

A Novel Bio-inspired Pressure Compensating Emitter for Low-Cost Drip Irrigation Systems

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One of the major issues that prevent a large-scale dissemination of drip irrigation system is the requirement of high pumping pressure, which incurs a high cost of pumping and power systems. The high pressure is used to maintain the working condition of pressure-compensate emitters, which are installed at the outlets of drip irrigation system to compensate pressure loss and evenly distribute flows for each crop. A new architecture of the pressure-compensate emitter is proposed using a flexible tube enclosed in a pressurized chamber similar to the design of a medical instrument called “Starling resistor”. This design enables the external pressure of the tube to correlate with the driving pressure, such that a higher driving pressure leads to a higher external pressure and consequently collapses the tube. The desirable feature that the flow rate is independent of the upstream pressure variation (also called “flow limitation”) can be achieved with this new design at a lower driving pressure. This paper is aimed to find the optimal combination of the design parameters that govern the physics behind the collapsible tube. A laboratory experiment has been conducted using rubber tubes with a variety of lengths, wall thicknesses and inner diameters. Then, an attempt to collapse the experimental results are made and empirical formula of activation pressure and regulated flow rate are given.