Title: Continuous separation of salts and solid products during Hydrothermal Liquefaction process

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The aim of this study:

Black Liquor to Fuel (BL2F) is a Horizon 2020 project that will use "Black Liquor" for green and high-quality biofuel production. Black liquor is a side-product from the pulp and paper industry processes, and it contain different organics and inorganics such as lignin, hemicellulose, and cooking chemicals (type 1 and type 2 salts). The organic part of the black liquor can be converted into valuable biofuel, but due to the crystallization of salts in the critical condition of water they can cause clogging in the continuous system.

BL2F project aims to evaluate a unique continuous integrated hydrothermal liquefaction (IHTL) at the pulp and paper plants, to develop a fuel intermediate for further upgrading in oil refineries. The aim of the present research is to investigate the efficiency of a novel continuous Hydrothermal Liquefaction (HTL) reactor designed for simultaneous salt and solid separation of Black liquor to avoid the blockage during the continuous HTL process. The BL2F reactor is designed to have two different thermal zones in supercritical and subcritical conditions. As it is visible in fig 1. the efficient HTL process takes place in the upper part (supercritical zone) of the reactor, while salt/solid separation and brine formation takes place in the lower part of the reactor (subcritical zone). The desalinated stream exits from the top of the reactor while the concentrated liquid brine is extracted from the bottom of the reactor.

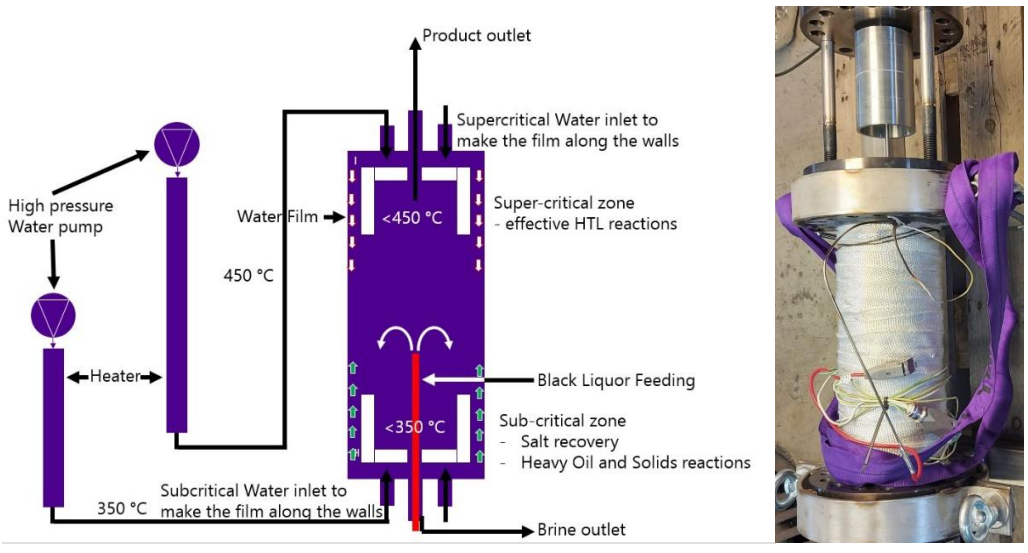

Figure 1. BL2F IHTL reactor

Novelty and Scientific innovation:

Salt separation and material recovery is an important factor to facilitate and industrialize the continuous HTL process. Currently, several studies have been conducted concerning material recovery and salt separation during Continuous HTL process, but it is for the first time that a HTL reactor have been designed in which both the HTL process and salt separation will be conducted in the same reaction media.

The BL2F IHTL reactor is constructed inside a container (fig 2.) to be a mobile HTL reactor and the process is controlled through the related user interface (fig 3.) from an office container.

