ENERGY OPTIMIZATION OF FLUIDIZED BED DRIER USED IN ACTIVATED CARBON PROCESSING INDUSTRY

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Declaration

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Under my direction, the above-mentioned candidate conducted Master's Dissertation research.

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Dr. Saliya Jayasekara

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Abstract

Drying is an essential part of most industrial material processing operations. Similarly, it takes a typically large capital expenses and operating cost. There are various types of dryers used in activated carbon processing industry. Among these active dryers, fluidized bed dryer is extremely popular not only in the activated carbon industry but also in other product drying facilities such as food industry, chemical industry, fertilizer industry and pharmaceutical industry etc. Fluidize Bed dryers are popular in industry because they are simple in design, easiness of operation and maintenance capability. To reduce the overall energy use, it is crucial to determine the ideal drying conditions for activated carbon in fluidized beds dryers. As a result, two parameters of drying temperature and hot air velocity were chosen while the remaining parameters remained fixed.

Therefore, in this study, the drying properties of activated carbons were examined by conducting number of tests on a fluidized bed dryer located in an activated carbon manufacturing plant. The trials were conducted at three distinct air speeds of 2 m/s, 3 m/s and 4 m/s at 03 various temperatures of 130 °C, 140 °C and 150 °C. The results of the experiment were fitted using the current drying models. The MS Excel Solver was used to evaluate the model coefficients and constants. The Singh et al. model was discovered as the best fit drying model to dry activated carbon at fluidized bed dryer with lowest Root Means Square Error (RMSE) of 0.005973. Then Minitab software was used to analyse energy consumption data and it was obtained that the overall drying energy reduces when the hot air velocity and drying temperature are raised. And it came to a minimum of 145 °C when the hot air velocity maintained at 3.7 m/s. For drying experiments, computed Effective Moisture Diffusivity values ranged from 0.001315 to 0.00175. Effective Moisture Diffusivity increases with increasing hot air velocity and temperature. Results also revealed that the Activation Energy of activated carbon range in-between 11.28 to 14.10 kJ/mol. In FBD, the maximum value of E_a was determined under high velocity conditions. The aforementioned drying properties are helpful for choosing the appropriate fluidized bed dryer operating point and design a precise drying system.

Key words: Fluidized Bed Dryer, Energy optimization, Activated Carbon, Drying Models, Effective Moisture Diffusivity.

Table of Content

List of Figures

List of Tables