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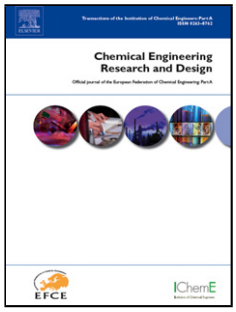

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Techno-Economic Optimization of IGCC Integrated with Utility System for CO_2 Emissions Reduction — Simultaneous Heat and Power Generation from IGCC

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Abstract

An integrated gasification combined cycle (IGCC) may be used to generate steam and power while providing a capture-ready CO_2 stream. This work addresses techno-economic optimization of an IGCC integrated with the utility system for a process site, with the aim of cost-effective reduction of CO_2 emissions. The IGCC can generate power and produce steam in parallel with the site utility system; integration of the IGCC into the site utility system means that the heat recovered from the IGCC is fed to the utility system, where it is used to generate steam to meet site heat and power demand. A relatively rigorous simulation model of the IGCC is applied to explore steam and power generation opportunities for various fuel flow rates. A simple, linear model is regressed from these simulation results to correlate fuel consumption and steam and power generation by the IGCC. The simple model is integrated into a model for simulation and optimization of the site utility system; the operating conditions of the overall system (IGCC and site utility system) can then be optimized to minimize the operating cost, taking into account the capacity and efficiency of equipment such as boilers and steam turbines, the cost of fuel, the cost or value of power, and costs associated with CO_2 emissions. The proposed optimization method is illustrated by application to an industrially-relevant case study. The results indicate that integrating an IGCC with a site utility system can provide an effective route for cogeneration of heat and power with low carbon emissions and low operating costs, although the economic benefits are sensitive to fuel, power and emissions-related costs.

Keywords: Carbon emissions; Integrated Gasification Combined Cycle; Utility system; Co-generation; Combined heat and power.

1. Introduction

Global energy demand has progressively increased as a result of industrial activities (IEA, 2013a). Conventional fossil fuels continue to be the dominant sources of primary energy in the process industries. However, utilization of fossil fuels in such an energy-intensive sector contributes significantly to greenhouse gas emissions, and in particular to CO_2 emissions, and in turn to associated environmental problems. In response to the Kyoto Protocol, there is great interest in technologies for mitigating CO_2 emissions, including technologies for CO_2 capture and sequestration (CCS) (Cormos, 2013).

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