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Wet Processing of Algae for Protein and Carbohydrate Recovery as Co-Product of Algal Oil

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Abstract : Historically, lipid extraction from dried algal biomass remained a focus area of the algal research. It has been realized over the past few years that the lipid-centric approach and conversion technologies that require dry algal biomass have several challenges. Algal culture in cultivation systems contains more than 99% water, with algal concentrations of just a few hundred milligrams per liter (< 0.05 wt%), which makes harvesting and drying energy intensive. Drying the algal biomass followed by extraction also entails the loss of water and nutrients. In view of these challenges, focus has shifted toward developing processes that will enable oil production from wet algal biomass without drying. Hydrothermal liquefaction (HTL), an emerging technology, is a thermo-chemical conversion process that converts wet biomass to oil and gas using water as a solvent at high temperature and high pressure. HTL processes wet algal slurry containing more than 80% water and significantly reduces the adverse cost impact owing to drying the algal biomass. HTL, being inherently feedstock agnostic, i.e., can convert carbohydrates and proteins also to fuels and recovers water and nutrients. It is most effective with low-lipid (10--30%) algal biomass, and bio-crude yield is two to four times higher than the lipid content in the feedstock. In the early 2010s, research remained focused on increasing the oil yield by optimizing the process conditions of HTL. However, various techno-economic studies showed that simply converting algal biomass to only oil does not make economic sense, particularly in view of low crude oil prices. Making the best use of every component of algae is a key for economic viability of algal to oil process. On investigation of HTL reactions at the molecular level, it has been observed that sequential HTL has the potential to recover value-added products along with biocrude and improve the overall economics of the process. This potential of sequential HTL makes it a most promising technology for converting wet waste to wealth. In this presentation, we will share our experience on the techno-economic and engineering aspects of sequential HTL for conversion of algal biomass to algal bio-oil and co-products.

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