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Experimental Investigation of Sustainable Fuel Production from Waste Oil for Aviation

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Abstract:-Air travel is increasing as airports are being constructed or expanded. Living near large airports has raised concerns about the population's exposure to potentially harmful combustion products. Jet fuels are readily characterized in terms of their physical and chemical properties. Studies on animals and after occupational exposure address the health effects of fuel vapours and liquid fuel. Jet fuel combustion products are not as well understood in relation to those. The type, load and fuel of an engine have an impact on the emissions that an aircraft produces. The fuels utilized in jet aircraft by both military and commercial jet engines differ. Particles such as CO2, H_2O,CO, C, NOx, and a variety of organic compounds are released when jet fuel burns. As of now, a hydrocarbon (HC) component (indicator) unique to jet engines has not been discovered among the emitted hydrocarbons. It appears that no heavy metals nor halogenated chemicals come from jet engines. Here the study shows the waste oil has very good combustible properties and can be utilized for aviation needs.

Keywords*: Sustainable Aviation fuel, Waste oil, Nano Addictives*

1. Introduction

Large number of solid trash are produced year by a variety of home, agricultural, and industrial activities. If this waste is not properly handled and disposed of, it can cause serious health and environmental issues. Simultaneously, enormous volumes of coal, oil, and natural gas are burned every day to create electricity and power for office, home, and industrial appliances. Not only does the overuse of fossil fuels put additional burden on the planet's limited resources, but it has also been a major contributor to environmental contamination. The scientific community has been searching for alternate and renewable fuel sources as well as a collaborative approach to waste management. The two biggest issues facing the globe today, if they are recognized and treated scientifically, can be overcome by sustainable energy derived from liquid and solid waste. Choosing the right raw materials and efficient technology for biofuel production is essential to producing high-quality products with little negative impact on the environment. In the current setting, recycling garbage through clean renewable energy sources are essential to the long-term viability of civilization and demand urgent attention on a number of fronts. It has been demonstrated that fewer than 10% of manufactured plastic is recycled annually. If the remaining 98% ever biodegraded, experts predict it would take more than 550 years and contaminate our water.

2. Objectives

Waste oil fuel is largely non-petroleum in order to provide energy security and environmental advantages while also substituting for traditional fuels like gasoline and diesel. Natural gas mostly composed of methane meets this criterion, and the natural gas is primarily stored as compressed natural gas in pressure vessels or as adsorbed gas that may be held at low pressure in a porous solid. Zeolites have a high crystallinity, a wide accessible surface area with a high free volume, a low framework density, and relatively strong interactions between the framework and the methane molecules. The increased usage of fossil fuels, the loss of natural resources, and environmental deterioration have made the sustainability of alternative fuels for automobiles more and more crucial. As a result, there is more demand on manufacturers and suppliers to make sure that their items are sustainable from an economic, social, and environmental standpoint. Though some research have also looked at the implications for life cycle costing, the majority of study in the subject of alternative fuels has been centered on environmental life cycle assessment. When considering the sustainability performance of alternative fuels, the social element seems to be the one that received the least attention.

3. Methods

Pyrolsis procedures are used to extract waste oil from waste items. The oil is recovered from waste goods utilizing thermal breakdown technologies. After being gathered, mixed plastic waste is filtered to remove any contaminants that aren't plastic, such paper or metal. The effectiveness of the pyrolysis process can be increased by performing specific pre-treatment procedures to slice or shred the plastic waste into smaller pieces, depending on the kind of trash. Waste plastic is placed inside a pyrolysis reactor, which is typically an oxygen-free, high-temperature container. Thermal breakdown of plastic occurs when the reactor is heated to

Fig.1 Waste Products

temperatures between 500°C and 1000°C (672°F and 1572°F). Plastic vaporizes when heated, producing a combination of volatile gases, including hydrocarbons. The reactor cools and condenses the gasses it produces. The cooling system divides the mixture into liquid and gaseous products. Condensed liquid products, including gasoline, diesel, and other hydrocarbon-based products, include a range of hydrocarbons that can be further separated to extract the required oil fractions.Gaseous by-products such as methane and hydrogen can be recovered and transformed into other usable compounds or used as a source of energy within the pyrolysis plant.Solid residues like as char and ash are left behind in the combustion process.the pyrolysis reactor and can be treated further or disposed. Additional refining and purifying stages may be performed to generate a higher-grade product depending on the quality and specific requirements of the extracted oil.The extracted oil can be utilized as an energy source, a feedstock for the petrochemical sector, or for other purposes. Pyrolysis provides a method for converting mixed plastic waste into useful resources while decreasing pollution andlandfilltrash.Itiscrucialtonote,however,thattheefficiencyandqualityof the oil recovered might vary depending on the kind of plastics utilized, the pyrolysis process parameters, and the equipment employed.

