Environmental Engineering and Management Journal *November 2016, Vol.15, No. 11, 2367-2374*
http://omicron.ch.tuiasi.ro/EEMJ/

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DIFFUSION CHARGING EFFECTS ON PM_{10} COLLECTION EFFICIENCY IN A WIRE-PIPE ESP UNDER MULTI-FIELD COUPLING

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Abstract

In this study, a mathematical model was introduced to calculate the collection efficiency of dust particles in a wire-pipe single-stage electrostatic precipitator (ESP). The aerodynamic diameters of these particles are less than 10 μm (PM_{10}). The mathematical model, using combined Deutsch-Anderson Equation, considers coupling effects among gas flow field, electric field and particle field. A simplified 2-D ESP model was established using GAMBIT and a software application (FLUENT) was used to investigate the effects of the diffusion charging on PM_{10} collection efficiency. Furthermore, the effects of different variables such as applied potential, gas velocity and particle distribution on diffusion charging and collection efficiency were also studied. The numerical results indicate that grade efficiency of ESP satisfies U-shape distribution. It was further demonstrated that, for particles with a diameter of less than 10 micrometers, the influence of diffusion charging on PM_{10} collection efficiency is significant with either decreasing applied potential or increasing gas velocity of the inlet. Moreover, the reduction of size distribution parameter and mean diameter of particles results in the phenomenon that diffusion charging has a more significant effect on PM_{10} overall efficiency, but there is no guarantee for improving overall collection in the case.

Key words: diffusion charging, electrostatic precipitators, particle distribution, PM_{10}, wire-pipe

Received: July, 2012; Revised final: July, 2013; Accepted: July, 2013

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