Pilot scale electrochemical plant at Tiller, Norway

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SINTEF's s primary task in the LIBERATE project is the design, build and operation of the pilot scale electrochemical plant. This involves the integration of both lignin conversion and downstream processing of the reactor product. Generating this knowledge is essential for a profound technical and economical evaluation of the process. The LIBERATE project is targeting a technology readiness level of 6, which means that this technology must be demonstrated in an industrially relevant environment and product samples from the pilot project will be distributed to project participants for testing.

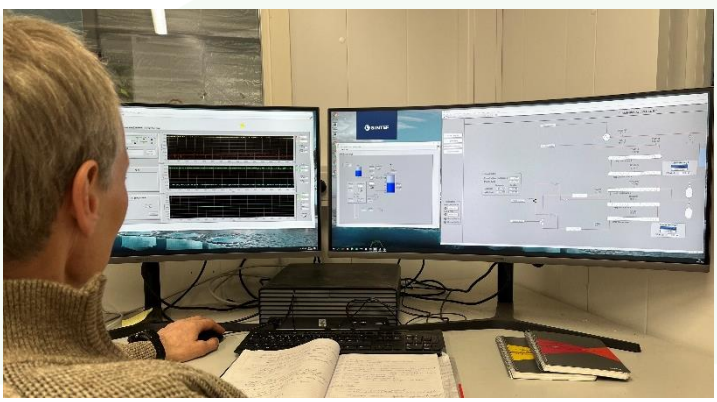
The vanillin-phenolic process is semi-continuous in design. Peroxidicarbonate (PODIC©) is used as the oxidizing agent and generated from sodium carbonate in an electrochemical cell with boron-doped diamond electrodes, which was developed by our project partner CONDIAS GmbH. A variety of feed modes offers the possibility to analyse different ratios and distributions of lignin feed and PODIC© stream.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 820735.

The chemical and thermal breakdown of the lignin molecules takes place in a plug flow thermal depolymerisation reactor, which is equipped with static mixers to ensure radial mixing along the reactor length. It was designed to work at a pressure of 16 bar and a liquid residence time of 2 to 5 hours. There are two temperature zones for temperatures up to 200 degrees Celsius across the 5 sections of the reactor. We have the possibility to take a sample after each section, which gives us the opportunity to accurately evaluate the effectiveness of the conversion of the lignin feedstock. The downstream separation system consists of an ion-exchange column and several evaporation units. Concentrated mixed phenolic compounds produced from Organosolv and Kraft lignin has been delivered to end-users Chimar and Oxiris, while samples of vanillin recovered from the reaction product by ion exchange will be delivered to end-user Perstorp.

In addition, samples of the effluent from the ion exchange and samples of untreated reactor product from both lignin sources have been sent to research partners LEITAT, Fraunhofer and the University of Alicante for further analysis and testing as part of the investigations on waste refining from the vanillin-phenolic process.

Since the start-up of the pilot in May 2021 more than 3000 kg of aqueous lignin containing feed solution (3-5 wt % lignin dissolved in 1 M NaOH) has been processed in the reactor system together with the oxidiser peroxydicarbonate, which is produced using the electrochemical cell.



The total amount of reactor product produced with the pilot plant is 7500 kg over 600 hours operating hours so far in the project.

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