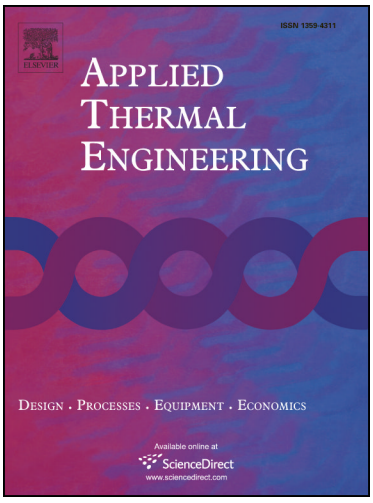

New trigeneration system integrated with desalination and industrial waste heat recovery for hydrogen production

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New trigeneration system integrated with desalination and industrial waste heat recovery for hydrogen production

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Abstract

An integrated trigeneration system for electricity, hydrogen and fresh water production using waste heat from a glass melting furnace is analyzed in this paper. The heat source for the integrated system is flue gas ejected from a glass melting furnace. The heat source is integrated with a thermochemical copper-chlorine (Cu-Cl) cycle for hydrogen production, reverse osmosis desalination for fresh water production and Rankine cycle for electricity production. A four-step copper-chlorine cycle is used in this paper. The trigeneration system is modeled and analyzed in Aspen Plus simulation software and Engineering Equation Solver (EES). The reverse osmosis desalination unit provides the system with 17.4 kg/s of fresh water, while the hydrogen production rate is 12 g/s. Energy and exergy analyses are performed on the integrated trigeneration system. The overall energy of the integrated system is 47.7% and exergy efficiencies are 37.9%. Additional results and sensitivity studies are presented and discussed in this paper.

Keywords: Trigeneration system, heat recovery, Cu-Cl cycle, reverse osmosis, energy, exergy, efficiency.

1. Introduction

Energy efficiency and waste heat recovery are important elements of sustainable energy solutions [1][2]. This paper examines the effective use of industrial waste heat for trigeneration energy systems involving hydrogen, electricity and fresh water production. Glass manufacturing processes can be divided into a batch or continuous processes for manufacturing of common glass like soda lime silicate glass and borosilicate. In continuous processes, the raw material is