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Recovery of flue gas energy in heat-integrated gasification combined cycle (IGCC) power plants using the contact economizer system

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ABSTRACT

Recovery of low potential energy of flue gases, mainly from industrial boilers, has become one of the problems of interest in research. In this work, the contact economizer system is used to recover low potential heat from the gas turbine exhaust (flue gas) stream of a heat-integrated gasification combined cycle (IGCC) design of the Elcogas plant adopted from previous studies. The underlying support for this idea was the direct relationship between efficiency of the IGCC and the boiler feedwater temperature. Recovery of the flue gas heat to preheat the boiler feedwater was demonstrated to be capable of further increasing the thermal efficiency of the plant. The methodology developed is divided into two parts, i.e., determining the maximum boiler feedwater temperature attainable and applying Mickley's graphical technique for dehumidification, following a slightly different procedure that allows for the calculation of the exact ratio between the liquid-phase heat-transfer coefficient and the gas-phase masstransfer coefficient, to demonstrate how the aforementioned temperature is achieved. The grand composite curve is used to check whether the determined boiler feedwater temperature is feasible. A case study on the Elcogas plant illustrated that the developed method is capable of increasing the gross efficiency from 54 to 55%. This increase in efficiency, however, has a penalty of operating at higher boiler and heat recovery steam generator (HRSG) pressures.