EVALUATION COMPARATIVE OF ANTI-CLOGGING DRIP EMITTERS DESIGN

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Abstract— The drip irrigation systems have been a common irrigation method in the world due to the shortage of water in wide areas. Dripper is the key factor of drip irrigation systems, that deliver slow and uniformity water to the plants. The drippers can be suffering from clogging due to escape some particles of sand from the filters. The emitter clogging problem has a significant effect on the drip irrigation system efficiency. In this study, computer aid design, CAD was used to design a new anti-clogging emitter. The water flow behavior in the diaper was simulated by using two phases –CFD analysis to confirm the new design can provide the lowest chance to block. Comparative the simulation results for the new driver with the simulation results for three drip emitter design include eddy channel, pre-depositing channel and round-flow channel, it is clearly seen that the new design has a better ability to resist the clogging. Additionally, CFD simulation results introduce a good observation about the relation between the pressure applied and the water flow rate. This result was obtained due to the integration of the characteristic of great sieving and good pressure dropping in the new designed drip emitter.

Keywords— Evaluation, simulation, drippers, CFD analysis.

I. INTRODUCTION

The water is a most significant factor in the agricultural production. Vast lands suffer from water shortage in many countries. In order to alleviate the impact of this problem, several irrigation methods are used to save irrigation water amounts,including under- membrane irrigation, micro irrigation, low pressure irrigation, sprinkles irrigation and drip irrigation.

The drip irrigation can be considered one of the most irrigation systems effective by using the rate about to 90% (Wei, 2011). Drip irrigation can be defined as a uniform and slow applied with low-pressure water to zone of root plant through a network of pipes, pumps, filters and emitters. The emitter is the most important device in the drip irrigation systems that is working to reduce water pressure to the smallest rate with dropping form(Zhang, *etal*.,2010;wei,2011;Zhengying,*et.al*.,2012:Wei,2011, Bassett, *et al*.,1983).

Many kinds of emitters were designed in order to provide a satisfactory performance, such as round-flow drip-tape, eddy drip – narrow and pre-depositing dripper. The reliability of dripper is defined as the capability of ordering the required amount of water under specific pressure of explicit time (Jeznach, 1998). The dripper suffers from blocking due to escape particles of quarts sand from the filters coursing ununiformed water supply that will greatly affect the quality of system service and increase the maintenance cost(Fan *et al*.,2011).

This research aims to hold a comparative for the performance of different types of emitters.

II. MATERIALS AND PROCEDURES

2.1. Details of simulation & experimental

The emitters are designed with complex and small size flows that can be likely suffering from clogging in the capillaries. In order to study the dropper's capability many researchers have been achieved an experimental and CFD simulation study to investigate the macro-hydraulic parameters such as emitter operating pressure and the discharge rate (Wei, 2008& Lawrence,2010).

2.2. The Computational Fluid Dynamics (CFD) Analysis.

Kindly the computational fluid dynamics analyses are used to investigate the emitter achieving that will provide a good idea about the emitter behavior. Three emitters, including a long-path predepositing emitter, an eddy drip arrow and long-path round flow drip were selected to investigate in previous studies (Wei, 2008). A new emitter was designed to represent an innovative design that mixes two kinds of emitters, the predepositing emitter and eddy drip arrow (Ali, 2013). The results of CFD analyses will explore in this study.

2.3 Experimental tests

Although the CFD analyses are adapted to find the discharge rateand operating pressure,these simulations could not provide accurate results, therefor the researchers are adapting the experimental exam to investigate the output pressure and theemitter discharge for specific times.

III. RESULTS AND DISCUSSION

The researchers assumed the drippers had been blocked when the discharge down to lower than 75% the normal output rate (Jun, 2007).The blocking rate of emitters can be defined as

$C_r = 100(1-\breve{q}/q_v)$

$q = (\sum_{i=1}^{n} q_i)/n$

Where C_r represents clogging rate,q □ donate the average discharge (L/h);q_v=nominal discharge (L/h);I is the number of drippers tested and q_i=emitter output.

The CFD results in the previous studies indicate that the blocking rate of the eddy drip arrow is lower than that of the predepositing emitter and the clogging rate of the round–flow. The predepositing emitter has a lower clogging rate than the round –flow drip tape (Wei, 2008). The new design emitter shows fine anti-clogging behavior where itkeeps the same discharge rate after many times examine restating.

The experimental tests had shown that the clogging in the three kinds of emitters at different stages of test replications due to suspend the sand particulars in the water path. The new innovated design emitter shows that the particulars of sands will deposit in the corner of cones without affecting the water flow or causing a clogging the labyrinth Chanel, therefore, the discharge rate keep at the same average.

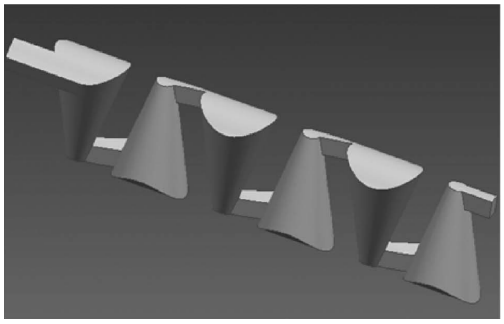


Fig 1: Eddy drip arrow from (Wei,2008)



Fig 2: round flow drip tape (Wei, 2008)

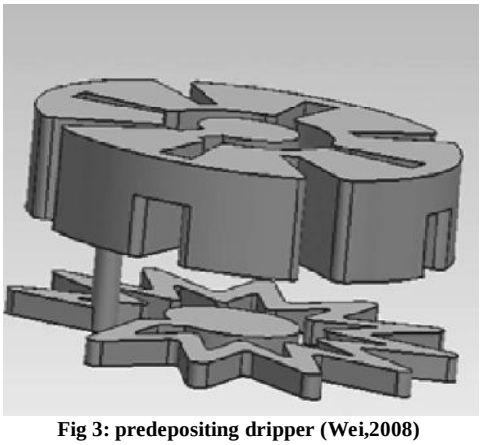


Fig 3: predepositing dripper (Wei,2008)



Fig 4 : New designed emitter (Ali, 2013)

CONCLUSIONS

As show above the new designed emitter shows a better performance compare with the other design of drippers, that because the deposition of sand on the cons without pass to the labyrinth channel. More innovation can be done for the different types of emitters in order to obtain a better performance.

ACKNOWLEDGMENTS

Many thanks to Dr. Graham Green the senior lecturer at the Mechanical Engineering displacement in the University of Glasgow- UK who provide his excellent advice in my research at the university of Glasgow.

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