© February 2021| IJIRT | Volume 7 Issue 9 | ISSN: 2349-6002

Impact of Ignition Improvers on Diesel Engine Characteristics Powered with Waste Mahuwa Seed Methyl Ester Biodiesel Blends

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Abstract **- Petroleum or gasoline based mostly oil fuels worldwide haven't simply resulted within the quick or rapid consumption of conventional energy sources however have in addition caused serious air and atmosphere contamination. The search for a substitute fuel has prompted numerous discoveries as a result of that a wide variety of alternative fuels are available to us at our disposal currently. The current investigations have revealed the utilization of vegetable oils for CI engines as an alternative for diesel fuel. But there is a limitation in utilizing straight vegetable oils in diesel engines because of their high viscosity and low volatility. In the present work mahuwa seed oil is converted into mahuwa seed methyl ester (MSME) through transesterification process. In the first phase of work, tests are conducted by using different blends of mahuwa seed methyl ester with diesel in a single cylinder with four stroke vertical and water-cooled Kirloskar diesel engine. The experimental result of fuel blends (MSME10, MSME20, MSME30, MSME40, MSME50 and MSME100) are compared with diesel oil (D100). The brake thermal efficiency, mechanical efficiency, unburned hydrocarbons and CO, NOX are found to be lower just in case of MSME biofuel blends than the diesel. And the results are indicated that the blend MSME20 have nearly the same emissions and performance characteristics as of the diesel fuel. Brake specific fuel consumption for blend MSME20 is 0.21kg/kW-h at full load condition be nearer towards diesel is 0.19kg/kW-h. The brake thermal efficiency for mahuwa seed biofuel blend MSME20 is 31.91% and it had been nearer towards the diesel fuel is 34.33% at full loading condition. The base test results demonstrated that the MSME20 blend having equivalent characteristics to those of diesel fuel. This prompted the conclusion that the blend MSME20 is the most suitable blend when compared with other MSME blends and therefore MSME20 is the substitute for the diesel, and which is able to reduce the diesel utilization nearby 20%.**

Index Terms **- mahuwa oil methyl ester (MOME), advanced injection timing, higher alcohols, 1-butanol, standard injection timing.**

I.INTRODUCTION

Biofuels thought about as another fuel for the fossil fuels that area unit depleting in no time and that they produce harmful environmental pollutions. The biofuels area unit typically thought about recently area unit completely different sorts of biofuels area unit grain alcohol and biodiesel.1 Shehata et al. studied that by mistreatment corn and soybean blends with diesel oil over a large vary of engine speeds, masses while not modifying the engine components. He completes that the brake thermal potency for diesel, two hundredth biofuels area unit reciprocally consistent with their viscousness or density and O content and at constant time their arrangement in descendent ordering relating to the heating values.2Also complete that the height pressure of the cylinder for diesel oil is over that for corn and soybean blending fuels with all engine conditions. Reducing the oxides of atomic number 7 and soot to meet the demanding emission standards received extensive attention in diesel combustion chemistry.3 Aqwu et al.experimentally complete that the soybean biodiesel with diesel blends was found that by mistreatment soybean blended with rock oil diesel, the engine worked well.4 Lebeckas et al. used oil in a very ICE, the facility output reduced and also the brake specific fuel consumption inflated.5 Sharon explained that mistreatment vegetable oil in a very ICE produces best power output and minimum emissions and conjointly with twenty fifth diesel shows improved specific fuel consumption.6 Sharon et al. terminated that the performance, exhaust gas emission and heat emission, tests on indirect injection diesel motor with 100 percent volume of crude oil blended with diesel. The results showed lower engine performance and better toxic-gas emissions once mistreatment the blended fuel.7 Canakci et al. reportable the performance of diesel engine run with helianthus oil. Smoke emissions were reduced whereas brake specific fuel consumption hyperbolic as compared to the engine mistreatment pure diesel.8 Hassan terminated that the utilization of oil on diesel motor reduces the emissions.9Fumigation may be a method want to scale back engine emissions compared to traditional operation. methyl alcohol fuel has been used to scale back oxides of chemical element, organic compound, and carbon monoxide10. The alcohol diesel blends scale back the smoke density and chemical element oxides from a diesel motor. The brake thermal potency decreases with increase in alcohol share within the blends.11 Sundarraj et al. studied that the influence of covering of air with methyl alcohol, alkyl alkyl group organic compound, and liquefied fossil oil gas and terminated that unburnt organic compound and monoxide emissions.12 an alternate for fuel is known as biodiesel. It is created by the chemical bonding of AN alcohol with oils, fats, and greases or with chemicals famed alkyl radical esters. Churchill et al. [1] have explored the impact of Indian Jujube seed oil as bio diesel on the performance and emission characteristics of single cylinder diesel engine. The tests were performed with blends of JB25, JB50, JB75 and JB100. The last outcome has uncovered that the BTE is marginally decreased, the emission temperature gave the best outcome, and the exhaust gas temperature is lower for JB75. And furthermore, it uncovers the non-eatable oi1 was a promise resource which be able to support bio-diesel development. Praveen et al. [2] had led an examination to analyze the performance and emanation characteristics of Watermelon bio diesel in a single cylinder four stroke direct injection diesel engine coupled to eddy current dynamo meter. During the test the engine was fueled with different blends like B0, B20, B40, B60, B80 and B100 and the outcomes were compared with pure diesel. The last end uncovered that among every one of the blends B20 demonstrated the closer performance with the neat diesel. Rengasamy et al. [3] extricated Oil from Artocarpusheterophyllus (Jackfruit) seeds and concentrated its application in biodiesel creation. This investigation incorporates the optimization of oil from feasible methods with respective solvents and the optimization dependent on the measure of oil yield. The most efficient yield was gotten in microwave oven extraction procedure resulting about 19.8% of yield utilizing methanol was solvent. The biodiesel yield got was about 92% by transesterification at 650C reaction temperature, 1: 9 molar ratios of oil: methanol and 400 rpm of stirring speed for 120 minutes with 1 wt% of sodium hydroxide as catalyst. Satish Kumaret al. [4] presented a third-generation bio diesel resource called ManilkaraZapota Seed Oil. They have been produced rough ManilkaraZapota oil (MZO) from ManilkaraZapota Seed by a mechanical expelled and found the physicochemical properties of unrefined MZO and ManilkaraZapota Methyl Ester (MZME) after transesterification process. At long last they have affirmed that new bio diesel ManilkaraZapota Methyl Ester satisfies the EN14214 bio diesel guidelines and could be a reliable substitute to the diesel in diesel engine applications.