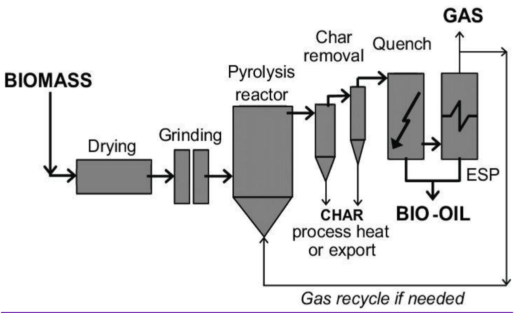

Fig.2 Pyrolysis Method

Next step is thecombinationofoilandparaffinindifferentratios,followed byaburntesttodeterminewhichratioburnsthelongest.Theobjectiveisto find the most efficient mixture. Oil and paraffin are mixed in different proportions, specifically in 50%:50% and 70%:30% ratios. Each of these mixtures is ignited andburned,andthetimeittakesforeachmixturetoburncompletelyisrecorded. Among the tested ratios, it is found that the 70%:30% mixture burns for the longestdurationcomparedtothe50%:50%mixture,indicatingitmaybethemost efficientcombination.The70%:30%oilandparaffinmixtureisthensubjectedto an FTIR (Fourier-Transform Infrared) test. This test is conducted to analyze the chemical composition and structure of the mixture, providing

Fig.3 Waste Oil

insights into the presence of specific functional groups and molecular bonds. It helps to better understand the makeup of the chosen combination. In summary, the experiment aims to find the most suitable ratio of oil and paraffin for a specific application by evaluating their combustion characteristics. The chosen 70%:30% ratio is further analyzed through FTIR testing to gain a deeper understanding of its chemical properties.

4. Results

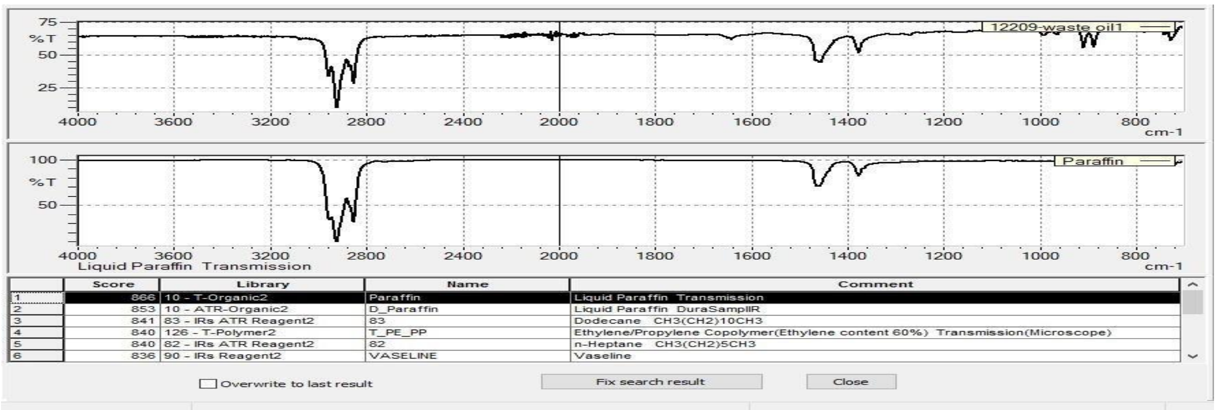

Fig.4 Waste oil Vs Paraffin

The above result shows the present of Paraffin in the waste oil which helps to elevate the burning rate of the fuel. Hence the nano substances added with this waste oil will improve the burning efficiency of the fuel. Also additional paraffin can be added with the waste oil. It can be ascertained that the factors proposed by the researchwork validated working in the aircraft Engines. The derived value of fit indices from the data obtainedfrom the satisfied the benchmark value of confirmative factor analysis shows thatthe waste oil and waste oil mixturesfuel is efficient again, the workapplied thesamemethodofconfirmation factoranalysis.

5. Discussion

Nano additives are added to fuels throughout the production process in order to improve their efficiency and performance. These nano additions have a range of effects on emissions, combustion processes, and fuels. Nano additives can increase the efficiency of combustion by better fuel atomization and mixing, which leads to a cleaner and more thorough burn. Nano additions can lower emissions of particulate matter (PM) and nitrogen oxides (NOx) from fuel combustion. They can act as catalysts or enhancers of combustion, enabling a more complete and clean burning process. Environmentally friendly fuels with reduced soot, particle emissions, and sulfur content may be developed with the help of nano additives. The manufacturing of sustainable fuel has a major source since aviation fuel is in such great demand. The main goal of supplying the demand is sustainable fuel development. There are many bio degradable waste available, and they may be grown more to improve the feedstock capacity. Therefore, the purpose of this experimental study is to explore the possibility of using waste oil fuel to produce a substitute fuel. As a result, this study used the transesterification approach to produce waste oil fuel from waste oil using methanol at 70 °C for three hours while using a 350 rpm magnetic stirrer. The Aviation fuel mix (20WOWP+80P) was made by blending 20% waste oil of wate products (20WOWP) and 80% paraffin (80P) by volume.

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