

Scale-up of Hydrothermal Liquefaction with Supercritical Water Oxidation in an Integrated Biorefinery

Principal Investigator

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Summary

This project will integrate hydrothermal liquefaction (HTL) with supercritical water oxidation (SCWO) technologies in an innovative integrated HTL-SCWO biorefinery approach, in which municipal wastewater sludges are converted to biocrude oil, to be upgraded to sustainable marine, diesel and aviation fuels. Co-products recovered from the process include phosphorus fertilizers and reclaimed water free of recalcitrant organic contaminants such as PFAS (per- and polyfluoroalkyl substances), microplastics and residual toxic organics generated in the HTL process. The SCWO process requires no catalysts and generates heat that can be recovered for use in HTL process, reducing greenhouse gas emissions by over 70% compared to fossil fuels.

In the HTL process the wastewater sludge (at approximately 20% solids and 80% water) is fed into the reactor heated to near 350 °C at about 250 atmospheres pressure, with the resulting products separated by filtration and decantation after cooling into the crude oil, water, solids and gaseous phases. The recovered oil phase contains about 50% of the initial organic carbon and near two-thirds of the energy content of the sludge feed.

Phase I of this project will verify the operation of the SCWO process in treating the post HTL aqueous phase (HTL-AP). This will be followed by a detailed, updated engineering design of the process with CapEx and OpEx compared to alternative processes and prior TEA and LCA studies for HTL, including upgrading of the HTL oil into liquid transportation fuels.