CFD SIMULATIONS OF A BIOMASS ENTRAINED FLOW REACTOR

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The entrained flow reactor represents one of the most promising biomass gasification technologies for biofuel production. The CEA is leading an important project to develop an experimental entrained flow reactor facility, called GIROFLE, linked to a resource preparation unit (torrefaction and grinding). The entrained flow reactor is designed to work at elevated pressure and temperature (power = 150 kW, temperature = 1 500 °C, pressure before burner = 35 bar). The biomass flow is suitable for industrial development (50 kg/h). The energy injection device is flexible and can be configured as an oxy-burner using natural gas, torrefied wood, or raw wood. This abstract deals with 2D axisymmetric RANS reactor simulations using ANSYS-FLUENT 14.5 software.

This abstract is about testing different reactor geometries (burner and biomass injection) in order to help reactor sizing and optimize reactor gasification performance (conversion rate and particle residence time). The influence of the biomass injection location (annular and central injection), biomass inlet velocity, and swirl velocity have all been studied.

The Discrete Phase Method was used to calculate the flow between gas and solid phases. Particle tracking, using the Lagrangian approach, was coupled with biomass gasification modeling, using the FLUENT gasification calculator module. Most of the parameters used in the module came from experimental results obtained using a drop-tube reactor. The gas mixture was limited to 12 species: N_2, CO, CO_2, H_2O, H_2, CH_4, C_2H_2, C_2H_4, C_2H_6, C_6H_6, C(s), and tar. Five chemical reactions were considered: oxycombustion, devolatilisation, water-gas shift, methane reforming, and gasification.

The simulation results show that the geometry has numerous effects on reactor performance.

The next step will be to perform 3D reactor simulations. The complete validation of results will be carried out using the GIROFLE experimental data in 2014.

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