THESIS

ASSESSMENT OF VARIABILITY IN HYDRAULIC PARAMETERS IN DRIP IRRIGATION LATERALS

SUBMITTED BY

SAMI ULLAH

2010-PG-WRE-19

For The Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES ENGINEERING

CENTRE OF EXCELLENCE IN WATER RESOURCES ENGINEERING

University of Engineering and Technology Lahore, Pakistan

2013

ABSTRACT

ASSESSMENT OF VARIABILITY IN HYDRAULIC PARAMETERS IN DRIP IRRIGATION LATERALS

Water is an essential element for survival of living things. It is a vital factor for economic development by augmenting growth of agriculture. Increase in demand and the resulting shortage of water has shifted conventional irrigation systems towards precise application of water in order to maximise food and fiber production. These systems are known as High Efficiency Irrigation Systems (HEIS) and drip irrigation system is one of these. To obtain the desired amount of water, accurate designing is of key importance and it can be achieved knowing detail hydraulics of the system components.

In this research study, hydraulic losses were determined in the plain lateral pipes induced during manufacturing and also due to emitter's insertion. The differences in losses between pipes without emitters and pipes with sealed emitters were measured for different flow rates. Equal lengths from four different pipe rolls were selected of both diameters i.e. 12.5 mm and 16 mm. Four types of local and imported emitters were selected for utilization in polyethylene lateral pipes. Characteristic curves were plotted between flow rates (Q) versus pressure head loss (H_L). These curves showed that losses increased with increase in flow rate for the same size pipe. By analyzing the measured data, the two types of regression relationships were developed. One was Polynomial regression relationship for hydraulic loss versus flow rate and second was Power regression relationship for pressure head versus flow rate. Using these, the hydraulic losses in lateral pipes with and without emitters of various barb face area were determined. The analysis of the collected data was done at recommended design flow velocity of 1.5 m/s.

The losses of plain lateral pipes showed variation not only due to change in diameter but also within the same diameter lateral pipes due to manufacturing process. Up to 26% reduction in head loss was estimated as pipe diameter was increased from 12.5 mm to 16 mm. The head losses within the same diameter pipes varied from 2.3% to 16.2% in small diameter pipe and 0.7% to 11.1% in large diameter pipe of equal length. Hydraulic roughness coefficient (C) of plain pipes and with inserted emitters was estimated using Hazen-William's equation. Coefficient was estimated as 155 and 160 for 12.5 mm and 16 mm diameter pipes without emitter's connection. Whereas, it was estimated 147 and 150 after emitter insertion for both diameter pipes. The estimated value of coefficient increased in large diameter because of less head loss as compared to small diameter pipe.

Energy loss due to emitters showed that they differ from one emitter to another and from one diameter pipe to another diameter pipe. The percentage of hydraulic loss due to emitters as compared with plain lateral pipes varied from 12.23% to 37.0% with emitter barb face area of 15.63 mm^2 to 44.05 mm^2. The equivalent lengths (Le) of both diameter pipes for different emitters at recommended design flow velocity of 1.5 m/s ranged from 17 cm to 53 cm. A dimensionless parameter as an Obstruction Ratio (OR) for the emitters was also derived. Losses were increased as OR increased and its value was more in small diameter pipe and less in large diameter pipe. Its maximum value calculated was 0.36 and 0.22 for 12.5 mm and 16 mm diameter pipe. From the spacing of emitters, length of lateral line and equivalent length of individual emitters, head losses were integrated as adjusted length. It was estimated from 36.27 m to 47.43 m for the selected lateral lengths and emitters. It was estimated that roughness coefficient decreased with increase in flow rate and also due to increase in obstruction across the flow for both diameter pipes.