SYMCOMP 2023
Évora, 30-31 March 2023

SIMULATION OF A RECUPERATIVE HEAT EXCHANGER INTEGRATED IN A THERMAL INCINERATOR WITH THE ε-NTU MODEL

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Keywords: Pollutants control, waste heat, heat transfer, mathematical model

Abstract *Thermal recuperative incinerators (TRI) are devices commonly used in the industry to control organic compounds in the exhaust air from a given industrial process. This is achieved by using these exhausts as comburent in the incinerator and thus both controlling emissions and generating process heat. Incinerators are designed to efficiently recuperate waste heat from the hot outbound combustion products and preheating inbound process air. They are usually large and geometrically complex devices, so modelling an entire TRI in detail is difficult. Along with the simulation of the combustion process, another of the challenging aspects is the detailed modeling of the combustion products-to-process air heat exchanger that encloses the combustion chamber and that acts as heat recovery and thermal insulation of the chamber. One strategy to deal with this challenge is to decouple the simulation of the combustion products-to-process air heat exchanger from the simulation of the combustion chamber. By doing so, the amount of heat transfer from the combustion products to the inbound process air can be determined and imposed as a boundary condition for the simulation of the combustion chamber. This work presents a simple mathematical model for describing the combustion products-to-process air heat exchanger integrated in a TRI used in a paint shop of an automotive assembly plant. The model relies on the well-established effectiveness method for modelling heat exchangers, the ε-NTU method. The results obtained in this work are validated using experimental data obtained in an industrial environment. They are used to simplify the description of the heat recovery in the TRI by estimating the heat transfer rate from the gases in the combustion chamber to the integrated combustion products-to-process air heat exchanger.*