基于Fluent的多级串联喷嘴液气射流泵的抽气性能研究

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摘　　要：为提高液气射流泵的抽气性能，在其主喷嘴后设置了多级串联喷嘴，通过Fluent软件对常规液气射流泵和多级串联喷嘴液气射流泵内气液两相流体运动情况进行了数值模拟，对比分析了相同工况下两种类型液气射流泵的抽气性能、压力场分布、速度场分布和气相体积分数分布。结果表明：在工作流体进口压力（表压）为0.3 MPa、0.35 MPa和0.4 MPa下，多级串联喷嘴液气射流泵的抽气性能较常规液气射流泵分别提高了18.1%、13.4%和20%，多级串联喷嘴结构有利于气液两相流体的混合和动量交换。研究结果对液气射流泵的优化设计和抽气性能提高具有一定的参考意义。

关 键 词：液气射流泵；多级串联喷嘴；抽气性能；数值模拟

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Research on the Pumping Performance of a Multi-stage Series Nozzle Liquid-gas Jet Pump Based on Fluent

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Abstract: In order to improve the pumping performance of the liquid-gas jet pump, it is proposed to install a multi-stage series nozzle behind the main nozzle of the liquid-gas jet pump. Numerical simulations of the gas-liquid two-phase fluid movement in the conventional liquid-gas jet pump and the multi-stage series nozzle liquid-gas jet pump were conducted using Fluent software. Under the same operating conditions, a comparative analysis was conducted on the pumping power, pressure field distribution, velocity field distribution, and gas phase volume distribution of two liquid-gas jet pumps. The results show that at the inlet pressure (gauge pressure) of the working fluid of 0.3 MPa, 0.35 MPa and 0.4 MPa, the pumping performance of the multi-stage series nozzle liquid-gas jet pump has been improved by 18.1%, 13.4% and 20% compared to the conventional liquid-gas jet pump respectively. The multi-level structure of the nozzle promotes pulse and momentum exchange between the gas-liquid phases. The research results have certain reference significance for the optimization design and improvement of suction performance of liquid-gas jet pumps.

Key words: liquid-gas jet pump; multi-stage series nozzle; pumping performance; numerical simulation

液气射流泵是一种通过高压水射流的紊动扩散作用，对流体进行抽吸输送的流体机械设备[1-2]。由于其具有内部结构简单、无相对运动部件、工作运行可靠、节能安全等优势被广泛应用于真空获得、环境保护、新能源和真空冶炼等领域[3]。

目前，国内外众多专家学者通过数值模拟和实验的方法对提高液气射流泵的抽气性能做了大量的研究[4-7]。Randheer等[8]研究了吸入室直径、喉嘴距和渐缩段角度等对液气射流泵引射系数的影响，发现吸入室的结构对液气射流泵的抽气性能会产生很大影响。李同卓等[9]设计了一种并联式液气射流泵，通过数值模拟发现其抽气性能优于常规结构液气射流泵。Li等[10]利用Fluent软件模拟分析了不同工质和不同结构参数对液气两相射流泵工作性能的影响，发现不同混合管长度对液气射流泵的抽气性能影响很大。王佼等[11]利用Fluent软件对液气射流泵中不同吸入室

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