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Comparative Analysis of Combustion Vs Auto-Gasification of Prosopis Juliflora Sticks for Rural Household Application

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Abstract

In 1870's the concern about deforestation, desertification and fuel wood shortage leading to the introduction of the *Prosopis juliflora* in India. The pro-line content in Prosopis is high under stress conditions, which helped the plant to thrive under extreme draught. Since *Prosopis juliflora* is abundantly available in rural areas, Indian rural households mainly depends on firewood for cooking and other thermal application using combustion route. The conversion efficiency of such system is very low and also degrade the environment. This paper analysis the combustion Vs autogasification route of converting *Prosopis juliflora* strikes into thermal as well as power application due to its high calorific value and ash properties. A novel gasification approach called autogasification has been employed converting solid combustibile to gaseous fuel without supplying of oxygen to enrich specific calorific value of producer gas.

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Keywords: Prosopis juliflora; Combustion; Autogasification.

1. Introduction

Achieving “Sustainable Development” is a formidable challenge in the present world. It concerns technologies that can help manage growth while considering economic, social, and environmental sustenance of the society. In fact there is an urgent need to solve the present problems faced by the society without creating any long- term negative impact, which could become a critical issue to resolve for the future generations.

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Energy need is an important ingredient in the modern economy and modern energy services must be evolved and deployed in all aspects of the development process – e.g., energy and communications, energy and industry, energy and the environment, energy and agriculture, energy and education, energy and public health and safety.

Biomass is one such source that can be used to provide sustainable supply of the required energy through biogas, vegetable oil, biodiesel, producer gas, and by directly burning the biomass. A large percentage of world's population continues to depend on biomass for their cooking needs. The cooking devices used by majority of them have very poor thermal efficiency and serious health impacts due to incomplete combustion. While past few decades have seen a lot of interest in development of better cook stoves for burning biomass, the magnitude of the problem is still a major cause of concern. In cook stoves the biomass combusted directly to release heat energy in which obtaining high thermal efficiency is difficult. So instead of direct combustion gasification technique is employed to achieve high thermal efficiency. Auto-Gasification is the novel approach in which the gasification process is done in an inert environment without supplying of atmosphere air.

The primary biomass selected for the plant is *Prosopis Juliflora*. This area has abundance of *Prosopis Juliflora* because of the extensive plantation done to stop desertification, as it is a very hardy plant that grows very fast even in very less water and is ready for harvest in 2- 3 years. The harvested plant grows back to its original size in 16 to 18 months and has a caloric value close to 3,600 to 4,000 kcal/kg making it the most suitable biomass fuel. Converting solid biomass fuel into gaseous fuel to run the IC engine is the efficient way for power production instead of direct burning in boiler based power plants.

A biomass power plant operation has the most positive effect to rural development and creation of additional employment in the rural sector. A successful operating biomass power plant would take the adjoining rural economy upward. Additionally, it generates green power, which is also a necessity in our country. Majority of schemes and support is to make rural India stronger and create employment opportunities in it, which are in a way by-products of a biomass power plant operation. Hence, amongst all the sources of renewable energies, top priority, support and cooperation is required in this segment of renewable energy.

2. Literature Review

V. Kirubakaran et.al (2007) explained the thermochemical conversion of poultry litter is the efficient route for its disposal as well as energy recovery from it on the paper titled Kinetics of Auto-Gasification of Poultry Litter. The ultimate analysis of poultry litter indicates that it has sufficient oxygen in itself to convert all the carbon to gaseous products. This establishes the auto gasification of poultry litter by the oxygen present in the litter itself.

V. Kirubakaran et.al (2007) reviewed the effect of size, structure, environment, temperature, heating rate, composition of biomass and ash based on that Auto gasification of biomass by the bio-oxygen and the catalytic ash would be feasible on the paper titled A Review on Gasification of Biomass.

C. Shankar et.al (2015) explained that Biomass can be converted into useful form through bio/thermo chemical routes and analyze the difficulties of usage of producer gas, gasifier output for IC engine applications and also he analyze the quality of producer gas from the wooden logs in a down draft gasifier using gas analyzer on the paper titled A Feasibility Study on Producer Gas Operated IC Engines.

N.S. Rathore et.al(2008) studied that thermal performance of gasification system for heating and concentrating Phosphoric Acid. It was analyzed that the gas outlet and flame temperature varied during the test similarly the quality of gas samples were analyzed and heat value of the producer gas was observed.

N. L. Panwaret.al (2009) analyzed with field related experience of a low temperature industrial heat application through biomass gasification. The liquefy petroleum gas (LPG) is fully replaced by sized wood on hourly basis such that tons of LPG over hours of operation is saved with the reduction of tons of CO₂ emission which leads to clean development mechanism.

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