On the Steam Reforming of Producer Gas for the Production of Clean Bio-Syngas

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This study was a part of the GreenSyngas project, funded by European Commission under its 7th Framework Program. The paramount objective of this project is to develop a novel gas conditioning process to clean the raw product gas (producer gas) from the gasification of wood. The conditioning of such a gas is challenging, as it will contain an unacceptable amount of various contaminants. Gas treatment may include several steps, e.g. removal of alkali metals and particulates, sulphur species, ammonia, and higher aromatic hydrocarbons, tars.

In addition to said aromatics, the gas will contain lighter hydrocarbons. In order to maximise the production of bio-syngas, these hydrocarbons should be converted in a catalytic reformer. However, due to the high level of potential catalyst poisons, the process will require robust catalysts that are able to operate in a harsh and corrosive environment. The objective of this study was to develop a catalytic reforming system for the conversion of hydrocarbons in the producer gas.

Steam reforming of a simulated producer gas was carried out in a fixed bed steel reactor. A set of commercial nickel based steam reforming was investigated with respect to stability at close to complete hydrocarbon conversion. After 100 hours of operation, no significant drop in methane conversion was observed, although a post experiment examination of the system revealed large amounts of carbonaceous materials covering the catalyst bed.

The effect of fine particulate carbon particles deposited on steam reforming catalysts was investigated. A soot generator was employed for this purpose. The generation was based on propane combustion, and the setup offered the possibility to control particle sizes and the elemental/organic carbon ratio. The amount of deposited carbon was estimated by means of TPO. The results indicate that even small amounts of carbon (0.5 - 1.0 wt-%) could lead to a 50 % drop in initial catalyst activity.