
Abstract:
Due to the high conversion rates and the low tar amounts in the product gas, entrained flow gasification of biomass can be an alternative process to state of the art gasification technologies, e.g., fluidized-bed gasifiers. Feedstock treatment is mandatory for entrained flow gasification (EFG). However, it has the potential of making residuals available for energetic use. In this study, the feasibility of EFG of solid biomass in an industrial-like test rig with a state of the art pneumatic dense-phase coal feeding system is shown. Four biomasses - torrefied wood (TW), beech wood (B), hydrothermal carbonized green waste (HCG), and corn cobs (CoC) - were used and compared to Rhenish lignite (RL). Especially, the gasification behavior of hydrothermal carbonized biomass is rarely known from the literature. The study includes a comparison of the fuels regarding feeding behavior, conversion rate, achievable gas composition, and cold gas efficiency (CGE) as well as tar formation. The oxygen stoichiometric ratio $\lambda$ was varied from 0.35 to 0.55. Investigations have shown that B is not appropriate for the stable, long-term operation of a pneumatic dense-phase feeding system. B and CoC exhibited higher conversion rates at low $\lambda$ values.
due to their higher volatile matter compared to the other fuels. The highest CGE of all trials was achieved with CoC (66.3%). B, CoC, and TW exhibited high amounts of CH4 in the product gas, even at high temperatures. With regard to fuel conversion, HCG and TW generally behaved more like RL. Although EFG is often referred to be a tar-free technology, tar formation - investigated by solidphase adsorption - was observed for all fuels especially at low λ values. Due to the high temperatures, mainly tertiary tars (e.g., naphthalene) were detected. A significant higher amount of tar was observed only for B (3.5 g/m3). For all of the other fuels, the total amount of tar was <1 g/m3 in all of the trials. Regarding feeding behavior, conversion rates and gas composition TW and HCG seem to be suitable as substitutes in coal fed gasification plants.