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A Review of Biodiesels used in Diesel engine

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Abstract:

This review paper investigates the various biodiesels and oils application in CI engine. Since demand of petroleum based fossil fuel increasing day by day and storage is decreasing rapidly. Emissions from CI engine in form of CO, NOx, PM and smoke are major worry. To overcome these issue recent researches shows biodiesels are good alternative fuel for CI engine. Primary characteristics of biodiesels are renewable and biodegradable which attract many researchers. Jatropha biodiesel, fish oil biodiesel, waste cooking oil biodiesel, palm oil biodiesel, opium poppy oil biodiesel, and microalgae biodiesel have been studied. Jatropha biodiesel blend with turpentine was found to be the most suited biodiesel because of its higher efficiency and lower emissions when comparing with diesel.

Keyword:- Diesel, biodiesel, combustion, emissions, performance

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Introduction:-

Diesel engines are backbone of power system in moving and non moving applications namely construction sectors, agriculture, transportation and power production. Since diesel engines are highly efficient, long durable, low maintenance cost and easy to repair that's why used widely. Hence Demand for fossil diesel fuel is therefore also rising at a considerable pace. However diesel engines release harmful emissions of combustion like CO, CO_2, NOx and PM.

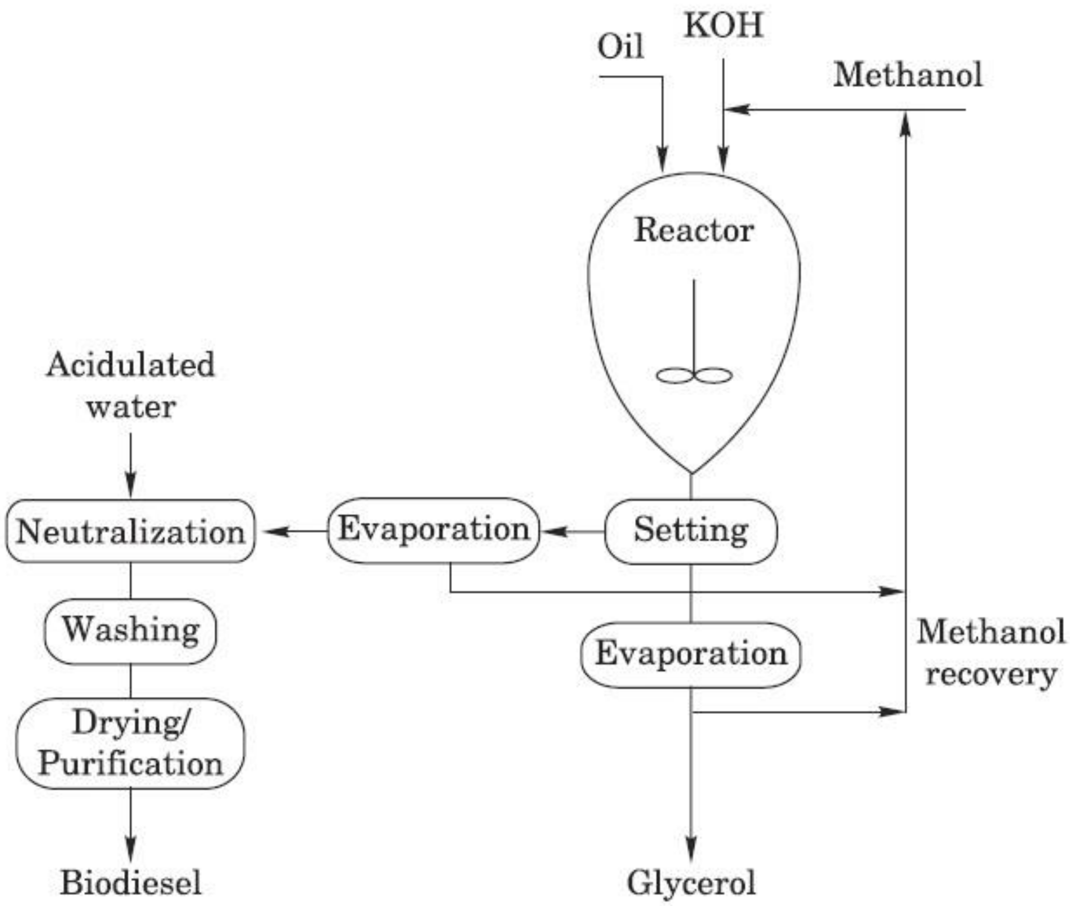

Fig1: Block diagram of biodiesel production process. [1]

Literature review:-

Kumar et al.[2] evaluated Jatropha biodiesel in diesel engine for performance and emission varying operating conditions injection timing as 12°, 15° and 18° bTDC, load as 40%, 70% and 100%, speed as 1500rpm, 2300rpm and 3100rpm. At 70% load, 3100rpm, 12° crank angle bTDC, engine fueled with jatropha biodiesel, smoke level reduced by 72.56% comparing with diesel fuel. Introduction of Jatropha increases BSFC and emission of NOx in all test conditions.

