Effect of Fly Ash Deposit on Thermal Performance of Spiral Finned-Tube Heat Exchanger under Dehumidifying Condition

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ABSTRACT

This research investigated the effect of fly ash deposit on thermal performance of a cross-flow heat exchanger, having a set of spiral finned tubes as heat transfer surface. A stream of warm air having high content of fly ash was exchanging heat with a cool water stream in the tubes. In this study, the temperature of the heat exchanger surface was lower than the dew point temperature of air, thus there was condensation of moisture in the air stream on the heat exchanger surface. The affecting parameters such as the air mass flow rate, the fly ash mass flow rate and the inlet temperature of warm air were varied while the volume flow rate and the inlet temperature of the cold water stream were kept constant at 10 l/min and 5°C, respectively.

From the experiment, it was found that the thermal resistance due to the fouling increased with time. Moreover, the deposit of fly ash on the heat transfer surface was strongly dependent on the air-ash ratio and the amount of condensate on the heat exchanger surface. The empirical model for evaluating the thermal resistance was also developed in this work and the simulated results were found to agree quite well with those of the measured data.

Key words: Particulate fouling, Heat exchanger testing, Thermal resistance

INTRODUCTION

Heat exchanger is an equipment for recovering heat from the waste heat source. For recovering waste heat from flue gas, the cross-flow heat exchanger type is commonly used. Normally, this kind of heat exchanger faces with the particulate from flue gas which usually deposits on the heat transfer surface. Because of the low thermal conductivity of the fouling material, the thermal performance of heat exchanger is therefore decreased.

Many researchers try to explain the fouling phenomenon of the heat transfer surface and develop many correlations for predicting the thermal resistance due to fouling. One well-known model for evaluating the thermal resistance of fouling