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A review on hydrothermal liquefaction of algal biomass on process parameters, purification and applications

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ABSTRACT

Algae, a potential biomass feedstock with a faster growth rate and capability of greenhouse gas absorption, mitigates the limitations of the first- and second-generation feedstock in bio-oil production. hydrothermal liquefaction (HTL) is known to be an active method capable of producing substantial energy resources. In HTL, biomass undergoes thermal depolymerization in the presence of water, at around 280 °C–350 °C following subcritical and near supercritical conditions to produce chemical compounds such as alkanes, nitrogenates, esters, phenolics, etc. The primary product, "Biocrude/Bio-oil" obtained from the reaction, is identified as the essential fuel source after processing and also as a distinct value-added chemical source, along with biochar and biogas as co-products. This review outlines a range of routes available for thermochemical conversion of the algal biomass. It also provides a better understanding of the reaction mechanism like depolymerization, decomposition, and re-polymerization, operating conditions like temperature, pressure, the quantity of catalyst required, and the solvent used in the process. The review also highlights the yield achieved by altering the aforementioned parameters, comparing and presenting them as a collective result.

1. Introduction

The energy thirst is surging in response to the swelling population of the world. This has paved the way for the depletion of fossil fuels leading to environmental degradation. In addition, the utilization of fossil fuel for power is inevitable in the present scenario, but it is not advisable as it produces greenhouse gases. In this context, it is clear that the energy to be utilized in the future has to come from an alternate resource [1]. In accordance with International Energy Agency (IEA) survey in 2016, the global population may increase to 9.1 million in 2040 i.e. by 30% between 2016 and 2040 [2]. Similarly, in 2010, 3900 million tons of oil equivalents (Mtoe) per year or 85 million barrels per day (Mb/d) of oil were produced, 10% higher than previous years. The fossil fuel emission was very high at 11 Gigatons of carbon (GtC) by 2020 before reducing to around 6 GtC by 2100 [3]. Mining fossil fuels also have an impact on the environment due to their nature of polluting the resources. For example, drilling for oil resources will greatly affect the environment by polluting it with toxic heavy metals, hydrocarbons and metallic salts. Also, when the drilling liquid is disposed of, thus various treatment systems like wastewater treatment, heavy metal removal etc., must be introduced to mitigate these effects [4,5]. On the other hand, 2021 International Energy Agency's Renewable Information 2021 edition given in Fig. 1, points out that there is an increasing trend in the usage of renewable sources for energy production, comparing last 20 years 2019 saw a

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