World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:08, 2020

Heat and Mass Transfer Modelling of Industrial Sludge Drying at Different Pressures and Temperatures

Authors : L. Al Ahmad, C. Latrille, D. Hainos, D. Blanc, M. Clausse

Abstract : A two-dimensional finite volume axisymmetric model is developed to predict the simultaneous heat and mass transfers during the drying of industrial sludge. The simulations were run using COMSOL-Multiphysics 3.5a. The input parameters of the numerical model were acquired from a preliminary experimental work. Results permit to establish correlations describing the evolution of the various parameters as a function of the drying temperature and the sludge water content. The selection and coupling of the equation are validated based on the drying kinetics acquired experimentally at a temperature range of 45-65 °C and absolute pressure range of 200-1000 mbar. The model, incorporating the heat and mass transfer mechanisms at different operating conditions, shows simulated values of temperature and water content. Simulated results are found concordant with the experimental values, only at the first and last drying stages where sludge shrinkage is insignificant. Simulated and experimental results show that sludge drying is favored at high temperatures and low pressure. As experimentally observed, the drying time is reduced by 68% for drying at 65 °C compared to 45 °C under 1 atm. At 65 °C, a 200-mbar absolute pressure vacuum leads to an additional reduction in drying time estimated by 61%. However, the drying rate is underestimated in the intermediate stage. This rate underestimation could be improved in the model by considering the shrinkage phenomena that occurs during sludge drying.

Keywords : industrial sludge drying, heat transfer, mass transfer, mathematical modelling
Conference Title : ICIWRT 2020 : International Conference on Industrial Wastewater, Reclamation and Treatment
Conference Location : Montreal, Canada
Conference Dates : August 04-05, 2020