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压力补偿灌水器分步式计算流体动力学设计方法

Step-by-step CFD design method of pressure compensating emitter

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中文摘要:

为提高压力补偿灌水器的设计和研发效率，该文采用计算流体动力学（computational fluid dynamics, CFD）分析方法，结合有限元分析技术，提出一种压力补偿灌水器的分步式CFD设计方法，研制了圆柱式压力补偿灌水器，并进行了灌水器流量预测，得到其设计压力-流量曲线。利用光固化快速成型技术，快速制作出压力补偿灌水器试验件，进行了水力性能试验，得到了灌水器试验压力-流量曲线，发现通过分步式CFD计算得到的预测压力-流量曲线，与水力性能试验得到的试验压力-流量曲线在压力补偿灌水器的有效工作压力区间内吻合度良好，验证了分步式CFD设计方法。在此基础上研究了压力补偿灌水器补偿区结构对其压力补偿性能的影响，发现补偿区高度对灌水器补偿性能影响显著，可以通过改变补偿区高度来设计不同补偿性能的灌水器。该研究对指导压力补偿灌水器的设计和开发具有一定的意义。

英文摘要:

In order to improve the design and development efficiency of the pressure compensating drip irrigation emitter, a step-by-step computational fluid dynamics (CFD) design method combined with finite element technology was proposed in the paper. The emitter flow rate was predicted by the step-by-step CFD method and the designed pressure-flow (P-Q) curve of the emitter was obtained. The test samples of pressure compensating emitter were manufactured by means of rapid prototype and manufacturing technology, the hydraulic performance experiment of the emitter was carried out and the experimental P-Q curve was obtained consequently. The results showed that the predicted values were coincident with the experimental results well within normal range of the emitter’s working pressures, which verified the step-by-step CFD design method. On this basis, the influence of the emitter structure on its pressure compensating performance was studied, which showed that the height of pressure compensating chamber had significant effect on the emitter pressure compensating performance, based on that the series of pressure compensating emitter could be designed by changing the chamber height. This research can provide a reference for design and development of pressure compensating drip emitter.

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