

Clean Gasification of Biomass with Integrated Tar Adsorption

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Abstract

Gasification of biomass is known for its valuable capabilities in small, flexible and decentral applications for cogeneration of power and heat. However, the produced raw syngas contains a variety of unwanted higher hydrocarbons such as aromatics and tar compounds in varying amounts adversely for a stable operation of such gasification plants.

This cooperative project between the University of Bayreuth (CVT, ZET), the UAS Hof and the company WS Wärmeprozessechnik aims to develop a new downdraft biomass gasification technology. Herein, the main innovation is the use of the charcoal directly formed by biomass pyrolysis in the gasifier as an adsorption agent for the unwanted tar components in a subsequent cooled adsorption section. The technology with regard to the formation of a suitable adsorption agent is in analogy to the common production of activated carbon by treatment of charcoal with CO₂ and/or H₂O at temperatures of around 900°C to achieve a high surface area. But here, the activated carbon is directly produced within the downdraft gasification reactor by the controlled, i.e. uncompleted conversion of the biomass coke formed by pyrolysis. Hence, the coke is only partly gasified to syngas and the residual amount is used as activated carbon for tar adsorption.

By subsequent cooling of the activated charcoal and the raw product gas to a temperature of 70°C suitable for adsorption, the tar components are almost completely adsorbed and removed from the syngas to make it usable for cogeneration without further treatment.

To gain all relevant informations about the main parameters of the overall process (char formation/conversion, formation and subsequent adsorption of tar), respective measurements were conducted in order to finally create a reliable numerical model of the process.

The respective results, e.g. regarding kinetic data of char conversion in the gasification unit and adsorption data achieved with naphthalene as a model substance for the tar, will be presented.