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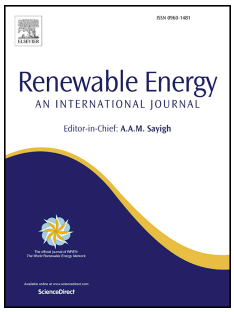

A comprehensive review on the pyrolysis of lignocellulosic biomass

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A comprehensive review on the pyrolysis of lignocellulosic biomass

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Abstract

In the pursuit of renewable sources of energy, biomass is emerging as a promising resource because of its abundance and carbon neutral nature. Pyrolysis is a prevailing technology for biomass conversion into the valuable hydrocarbon and alternative fuels. In this review, pyrolysis of lignocellulosic biomass has been addressed, focusing primarily on the ideal feedstock, technologies, reactors, and properties of the end product. Technical problems in using biofuel from pyrolysis, as transport fuel have also been discussed, along with solutions to address these challenges, and comments on the future scope of the pyrolysis process.

Keywords: Pyrolysis, Lignocellulosic, Biomass, Feedstock, Reactors

1. Introduction

With the depleting fossil fuel resources, increasing environmental concerns, and political commitment, research has been growing in the field of alternate energy sources. The UN climate panel has aimed for a reduction in greenhouse gas emission by 50-80 % by 2050 [1]. To realize this target, it is essential to shift the dependency from fossil fuels to the renewable energy sources. The renewable resources are inherently conceived using the energy present in sunlight and its direct and indirect impacts on the Earth (falling water, heating effects, photons, plant growth, wind, etc.), gravitational forces (the tides), and the heat of the Earth's core (geothermal). These resources represent a gigantic underexploited capital of energy, which can meet much of the growing energy demand at prices less than those of conventional fossil fuels if provided adequate support.

Biomass is the generic term for the plant *(phytomass)* and animal *(zoomass)* biomass. Lignocellulosic biomass refers to dry plant matter, which is an abundant and low-cost source of renewable energy. It is significantly cheaper than the conventional fuel on an energy basis. On agricultural land, the growth rate of lignocellulosic biomass on a per energy basis is 30-240 Barrel of oil equivalent per hectare per year [2]. Lignocellulosic biomass can be utilized in following the ways to procure energy:

(a) Direct combustion to produce heat. The heat generated by this method must be exploited immediately for heating or power generation. Other than the obvious problem of low efficiency, this approach also leads to undesirable ash buildup. The huge amount of CO_2, produced as a by-product of combustion is also a significant disadvantage.

(b) Conversion of biomass into biofuels and valuable hydrocarbons using thermochemical or biochemical routes.

Biofuels are the liquids or gases produced from biomass, which can be burned for obtaining energy. The first generation of biofuels comprised of biodiesel and bioethanol produced from different biomass such as edible and non-edible crops, agricultural wastes, and aquatic plants. The second generation of biofuels will be based on biomass resources processed from integrated bio-refineries, covering not only the production of biofuels, heat, and electricity, but also biomaterials [3]. Despite having a low carbon content, biofuels are environment-friendly, as they have negligible