Krishania et al. [3] considered diesel engine for the emission and performance analysis with jatropha biodiesel, tyre pyrolysis oil and microalgae biodiesel. With blend of 80% Jatropha biodiesel and 20% tyre pyrolysis oil decreases smoke emission by 11.58%, particulate matter with 5.3% while NOx with 10.16% relative to diesel. While BSFC increased and BTE decreased.

Roy et al. [4] investigated dual fuel blend Jatropha-Castor biodiesel in diesel engine and reported blend of 5% Water emulsion, 75% Diesel, 10% Jatropha, 10% Castor increases break thermal efficiency by 14% and decreases break specific consumption by 16.7%. While blend shows 60% reduction in CO emission and reduction in NOx by 61%.

Gad et al. [5] investigated CI engine for the emissions, performance with Jatropha biodiesel combined with nano-additives like Al_2O_3, TiO_2, CNT were examined. Jatropha biodiesel blend with CNTs observed to be decrease in emissions up to 52% for NOx.

Abed et al. [6] studies various biodiesel sources, such as waste cooking oil, algae, palm and Jatropha for CI engine. At constant engine speeds of 1500 rpm exhaust emissions were measured and by varying engine loads of 1kW, 2kW, 3kW, and 4 kW. CO_2, CO, HC, NOx,and smoke emissions are measured and compared to diesel fuel emissions.

Madiwale et al. [7] studies on Biodiesel from Cottonseed, Palm, Soybean, and Jatropha with Ethanol as an additive. The blends were made up of 20 %, 40 %, 60 %, and 80 % biodiesel with no ethanol in the diesel fuel, and 25 %, 45 %, 65 %, and 85 % biodiesel with 5% ethanol in the diesel fuel. According to the investigation, the BSFC for blend of Jatropha oil biodiesel 20%, Diesel 75% and Ethanol 5% grows from 2 to 9%, for blend of Soybean oil biodiesel 20%, Diesel 75% and Ethanol 5% from 1.5 to 2.5 %, and for blend of Palm oil biodiesel 20%, Diesel 75% and Ethanol 5% from 1 to 7%. BTE increases from 5 to 9 % for blend Jatropha oil biodiesel 20%, Diesel 75% and Ethanol 5%, from 3 to 9 % for blend Soybean oil biodiesel 20%, Diesel 75% and Ethanol 5%, and from 4 to 7 % for blend Palm oil biodiesel 20%, Diesel 75% and Ethanol 5%.

Dubey et al. [8] studies diesel engine for effect of turpentine oil and Jatropha biodiesel. It was observed that at full load at CR 20, BTE enhanced by 2.17 %, while smoke opacity, NOx, HC and CO decreased by 30.8, 4.21, 17.5, and 13.04 percent respectively.

Kathirvelu et al. [9] studies jatropha seeds and fish wastes effect on emission for CI engine. Relative to diesel fuel soot emissions, UHC and CO are decreased for both blends at all loads, although NOx emissions are somewhat higher.

Viswanathan et al. [10] studies preheated FOEE as a fuel for the application in diesel engine. Investigation was done at temperature range from 60-80°C. Engine performance of FOEE are optimum on 80°C.

Subramani et al.[11] evaluated on diesel engine fuelled using algal biodiesel blend optimized injection time and anti-oxidants. By using Taguchi orthogonal array optimization technique optimum influcing factor and optimum combinmation level was achieved. It was reported that the optimum retarded injection time with 20° with 500 ppm BHT and 250 ppm PY.

Nayak et al. [12] studies influence of fish oil in CI engine for emission control and optimum efficiency. It was observed that the emissions of carbon monoxide, hydrocarbons, smoke are decreased by 18.2%, 23.4%, 15.4%, respectively.

