Roof solar drying processes for sewage sludge within sandwich-like chamber bed

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Keywords

Solar drying, Sandwich-like chamber bed, Sewage sludge, Drying kinetic modelling

Abstract

Cost-effectively drying of sewage sludge is the prerequisite step for further disposal, such as landfilling, incineration and pyrolysis. A novel solar drying method was developed using a thin layer sandwich-like chamber. The drying rate was optimized by adjusting the operating variables such as the thickness of sludge bed, and solar radiation intensity. Lower height of sewage sludge bed facilitates the faster drying process in thin layer sandwich-like solar drying chamber. In this experiment, the most suitable thickness of sewage sludge layer was found to be 0.5 cm for quick drying (average drying rate 6.72 g/h) under the sunlight in sandwich-like dryer. The water content in sewage sludge was decreased from 79% to 5% in 11 h drying with thickness of 0.5 cm under the solar radiation intensity of 500 W/m2. It was observed that the solar radiation influenced the drying process significantly, the drying time was reduced from 18 h to 9 h, as the solar radiation was increased from 300 W/m2 to 700 W/m2, respectively. To identify the drying kinetics of raw sewage sludge inside the sandwich-like drying chamber, eight established drying kinetics models were tried and compared the suitability of the model based on the R2, sum of square error (SSE), chi-square value, and root mean square error. Among these models, Danish model was found applicable for sewage sludge drying in this newly designed thin layer sandwich-like dryer. Based on the results obtained for solar drying of sewage sludge in thin layer sandwich-like drying chamber, it could be proposed that thin layer solar dryer may be a good choice for fast drying of sewage sludge in a cost-effective way.