Technical University of Denmark (DTU)

The CHEC (Combustion and Harmful Emission Control) research centre at the Department of Chemical and Biochemical Engineering, Technical University of Denmark (DTU) focuses on the fundamental and applied research on high temperature processes, formation and control of harmful flue gas species, ashes and other particulates. The specific research subjects include:

- Inorganic metal species in high temperature processes;
- High temperature heterogeneous reactions;
- High temperature homogeneous reactions;
- Wet flue gas desulphurisation;
- Catalysis;
- Fluid dynamics in chemically reacting systems;
- Measuring techniques.

Figure 1: Pilot-scale facilities in CHEC Research Centre at DTU.

Entrained Flow Reactor (EFR)
Within the consortium of BRISK, DTU offers access to an atmosphere pressure high temperature entrained flow reactor (EFR). The EFR was designed to simulate the environment of high temperature thermal reactors such as suspension-fired boilers, entrained flow gasifiers or the freeboard of grate-fired boilers. The reactor is well-suited to study heterogeneous reactions at high temperatures and short residence times.

The complete setup of the EFR consists of a gas supply system, a fuel feeding system, a vertical reactor, a movable gas and particle extraction system, several gas analyzers and an ash deposit probe system. The gas supply system is regulated by accurate mass flow controllers which can send different gases (e.g. N_2, O_2, CO_2, CO, H_2O (g) and SO_2) to the reactor. The fuel feeding is controlled by a gravimetric screw feeder, with a feasible feeding rate varying in a range of 0.05–1 kg/h.

The vertical reactor has a total length of 2m and an internal diameter of 8cm. It is electrically heated to a maximum temperature of 1600^{o}C and the temperature profile is adjustable by regulating the heating elements of the reactor. A movable

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Figure 2: Entrained flow reactor in CHEC Research Centre at DTU.

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gas and particle extraction system can be installed to sample the flue gas and particles at different locations of the reactor. The particles can be collected by different equipment, such as cyclone, filter and cascade impactor.

The compositions (e.g. O_2, CO_2, CO, SO_2, NOx, HCl, H_2, CH_4, C_2H_4, C_3H_6 and higher hydrocarbons) of the extracted flue gas can be analyzed by a series of analyzers. Besides the movable extraction system, an ash deposit probe system can be installed on the setup to study the ash deposit formation under well-controlled flue gas temperature and probe surface temperature.

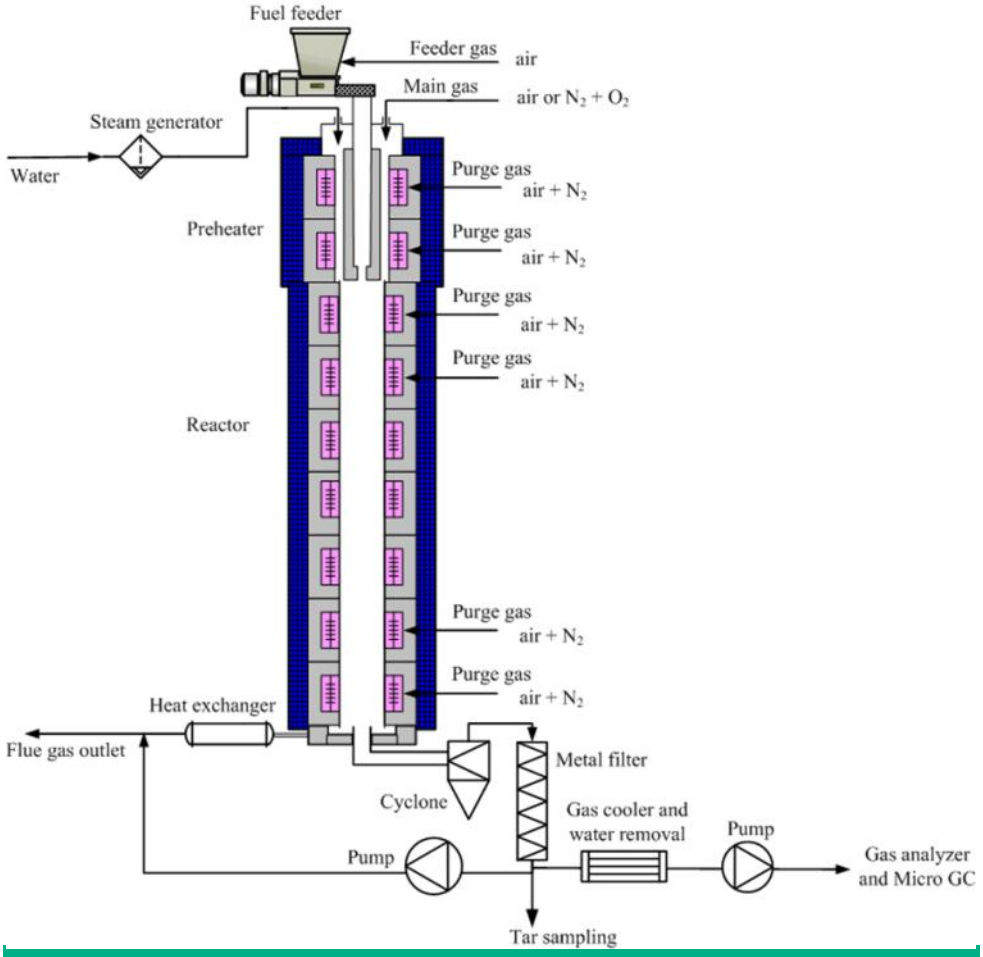

Figure 3: Schematic drawing of the entrained flow reactor for gasification study.

Recent research activities in EFR

These include:

- Combustion or co-combustion of pulverized solid fuels under air and/or oxyfuel combustion conditions, with emphasis on burnout, gaseous emissions (e.g. NO_x and SO_2), ash chemistry and deposition behaviours. The studied solid fuels include coal, biomass, waste materials and additives applicable in combustion.
- Entrained flow gasification of coal, biomass and their mixtures under different temperature and gas environment conditions. The research focuses on the influences of different fuels/fuel mixture and operational parameters on the gasification products including different gaseous species and solid particles such as soot and inorganic particular matters.
- Characterization of the pyrolysis behaviour and the char reactivity of solid fuels (e.g. coal and biomass) under different temperature, gas atmosphere and residence time conditions.

Contact

For further details about how to apply to utilise DTU's facilities as part of the BRISK initiative contact:

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