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Hydrothermal Liquefaction of Algae for Production of Biofuels- A Review

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Abstract—*The steady rise in energy consumption buckled with the serious environmental pollution has become a major driving force for research activities in renewable energy and alternate fuels. The planet is progressively advancing towards a critical energy crisis along with the unbound and unchecked demand for energy overshooting its supply. As such energy and alternate fuels has been a trending issue and subject of research in recent years. Bill Gate once said in an interview that if he was to start an enterprise or an entrepreneurial start up in the present era it would be either related to energy or artificial intelligence (AI). Biofuels are being increasingly and constantly viewed as the possible solution for limiting the sufficiency on fossil fuels and very liable alternate energy source.*

1. INTRODUCTION

Various routes such as steam reforming, hydrothermal liquefaction, pyrolysis, transesterification etc. are being employed to convert biomasses into feasible and workable biofuels but more often these techniques are damped by various issues like large scale production face serious consequences [1]. The Hydrothermal liquefaction of wet biomass is proving to be a promising route. Therefore, this article briefly illuminates and highlights the few concepts related to hydrothermal liquefaction.

2. HYDROTHERMAL LIQUEFACTION

The hydrothermal liquefaction of biomass is actually a thermo chemical conversion of the biomass into liquid fuels by processing the biomass in a pressurized and hot water environment for an adequate time to break the solid biopolymeric structure into predominantly liquid fuels. Standard hydrothermal processing conditions are 523-647 K of temperature and a pressure varying from 4 to 22 MP. The vital parameters that drive the researchers to work on liquefaction are the high efficiency, low operating temperatures and low tar yield as compared to pyrolysis [2].

2.1 Feedstocks and Products

Generally, any type of biomass can be used as feedstock for the liquefaction process. It may be in the form of dry feedstock which includes dry woody biomass or lignocellulose. It can also be in the form of wet feed stocks which include algae, aquatic plants or weeds. The major difference among the two types lies in pretreating the wet feedstock as compared to dry feedstock. The liquefaction products can be separated into three main products which include bio-oil, solid residues and aqueous phase. The bio-oil is the concerned product while as aqueous phase generated can be used for various other processes e.g it is used circulated back in case of algae and used for the algal production. The solid residues is the undesirable product and needs to be as minimum as possible for maximum efficiency [2].

2.2 Fuel Properties

The reaction conditions such as temperature, solvent, solvent density etc. used during the hydrothermal liquefaction process decides the chemical composition of the bio-oil obtained but the feedstock composition has the most substantial effect. The bio-oils obtained are usually complex compounds which contain a mixture of fatty acids, aldehydes, ketones, carboxylic acids, aromatics and fatty acid esters. Oils with low ash content and high energy density are desirable indicating clean and efficient fuel.

3. RECENT TRENDS

Recently hydrothermal liquefaction of various aquatic species particularly algal species have shown very promising results. Many algae species have shown encouraging oil as well biochar yields ranging from 14%-50% . Besides, the ash content of oil obtained is usually less than 1% indicating clean fuel. The heating value of oil produced from liquification of various algae like macro brown algae, microalgae *Dunaliella Tertiolecta*, micro-algae *Laminaria saccharina* , *Spirulina* algae are 34MJ/Kg, 30.74 MJ/Kg, 36.5MJ/Kg, 36MJ/Kg respectively. The respective heating values are not much far from that of present day regular fuel petrol which is at 45.8MJ/Kg. Moreover, the aqueous phase generated during hydrothermal liquefaction of algae can be circulated back and used for algae cultivation which helps in the betterment economy of the process [3, 4].

4. CONCLUSION

Apart from various types of weeds and aquatic plankton, *Dal Lake* is home to a total of 91 algal genera, comprising of 217 species, 41 varieties and 8 forma. Citing above results, these species or varieties can be used as potential feed stocks for hydrothermal liquefaction process. Besides, most of these genera have led to the eutrophication of *Dal Lake* and need to be removed, so instead of being dumped as wastes it is better to use them as credible fuel resources [5].

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