II. PREPERATION OF BLENDS WITH DIESEL

The obtained Bio- Diesel is blended for conducting the performance test, the mahuwa seed oil Bio- Diesel is mixed in proper proportions. Preparation of various fuel blends are shown in Fig.3.1 and Fig. 3.2.

2.1 Procedure:

1. The Bio- Diesel is first filtered form impurities.
2. Required amount of fuel and Biodiesel is taken into the measuring jar and mixed thoroughly the amount of proportions. The fuel quantity with diesel and biodiesel is presented in Table 2.1 and Table 2.2.

Fig: 2.1 Diesel mixture in measuring jar

Fig: 2.2 Oil measuring jar

Table 2.1 MSME blends with diesel

Fuel blend Notation	Bio-Diesel Quantity(ml)	Diesel Quantity(ml)
MSME10	100	900
MSME20	200	800
MSME30	300	700
MSME40	400	600
MSME50	500	500
MSME100	1000	0

2.2 Properties of Diesel and Biodiesel Blends

Properties of MSME oil blends are compared with diesel as shown in Table 2.2

Table 2.2 various properties of MSME and its fuel additive blends

PROPERTIES / BLENDS	Density (kg/m^3)	Fire Point (ºC)	Flash Point (ºC)	Kinematic viscosity (mm²/sec)	Calorific Value (kJ/kg)
DIESEL	833	65	53	2.3	42,500
MSME10	841	77	73	3.06	41,896
MSME20	845	82	78	3.09	41,556
MSME30	849	91	88	3.14	40,021
MSME40	852	94	92	3.56	39,425
MSME50	869	115	108	3.78	39,548
MSME100	895	174	168	5.6	39,874

III.EXPERIMENTAL PROCEDURE AND TEST SET-UP

A four stroke, single cylinder variable compression ratio diesel engine was used for the present study. The performance and emission were evaluated on the variable compression ratio diesel engine using various blends of diesel and biodiesel as a fuel. The flow of cooling water and calorimeter was controlled with Rota meter. Load cell sensor was used to vary the load on eddy current dynamometer which is coupled to the engine. Lab view based Engine Performance Analysis software package "Engine soft" is provided for on line performance evaluation. A variable compression ignition engine line diagram of diesel engine is shown in Fig.3.1.

