

Thermal and Flow Assessment of Rotating Plate Air Preheaters - An Optimization Case Study

Abstract

Rotating-plate regenerative Air Pre-Heaters (RAPH) play a critical role of recovering heat from the waste flue gas thereby increasing the overall efficiency of a thermal power plant. The heating plate elements in this periodic Heat exchanger are arranged in a matrix configuration in baskets that rotate at low rpm, after ensuring that the design meets pressure and temperature conditions. The effective design of these plates in the RAPH, where heat exchanges between fresh air and exhaust flue gas gains utmost importance. Most conventional programs base the sizing of RAPH plates on gas and air side temperature distributions. In certain cases, like in the current work catering to applications related to emission reduction, prediction of metal temperature distribution is essential. This is for design of new profiles of RAPH plates catering to Selective Catalytic Reduction, that require enamel coating on a section of the plates. The area that is to be enamel coated is to be optimized. An analytical program is developed to predict transient metal temperatures and coating area required for the RAPH plates. The results from it are validated with experimental flow and temperature results. The close match of experimental and analytical findings enables the usage of this program for predicting metal temperature distribution of RAPH plate elements, thereby reducing the time and cost of repetitive experimentation. The results have been applied to form the design basis of Air Preheater metal temperatures for an 800 MW Supercritical plant.