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Dust Particle Removal from Air in a Self-Priming Submerged Venturi Scrubber

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Abstract : Dust particles suspended in air are a major source of air pollution. A self-priming submerged venturi scrubber proven very effective in cases of handling nuclear power plant accidents is an efficient device to remove dust particles from the air and thus aids in pollution control. Venturi scrubbers are compact, have a simple mode of operation, no moving parts, easy to install and maintain when compared to other pollution control devices and can handle high temperatures and corrosive and flammable gases and dust particles. In the present paper, fly ash particles recognized as a high air pollutant substance emitted mostly from thermal power plants is considered as the dust particle. Its exposure through skin contact, inhalation and indigestion can lead to health risks and in severe cases can even root to lung cancer. The main focus of this study is on the removal of fly ash particles from polluted air using a self-priming venturi scrubber in submerged conditions using water as the scrubbing liquid. The venturi scrubber comprising of three sections: converging section, throat and diverging section is submerged inside a water tank. The liquid enters the throat due to the pressure difference composed of the hydrostatic pressure of the liquid and static pressure of the gas. The high velocity dust particles atomize the liquid droplets at the throat and this interaction leads to its absorption into water and thus removal of fly ash from the air. Detailed investigation on the scrubbing of fly ash has been done in this literature. Experiments were conducted at different throat gas velocities, water levels and fly ash inlet concentrations to study the fly ash removal efficiency. From the experimental results, the highest fly ash removal efficiency of 99.78% is achieved at the throat gas velocity of 58 m/s, water level of height 0.77m with fly ash inlet concentration of 0.3 x10^{-3} kg/Nm^3 in the submerged condition. The effect of throat gas velocity, water level and fly ash inlet concentration on the removal efficiency has also been evaluated. Furthermore, experimental results of removal efficiency are validated with the developed empirical model.

Keywords : dust particles, fly ash, pollution control, self-priming venturi scrubber
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