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Process simulation and techno-economic assessment of SER steam gasification for hydrogen production

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ABSTRACT

In the SER (sorption enhanced reforming) gasification process a nitrogen-free, high calorific product gas can be produced. In addition, due to low gasification temperatures of 600 −750 °C and the use of limestone as bed material, in-situ CO_2 capture is possible, leading to a hydrogen-rich and carbon-lean product gas. In this paper, results from a bubbling fluidised bed gasification model are compared to results of process demonstration tests in a 200 kW_{th} pilot plant.

Based upon that, a concept for the hydrogen production via biomass SER gasification is studied in terms of efficiency and feasibility. Capital and operational expenditures as well as hydrogen production costs are calculated in a techno-economic assessment study. Furthermore, market framework conditions are discussed under which an economic hydrogen production via SER gasification is possible.

Introduction

Ambitious targets for reducing the release of greenhouse gases, as defined in different global emission treaties such as the Kyoto Protocol and the Paris Agreement [1,2], require an extensive reduction of greenhouse gas (GHG) emissions globally. While the share of CO_2 free electrical energy (by increasing the share or renewable energy or by introducing CCS & CCU technologies) is increasing, the share of renewable energy in other energy intensive applications such as transport, heating or chemical industry is still low [3].

A hydrogen based economy could be a way for reducing the CO_2 emissions from sectors other than power production since hydrogen can be used as a transport fuel (e.g. in fuel cells) and as a raw product for the chemical industry.

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