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Hydrogen-rich gas production through steam gasification of charcoal pellet

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ABSTRACT: The University of Perugia has developed an Integrated Pyrolysis Regenerated Plant, which can be integrated with a steam gasification plant to produce hydrogen from charcoal. The advantage of using charcoal instead of biomass in steam gasification is represented by the reduction of tar production. To verify this new plant concept an experimental campaign was performed feeding water into a hot char bed. An interesting gas composition was measured, with hydrogen concentration equal to 58.26% in volume. Based on the mass and energy balance of the experimental tests a plant based on a pyro-reforming stage, coupled with a steam gasification was designed, focusing the analysis on heat integration between the pyro-reforming and the steam gasification process. The results show that the pyrolysis process can entirely provide the heat of reaction of the pyrolysis itself, the reforming stage and the steam gasification stage. A yield of 0.03 kg of hydrogen for 1 kg of biomass can be achieved.

keywords: charcoal; pyrolysis; hydrogen; steam gasification;

Abbreviations

η	Efficiency	-
λ	Air to fuel ratio	-
AAEMS	Alkali and Alkaline Earth Metals	-
db	dry basis	-
H ₂ /CO	Hydrogen to Carbon monoxide ratio	-
H	Enthalpy	MJ
IPRP	Integrated Pyrolysis Regenerated Plant	-
LHV	Low Heating Value	MJ/kg
STCR	Steam to Carbon Ratio	-
wb	wet basis	-

Subscripts

air	air	-
bio	biomass	-
c	combustor	-

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