ABSTRACT

Hydrocyclones are devices used in many chemical and mineral based process industries for separation of fine particles. Several design modifications have been proposed to improve the hydrocyclone performance. In this present investigation, a ribbed hydrocyclone (RH) is designed and fabricated to study the effect of rib on performance of the hydrocyclone. It is interesting to note that by using a rib in the cylindrical part of the hydrocyclone resulted in lower pressure drop and improved separation efficiency. The pressure drop decreases by 17.5% and total efficiency increases by 10.5% at a feed velocity of 5 m/s and at a vortex finder depth of 7.6 cm. CFD (Computational fluid dynamics) is a useful tool to study the velocity and pressure distribution of complex turbulent flow in a hydrocyclone. Flow simulations are carried out using a three-dimensional double precision, segregated, steady-state solver tool. The obtained CFD simulated results in correlation with experimental data shows that the pressure drop reduces by 13.9% at a velocity of 2.5 m/s by using rib. The influence of vortex finder diameter on pressure drop and performance was analyzed by experimentally as well as numerically. Decreasing the vortex finder diameter of the RH by 24.2%, the pressure drop and split ratio increases by 66% and 136% respectively. Experiments have been conducted to remove both alumina and fluoride from aqueous solution using ribbed hydrocyclone in a continuous mode. Maximum fluoride removal efficiency was 49.5%, and 80% for alumina and HCl treated alumina for the initial concentration of 10 mg/l at a slurry flow rate of 50 LPM. Wastewater purification have been done by removing both fly ash and dyes in a ribbed hydrocyclone. Maximum methyl orange removal efficiency was 68% for the initial concentration of 60 mg/l for the dose of 3 g/l at a slurry flow rate of 50 LPM. The novelty of this study revealed that pressure drop decreases and separation efficiency increases with the introduction of the spiral rib.

Keywords: Ribbed hydrocyclone; Performance efficiency; Pressure drop; Separation efficiency; Computational fluid dynamics; wastewater purification