

Research Paper :

Study on design and performance evaluation of hydrocyclone separators for micro-irrigation systems

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ABSTRACT

Hydrocyclone is a simple mechanical device, with no moving parts, where solid particles or immiscible liquids are separated from liquid. It is used as a primary filter for micro irrigation systems to remove floating particles as well as to remove high density particles from the irrigated water. In this study, the six hydrocyclone models were designed, fabricated and tested for its performance evaluation. The models were designed for the removal of particulate matter of size 48microns and larger sizes from irrigation water. The models were designed with combination of 20° and 26° cone angles and 0.04, 0.05 and 0.065m underflow cylinder diameters. These hydrocyclones were fabricated with 3mm thick mild steel sheet. The clean water pressure drop and the percentage of sand trapped in hydrocyclone were recorded. It was found that, the hydrocyclone model M₃ with 26° cone angle and 0.065m underflow cylinder diameter was the best model with the removal efficiency of 95.68% among all the six models.

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Key words : Hydrocyclone filter, Vortex finder, Micro irrigation, Cut size

Originally in the later part of the 19th century hydrocyclone was used as a solid/liquid separator to remove sand from well water. A typical hydrocyclone consists of a cylindrical section, a conical section, an underflow cylinder section and a sand collection basket is shown in Fig. 1. The separation is based on density difference between the liquid and the matter to be separated. The principle of centrifugal separation is used to remove or classify solid particles from a fluid, based on particle size, shape and density. Hydrocyclones are used as a primary filter for separation of larger sized particulate matter in irrigation water before it is passed through the screen filters or sand filters. These primary filters are basically meant to reduce the workload on the secondary filters. The hydrocyclones that are presently used in drip irrigation are those that have been designed and used in other industrial applications and there is a good scope for improving their efficiency. For this purpose, there is a need to design hydrocyclones that are meant to be specifically used in drip irrigation systems, taking into account the needs of the system.

METHODOLOGY

The present study on study on design and performance evaluation of hydrocyclone separators for

micro-irrigation systems was conducted at Jain Irrigation systems Limited, Jalgaon, Maharashtra. A standard cyclone is defined as, a cyclone which has the proper geometrical relationship between the cyclone diameter, inlet area, vortex finder and apex orifice and has sufficient length to provide retention time in order to properly classify the particles. There are various design parameters of hydrocyclone which are as follows:

Cone angle:

For design purpose, 20° and 26° cone angles were chosen. Arterburn (1976) reported that the larger the hydrocyclone diameter, the coarser the separation. The included angle of the cone section is normally between 10° and 20°.

Cone section length:

The length of cone depends upon the underflow cylinder diameter and cone angle.

Length of the underflow cylinder section:

The length of underflow cylinder section varies with the cone length and cone angle. The underflow cylinder section starts at the point where it joins the cone section at one end and ends where the apex of the imaginary cut