spiral motion. With the difference of working condition in different filled ratio and speed ratio, gas-liquid two-phase flow presents the diffe characteristics of combination and distribution law, and it influences the external output performance parameters of the coupling for this reason. Torque limited hydrodynamic coupling's torque limiting function is mainly through the work of changing gas-liquid two phase flows to split the fluid in the working chamber to the front auxiliary oil chamber wh the coupling overloads. It is difficult to establish an accurate mathematical model to describe it due to the complexity of its internal gas-liquid two-phase flow. In engineering it is usually through adjusting the flow channel structure parameters repeatedly in the way of the combination of experience design and performance test to meet certain overload and start matching requirements, but it is lack of quantitative basis theoretical guidance in design process. In this paper, the three-dimensional transient gas-liquid two-phase flow of torque limited hydrodynamic coupling can be carried on numerical simulation in the way of CFD, and focused on forecasting and analyzing its characteristics of the gas-liquid two phase flow and its ability of overloading. The torque limited hydrodynamic coupling with front auxiliary oil chamber can be treated as analysis model and its cycle diameter is 200 r The high-quality full flow channel model was built by using hexahedral structured mesh, and the sliding mesh method was established for solving the transient flow field. The volu of fluid (VOF) model was used, along with realizable k-ε model on the turbulence model and second-order upwind scheme for solving the momentum and kinetic energy equation, PISO algorithm was used for pressure and velocity coupling. Finally the numerical simulation can be calculated to analyzing the gas-liquid circulation at different working conditio such as i=0.96, i=0.6 and i=0 when the filled ratio at q=40%, q=60% and q=80%. The results of the numerical simulation show the process clearly that the distribution of the gas-liq two-phase flow varies with load increasing. By comparing with flow field test results which were acquired by installing the plane array sensor on the pressure surface and suction surface of pump blades, it verified the effectiveness of the emulation algorithms and the calculation results. The research provides a numerical calculation method to forecast the torque dropping condition and estimate the overload capacity of the torque limited hydrodynamic coupling, and provides a theoretical reference for advising the parameters desig the flow channel structure qualitatively and quantitatively.

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