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The Thesis Submitted for the Degree of M.Sc (in the Field of Water Resource Engineering)

Experimental Evaluation of Friction Losses in Lateral Pipes with Five Different Emitter Types and Spacing

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Abstract:

Appropriate design of a drip irrigation system needs a detailed assessment of friction losses in lateral pipes especially local losses due to emitter connections in order to increase irrigation efficiency and distribution uniformity. In this paper, the barb effects of five types of commonly used emitters in Iran including Katif, Original Netafim, similar to Original Netafim, Micro Flapper and Eurodrip (Corona) as first factor, four emitter installation distances of 0.5, 0.75, 1 and 1.25 meter on 16 millimeter lateral pipe as second factor, air temperature of between 10-40 degrees as third factor and different flow rate (15 different flows) as forth factor and on the amount of local and total friction losses of drip irrigation pipes were investigated. Also, according to the publicity of Hazen-Williams equation in the hydraulic design of drip irrigation, it was calibrated based on experimental results. To do this, some experiments were conducted in research fields of Isfahan and West-Azerbaijan. In order to investigate the local loss of emitters, the flow velocity, pressure, local friction coefficient, local friction of each emitter, total local loss, friction loss of lateral pipe and total loss of lateral pipe were calculated by means of Hazen-Williams and Darcy-Weisbach equations as well as Netafim Hydrocalc software. The flow velocity was achieved equal to 0.75 m/s in 0.1 l/s flow rate, 1.51 m/s in 0.2 l/s flow rate, and 1.81 m/s in a maximum flow rate of 0.24 l/s. The results obtained in this study indicated that the Darcy-Weisbach equation is less accurate than Hazen-Williams for computing friction losses and influencing on local drop in 16 millimeter pipes. On the other hand, Netafim Hydrocalc software performs well in calculating friction losses of lateral pipes when compared to the experimental results. Based on the calibrated results, the coefficient of C in Hazen-Williams equation were obtained of 100-125 depending on flow rate. Comparing the total local loss measured through a digital monometer, WIKA, DG-10_E model with a given accuracy of 0.001 bar, expressed that in all cases, the emitters Katif, original Netafim, similar to original Netafim, Micro Flapper and Eurodrip (Corona) provide the lowest to the highest local loss, sequentially. On the other hand, Original Netafim and Katif applicators showed the lowest and similar to Original Netafim had the highest variability to the temperature changes in low velocities (less than 1 m/s). In high velocities, Original Netafim applicator had better performance compared to Katif applicator. According to the results, the best emitter distance was 1 m and then 0.75 m. Moreover, the optimal velocity for designing drip irrigation system is proposed as 1.5 m/s, although it should be considered less in cold regions.

Key words: Local loss, Barb, Applicator, Friction loss, Netafim Hydrocalc