Burner Development for High Pressure Entrained Flow Gasification

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Entrained flow gasification, where low-grade anthropogenic and biogenic fuels are converted into a high quality syngas ($CO + H_2$), is one key enabling technology for circular economy and sustainable use of resources. To guarantee for complete conversion of the fuel and a high quality syngas, droplet size and related flow field generated by the burner nozzle, play a major role.

Typically, spray investigations are done in lab-scale at low liquid mass flows, thus knowledge concerning mass flow scaling of gas-assisted burner nozzles towards industrial throughput range is scarce. In consequence, investigations keeping the most important characteristic numbers (We_{aero}, GLR) constant, while increasing the liquid mass flow, were carried out. One specific nozzle was designed for each mass flow. Primary breakup and resulting droplet size were analyzed. A correlation for liquid mass flow scaling was derived, allowing for nozzle design for a target SMD.

Accompanying gasification experiments were performed at atmospheric pressure, to estimate the influence of the spray on flame position.

Additional research work will combine the knowledge about nozzle scaling, nozzle geometry [1, 2] and the interdependence in terms of flame position and syngas quality to derive design criteria for burner nozzles.

[1] Wachter, S.; Jakobs, T.; Kolb, T.; Appl. Sc. (Switzerland), 2022, 12 (4), 2123. doi:10.3390/app12042123, 2022

[2] Wachter, S.; Jakobs, T.; Kolb, T.; Appl. in Energy and Comb. Sc.,2021, 5, 100019. doi:10.1016/j.jaecs.2020.100019, 2022