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A CFD study of the effect of inlet angle on the performance of cyclone separators

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***Abstract*— Cyclones are very popular in industrial applications and separate particles from gas based on centrifugal forces. Their popularity is because of simple geometry, high durability and low operating and maintenance costs. A 3D Eulerian–Lagrangian computational fluid dynamics (CFD) model was developed for the gas-particle flow simulation inside a cyclone. The renormalization group (RNG) k–ε model was used to investigate the effect of turbulence and the particle trajectories were calculated via discrete phase model (DPM). The velocity fluctuations were simulated with discrete random walk (DRW) model to study the turbulent dispersion of particles. In this method, the flow is considered as a continuous phase and particles are considered as a discrete phase. The simulation of the gas-particle flow inside the cyclone was developed by using Ansys Fluent 18.2 and the effects of inlet angle on separation efficiency and pressure drop were investigated. The results show separation efficiency is increased with an increase of particle size. Comparing the results of Azadi [1] with the present work show good agreement in simulation results. Final results show that the inlet angle affects the separation efficiency and the 20° inlet causes the best efficiency respect to 0° and -20° inlet.**

Keywords: Cyclone, CFD, Inlet duct angle, Separation efficiency, Pressure drop

I. INTRODUCTION

Cyclones are dust collectors that separate particle from the gas flow by centrifugal force. Inside a cyclone there are two vortices that are created during operation. The main vortex spirals downward and carries the coarser particles. An inner vortex, created near the bottom of the cyclone, spirals upward and carries finer dust particles [2].

Cyclones have low efficiencies in removing fine particles. They are typically used as pre-cleaner to remove coarser particles that could damage the bags in fabric collectors or plug wet scrubbers. Pressure drops range from 3 inches wg for low efficiency inertial cyclone collectors and up to 8 inches wg for higher efficiency models [3].

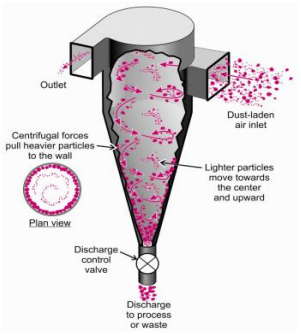

Figure1. Typical design of a cyclone dust collector

Many cases can affect the function of the cyclones such as inlet angel, inlet velocity, vortex length, particle size, outlet geometries, pressure drop and collection efficiency. Higher axial and tangential velocities in conventional dust outlet geometries may worsen the collection efficiency by allowing particle re-entrainment and flow pattern and particle trajectories inside the cyclone separator with respect to dust outlet geometry, the dust outlet geometry may change the flow pattern and particle trajectories [4].

Collection efficiency increased due to an increase in the centrifugal field caused by the displacement of the tangential velocity peak toward the wall and the higher tangential