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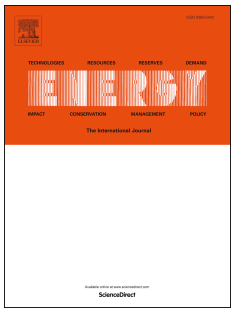

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PII: S0360-5442(17)31862-5

DOI: 10.1016/j.energy.2017.11.012

Reference: EGY 11800

To appear in: *Energy*

Received Date: 31 July 2017

Revised Date: 1 November 2017

Accepted Date: 4 November 2017

Please cite this article as: Pashchenko D, First law energy analysis of thermochemical waste-heat recuperation by steam methane reforming, *Energy* (2017), doi: 10.1016/j.energy.2017.11.012.

# First law energy analysis of thermochemical waste-heat recuperation by steam methane reforming

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**Abstract**

Thermochemical recuperation of waste flue gas heat may be advantageous for improving energy efficiency of hydrocarbon fuel-consuming furnace. The schematic diagram of thermochemical recuperation (TCR) by steam methane reforming is described. Thermodynamics equilibrium analysis of steam methane reforming (SMR) process has been investigated via Gibbs free energy minimization technique to determine the effects of pressure, inlet steam-to-methane ratio and temperature on TCR efficiency. The energy analysis was carried out for temperature range and steam-to-methane ratio of 600-1300 K and 1-6, respectively, at different pressure of 1-20 bar. The results shown that TCR efficiency can be controlled for maximum energy efficiency by the operating pressure, temperature and various inlet feed stocks. The recuperation rate and heat balance of TCR were analyzed for different waste flue gas temperatures, steam-to-methane ratio at mixture inlet and pressure. For the effective operation of thermochemical recuperation it is necessary to use a pressure of less than 10 bar, because in this case the percentage by volume of non-combustible components in the synthesis gas is minimal. The optimal operation conditions for TCR were determined: steam-to-methane ratio is 2 for flue gas temperature 900-1100K; steam-to-methane ratio is 1 for the temperature range above 1200K; optimal pressure is 5-10bar.

*Keywords:* Steam methane reforming, Hydrogen, Energy efficiency,

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