Determination of Optimum Body Diameter of Air Cyclones Using a New Empirical Model and a Neural Network Approach

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ABSTRACT

This paper presents a new empirical model and a two-layer neural network approach for the determination of optimum body diameter (OBD) of air cyclones. OBD values were calculated by help of a MATLAB® algorithm for 505 different artificial scenarios given in a wide range of five main operating variables. The predicted results obtained from each proposed approach were compared with the well-known Kalen and Zenz’s model. The computational analysis showed that the empirical model and neural network outputs obviously agreed with the Kalen and Zenz’s model, and all the predictions proved to be satisfactory, with a correlation coefficient of about 0.9998 and 1, respectively. The maximum diameter deviations from Kalen and Zenz’s model were recorded as only ±1.3 cm and ±0.0022 cm for the proposed model and NN outputs, respectively. In addition to proposed approaches, the pressure drop problem was controlled using a MATLAB® algorithm, and results were obtained rapidly and practically for varying data used in the cyclone design.

Key words: cyclone separators; optimum body diameter; neural network; Kalen and Zenz’s model; pressure drop; MATLAB®

INTRODUCTION

The separation of solid particles from the waste air streams is required in many industrial processes. For this purpose, cyclone separators are widely used as the most common devices. Conventionally, cyclone separators have been used as precleaning devices for the removal of particles bigger than 10 μm from the carrier gas in both air pollution control and other processes. Because of their adaptability, simple design and low costs in terms of maintenance, construction, and operation make cyclones ideal for use in the various stages of industrial applications (Yang and Yoshida, 2004). Cyclones are also used as bio-aerosol samplers in air quality applications and hospitals in addition to chemical, metallurgical, and petroleum industries (Pant et al., 2002). In

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