ABSTRACT

This dissertation identifies the key aspects of solids waste incineration optimization in a rotary kiln on an industrial scale. The preparatory activities were study visits and an internship carried out in hazardous waste incineration plants, including medical ones, equipped with a rotary kiln with an afterburning chamber. The rotary kiln is dedicated to the thermal processing of hazardous waste. Despite the maturity of the rotary kiln waste incineration technology, there are some areas for potential optimization of the rotary kiln operation. They are defined as: selection of the charge material for the rotary kiln, the movement of the charge material in the rotary kiln by testing its characteristics, the waste incineration process in the rotary kiln with an afterburning chamber. In the first area, an optimization tool was developed, using an artificial intelligence algorithm, selection of feed material for a rotary kiln, based on the analysis of: calorific value and elemental composition, content of chlorine and other halides, pH, alkaline salts and other compounds of this nature in the solid waste burned. The application of the selection of components of the waste mixture is aimed at optimal composition of the portion of the input material for the rotary kiln in the hazardous waste incineration plant. Optimal means ensuring the maintenance of specific parameters of the installation and minimizing the occurrence of operational problems in the incineration plant. In the second optimization area, the flow parameters related to the solid phase were investigated in the form of an analysis of the distribution of the waste time in the furnace depending on the selected operating parameters: the rotational speed of the furnace, the angle of inclination and the type of waste material, along with a simulation of its characteristics changed during the combustion process. An element of the study was also the use of regression analysis in the selection of the calculation algorithm for the average residence time and the size of the solid phase dispersion (mixing) in the kiln. In the third area, numerical optimization of the combustion process in a rotary kiln with an afterburning chamber, was proposed and verified with measurement data from a real object on an industrial scale. Based on the model, various variants of the incineration plant operation were determined, with particular emphasis on the combustion conditions in the thermo reactor - the afterburning chamber.