Gad et al. [13] studies CI engine with fuel replaced by kerosene and gasoline with waste cooking oil. When employing biodiesel/gasoline, biodiesel/gasoline, biodiesel/kerosene, and biodiesel/kerosene in the ratio of 95/5, 90/10, 95/5, 90/10 respectively, then the smoke emissions were reduced by 30, 34, 41, and 44 %, respectively.

Giridharan et al. [14] studied algae oil in CI engine for performance and emission properties. The study revealed that the B15 blend has high overall and mechanical efficiency, as well as emitting a low percentage of CO and CO2.

Subramaniam et al. [15] studies CI engine for performance, combustion and emission using Azolla pinnata algae. Break thermal efficiency was decreased for blends of Azolla pinnata algae. AT lower load CO emission was high. Linear increament in NOx emission was observed at all load. While by algae emission was decreases significantly by increasing load.

Nguyen et al. [16] studies effect of fish oil biodiesel in CI engine. When engine run with 30% fish oil and 70% diesel decrement of 26.2%, 14.3%, 3% in soot emissions, unburned hydrocarbons and carbon monoxide was observed when load 75%. 5.1% increase in NOx and 3.4% increase in BSFC was observed comparing with diesel fuel.

Gad et al. [17] reported waste cooking oil biodiesel in diesel engine with gasoline additive. When comparing pure WCO to WCO-gasoline blends, smoke opacity, NOx, UHC, and CO emissions are reduced by 30, 20, 30 and 25 percent respectively. When employing WCO-gasoline blends instead of pure WCO, the bsfc is reduced by ten percent.

Akcay et al. [18] investigated waste cooking oil biodiesel blend with diesel in addition with hydrogen for emission and performance. For all test settings, hydrogen was found to have a beneficial influence on BSFC, with the largest reductions of 12.5 percent and 11.2 percent for the diesel and 25% blend waste cooking oil biodiesel with diesel fuels, respectively.

NIrmala et al. [19] studies on waste cooking oil for emission, CI engine. Biodiesel made from waste cooking oil and algal oil is 6.4 percent and 7.9 percent denser than regular fuel, respectively. When compared to WCOBD, algal oil biodiesel has a higher calorific value and is just 2.5 percent less than CD.

Rajak et al. [20] studies spirulina microalgae biodiesel for performance, emission and combustion effect on diesel engine. The results show a 0.98 percent reduction in brake thermal efficiency, a 1.7 percent increase in exhaust gas temperature, a 16.3 percent increase in hydrocarbon (HC), a 3.6 percent increase in carbon monoxide (CO), a 6.8 percent increase in NOX emission, and a 12.35 percent increase in smoke emission.

Gozmen et al. [21] used opium poppy oil and palm oil for replacement of diesel in CI engine. The engine's lowest BTE was 34.92 percent at 1600rpm with palm biodiesel, while the maximum BTE was 35.85 percent using diesel fuel. The comparable fuel types exergy efficiency varied from 32.50 percent to 33.64 percent for palm biodiesel and diesel fuels, respectively.

Yesilyurt et al. [22] studies of waste cooking oil biodiesel for performance and emission of CI engine. It was reported that emission was significantly decreases by using waster cooking oil. When compared to normal diesel fuel, the engine torque, brake power, CO, unburned HC, and smoke opacity of biodiesel blended fuels were reduced; nevertheless, BSFC, exhaust gas temperature, NOX, and CO2 emissions increased.

Bencheikh et al. [23]studied ternary waste cooking oil biodiesel–diesel–propanol blends: fuel characteristics, characterizations, and engine and emission performance evaluations . Results revealed that BSFC and BSEC has been enhanced by addition of propanol and decrease in CO, NOx, smoke and EGT was observed.

Conclusion:-

This study presents a review of the current level of knowledge about the performance, combustion, and emission characteristics of diesel engines running on neat biodiesel and its mixes as alternative diesel fuels. The following results were drawn from a study of biodiesel fuels.

1. Performance and emission study of different biodiesel fuel such as Jatropha biodiesel, waste cooking oil biodiesel, fish oil biodiesel, palm oil biodiesel, opium poppy oil, microalgae biodiesel has been done.
2. Mostly Biodiesel shows decrement in thermal efficiency and increase in break specific fuel consumption since low calorific value of biodiesels.
3. CO and HC emission are decreases and NOx emission and CO_2 increases for most of biodiesels.
4. Jatropha biodiesel blend with turpentine found to be most suitable biodiesel due its higher efficiency and lower emission comparing with diesel.

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