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Resorption and Flowability of the Spray-Dried Particles of Desulfurization Wastewater

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Extended Abstract

Spray drying, which extracts high-temperature flue gas before air-preheater to evaporate atomized wastewater, is now widely utilized in the desulfurization wastewater treatment in the coal-fired power plants of China [1]. Some of the drying products were captured by the following precipitator, while others were collected at the hopper located at the bottom of the spray dryer [2]. However, high salinity in the drying products may influence the resource utilization of fly ash in power plants [3], and thus they are considered as solid waste. Moreover, the spray-dried particles of wastewater are porous [4] and contain a high concentration of crystalline salts, making them more prone to moisture sorption and caking. The caking and deterioration of the flowability pose a great threat to the storage and disposal of these powders.

The objective of this study is to evaluate the resorption characteristics and the flowability of the evaporation products of practical desulfurization wastewater from power plants. The evaporation products from the spray drying tower of different power plants are collected and characterized. Influences of the temperature, humidity, and components on the resorption process are investigated by the environmental test equipment. Moreover, the flowability of the evaporation products is tested by multiple methods including the angle of repose (AoR) tests, uniaxial compression tests, and Jenike shear tests, results of which could also provide valuable insights on the design of the spray dryer.

The results suggest the rising salinity in the spray-dried particles directly causes increasing hygroscopicity of the powders. Ambient humidity, rather than the temperature, plays a dominant role in determining the sorption capacity of the spray-dried products of desulfurization wastewater. Moisture sorption isotherm at 25 ℃ is established, which could be classified into the type III isotherm with a critical deliquescence humidity at 50% RH. The flowability of the particles characterized by several methods is found to decrease with an increase in moisture content, due to the increasing strength of inter-particle friction imposed by liquid bridges. When the spray-dried products undergo the cycle of high-low temperature or humidity, sorption and re-crystallization may take place, which contributes to the formation of solid crystal bridges and increases the caking risk. Moreover, the hopper design of the spray dryer based on the Jenike theory is conducted considering the original spray-dried particles with a moisture content of 2%. The maximum hopper half angle is 34° and the minimum hopper outlet diameter is 0.08 m in order to achieve the mass flow of the given powders.

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