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Abstract: The formation of tars in gasifiers based on fluidized- or fixed-bed technology is a major problem in biomass gasification. By pretreating biomass using hydrothermal carbonization (HTC), entrained-flow gasification becomes applicable. Oxygen-blown entrained-flow gasifiers (EFGs) operate at very high process temperatures, leading to an almost tar-free syngas. However, in decentralized small-scale units, preferably air is used as the gasification agent, which, in turn, causes lower gasifier temperatures. The specific impacts of air-blown gasification conditions and fuel properties of biocoal from HTC on tar formation require particular attention. Therefore, in this work, tar formation under air-blown gasification conditions is investigated using solid-phase adsorption at an electrically heated EFG with temperatures of 900–1300 °C and different air/fuel equivalence ratios λ. Furthermore, tars are measured in the hot syngas of an industrial-like autothermal EFG. HTC biocoops of various feedstocks (beech, biogenic residuals, municipal waste, and green waste), raw biomass (corn cobs), and fossil fuel (Rhenish lignite) are used as fuels. The results show that the main influencing parameter on tar loading in the syngas is the
temperature, whereas the residence time and $\lambda$ have less impact. However, in autothermal operation, the choice of $\lambda$ controls the gasifier temperature and, thus, effectively affects the resulting tar loading. Identified tar compounds are mainly light polycyclic aromatic hydrocarbons, of which naphthalene is the most frequently occurring. At 1300 °C, tar loading is reduced to less than 0.2 g/Nm³, which allows for direct syngas use in internal combustion engines.