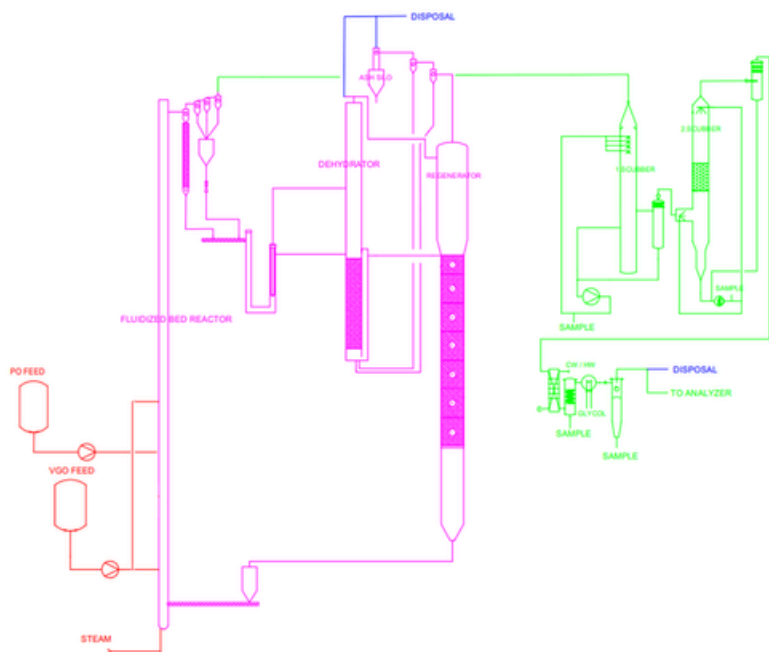


To make fast pyrolysis bio-oil compatible with fossil fuels, oxygen removal is essential. One promising route is co-processing bio-oil in conventional oil refineries, particularly in fluid catalytic cracking (FCC) units. This approach allows for decentralized bio-oil production near biomass sources, with only the upgraded biocrude transported to centralized refineries—reducing logistics costs thanks to its higher energy density compared to raw biomass.

A key advantage of FCC is that it requires no additional hydrogen and minimal refinery modifications. However, challenges remain due to the poor thermal stability and immiscibility of bio-oil with fossil fuels. In the Refolution project, co-FCC of bio-oil will be further studied in a modified pilot unit at VTT (target capacity ~ 10-20 kg/h). The pilot unit is a circulated fluidized bed (CFB) unit, which has previously been used for biomass pyrolysis.



The pilot unit at VTT consists of a 10 m reactor tube, which is divided into a bottom feeding section and top riser. Catalyst is introduced to the bottom section with a screw feeder and steam is used to lift the catalyst above the feed injection nozzles of VGO and bio-oil.

After the riser, three cyclones are used to separate the catalyst from the vapours before entering the liquid recovery system. The bottom part of the first cyclone is fluidized with nitrogen to strip the organics from the catalyst. After that, spent catalyst is preheated and regenerated in the dehydrator at 600 °C and finally in the regenerator at 700 °C.

From the regenerator, catalyst is partly cooled, to obtain the target temperature and catalyst/oil ratio, before the introduction to the reactor tube. Quenching of product vapours is achieved using two scrubbers and two coolers. Droplet separators have been installed after the scrubbers and coolers to further improve the condensation. The flow and composition of the non-condensable gases is measured before incineration in a boiler. Products from each condensation units are emptied in different canisters on scales.

Conclusions

For feeding of the pyrolysis oil and VGO two different feeding tanks will be used. The maximum feeding capacity of the system is 20 kg/h, with a bio-oil feeding capacity of 5-20 wt%. Bio-oil is introduced as cold from a cooled nozzle lance to prevent the polymerization and blockage of the feeding line and nozzle. VGO is preheated to around 200 °C to reduce its viscosity and achieve good atomization and dispersion through the feeding nozzle. Two different VGO feeding locations, one upstream and one downstream compared to bio-oil are available to test the influence of feeding location in co-FCC.