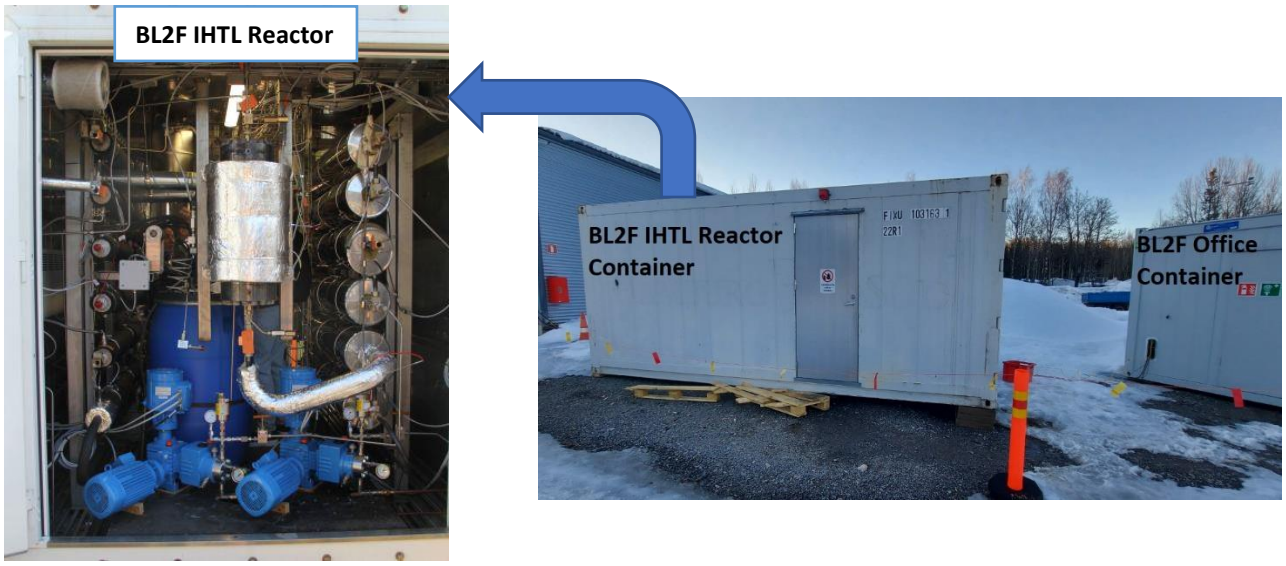

Figure 2. BL2F IHTL Reactor and Office container

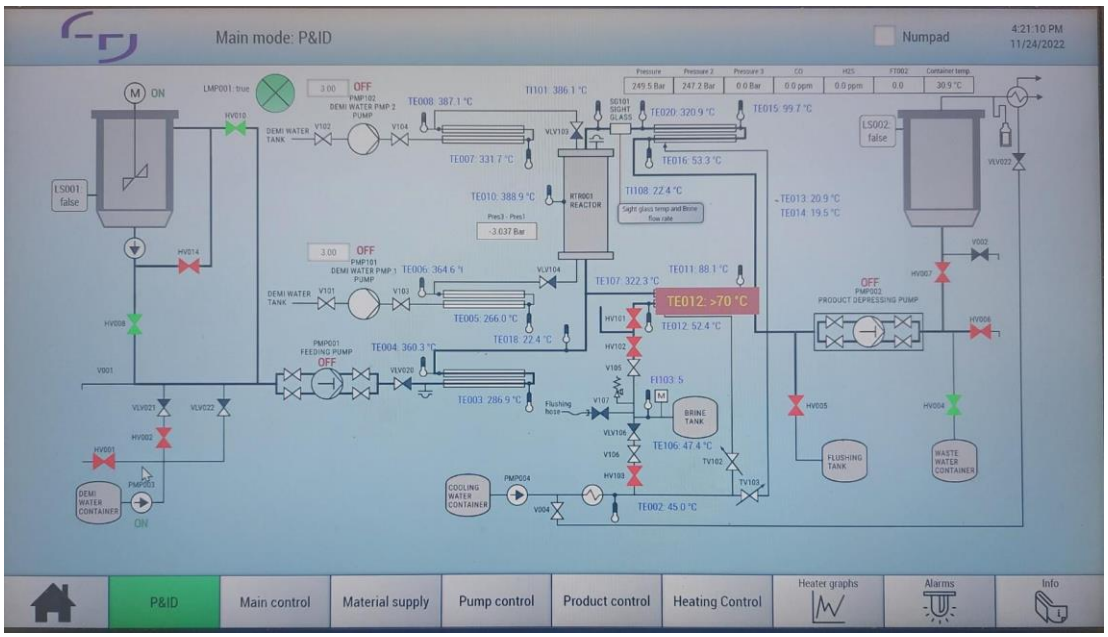

Figure 3. BL2F IHTL User Interface

Results and Conclusion:

The first runs were conducted using a model solution prepared from 5 wt.% K_2SO_4 (type 2 salt) and 5 wt.% Na_2HPO_3 (type 1 salt) without organics. 10 liters of model solution was used in each run, and it takes roughly 5 hours to conduct the experiment. Both the experiments were successful without any blockage and the concentrated brine and clear desalinated products were collected at the end of the experiments.

Figure 4. Concentrated Brine and Desalinated Product collected from IHTL Process

Further results will be reported in EUBCE 2023 conference.