Flexible TwoStage biomass gasifier designs for polygeneration operation

As increasing amounts of wind and solar are integrated into the energy system, there is a growing need for the development of flexible and efficient biomass-based energy plants. Currently, a Polygeneration concept is being investigated: a system based on thermal biomass gasification and solid oxide cells that can either produce power or biofuels depending on the electricity prices. This study investigates gasifier design opportunities for large-scale and fuel flexible TwoStage concepts that only applies partial oxidation for tar conversion. Thermodynamic modeling is carried out for a total of 12 gasifier cases, featuring 3 main systems that each can process wood/straw and use air/oxygen. It was found that despite the varying operation conditions, process parameters remained relatively stable and that partial oxidation could be effectively applied as the only tar reducing measure. The systems all achieved high cold gas efficiencies of 84-88% and were found to be significantly more effective than competing technologies, while also obtaining higher fuel flexibility.

General information
Publication status: Published
Organisations: Department of Chemical and Biochemical Engineering, CHEC Research Centre, Department of Mechanical Engineering, Thermal Energy
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Pages: 939-950
Publication date: 2019
Peer-reviewed: Yes

Publication information
Journal: Energy
Volume: 166
ISSN (Print): 0360-5442
Ratings:
BFI (2019): BFI-level 2
Web of Science (2019): Indexed yes
Original language: English
Keywords: Biomass gasification, Polygeneration, Thermodynamic analysis, Two-stage gasifier
DOI: 10.1016/j.energy.2018.10.144
Source: FindIt
Source-ID: 2441009233
Research output: Contribution to journal › Journal article – Annual report year: 2019 › Research › peer-review