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Structural optimization of the low-pressure Venturi injector with double suction ports based on computational fluid dynamics and orthogonal test

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ABSTRACT

In the low-pressure irrigation system, a Venturi injector of low working pressure and energy consumption with a double-suction port was designed. The computational fluid dynamics method was used to simulate the inner flow field of Venturi injectors to obtain hydraulic performances. Taking the fertilizer mixing concentration as the evaluation index, an orthogonal test of six factors and five levels was designed to acquire the optimal structure with numerical calculation. The parameters in the optimal structure were as follows: the convergence angle 24°, the throat contraction ratio 0.2, the throat length-diameter ratio 2.0, the expanding angle 6°, the inclination angle 50°, and the number of suction port 2. Compared with the Venturi injector with a single suction port of inclination angle 90°, fertilizer suction discharge and mixing concentration of the double-suction port structure were increased by 236% and 198.8%, respectively. The double-suction port structure with an inclination angle 50° has better performances, including lower starting working pressure, more fertilizer suction discharge and mixing concentration, and is suitable for the low-pressure irrigation system.

Keywords: Venturi injector; Low-pressure irrigation system; Computational fluid dynamics; Injection performance; Orthogonal test

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