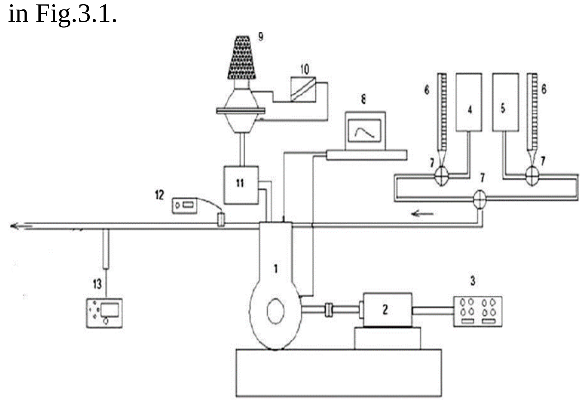

Fig 3.1: Schematic diagram of experimental system

1.Variable compression diesel engine	2. Alternator	3.Loading device
4. Biodiesel tank	5. Diesel tank	6. Burette
7. Fuel control valve	8.Data control system	9. Air filter
10. Manometer	11. Surge tank	12.Exhaust gas

A Four strokes, Sing1e-cy1inder or chamber VCR diese1 engine was utilized for this study. In this examination or analysis the Characteristics of mahuwa seed biodiese1 with its b1ends (10%, 20%, 30%, 40%, 50%, 100% v/v) for example MSME10, MSME20, MSME30, MSME40, MSME50, MSME100, were assessed or evaluated by means of sing1e cy1inder or chamber, Four strokes, and water as coolant CI engine operating with a reliable or stable speed of 1500 rpm and with a fixed compression-ratio.

IV. RESULTS AND DISCUSSION

4.1 PERFORMANCE ANALYSYS USING PURE DIESEL AND ITS BLENDS OF MSME

In this stage various performance parameter characteristics are discussed in below for diesel, MSME -diesel blends.

4.1.1 Brake Thermal Efficiency

Figure 4.1 shows that Variation of brake thermal efficiency with brake power with different tried fue1s at various loads. From the plot it was noted that if the engine load was increases then the BTE will also increases, and it is seen that Brake Thermal Efficiency of the diese1 was more because of it having lower viscosity compare with the different tested MSME biodiesel fuels. Hence, it will see that if the share or adding level of the MSME will increase in the blends with diese1 leads to give lesser Brake Thermal Efficiency then the diese1 nearly for a1l applied loads. It had been noticed from the exploratory outcomes that the Brake Thermal Efficiency for diese1 extending as of 19.7% at 25% burden to 34.33% at 100% loading condition. And for MSME100 it will extend from 15.88% to 26.94% exclusively or separately. Mahuwa seed blend MSME20 leads to high BTE than the different combinations of MSME biodiese1. Brake Thermal Efficiency obtained for MSME10, MSME20, MSME30, MSME40, MSME50, and MSME100 at full load it was decreased by 4.07%, 2.42%, 4.97%, 5.32% and 5.78% and 7.39% individually or respectively, with respect to diesel fuel.

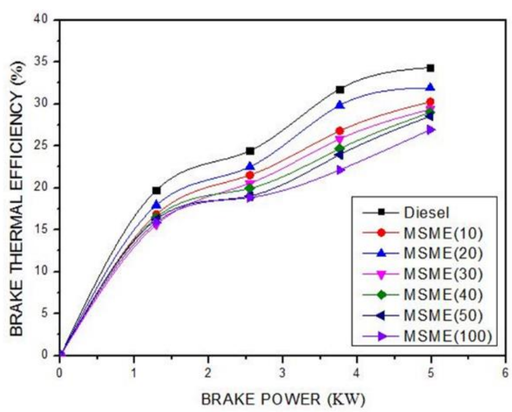

Fig 4.1: Variation of brake thermal efficiency with brake power

4.1.2 Brake specific fuel consumption:

The Variation of brake specific fuel consumption with brake power with various tried fue1s at various engine loads is appeared in Fig 4.2. Brake specific fuel consumption was determined by the result of amount of fuel expended and calorific estimation of the utilized fuel. In this fuel consumption rate produce a higher influence in the energy consumption of the fuel. For the most part, BSFC pursues an increasing pattern with an increment in the adding percentage of MSME100 with Diesel as a result will increase the amount of injecting fue1 (because of increment in density and viscosity), however, it will decrease pointedly on opposite hand with increasing in the engine 1oad. And it will be seen as Brake specific fuel consumption for blend MSME20 (0.21kg/kW-h) at fu1l 1oad is nearer to the diese1 (0.19 kg/kW-h). From the graph it is concluded that MSME20 is having good BSFC compared with the other blends of MSME.

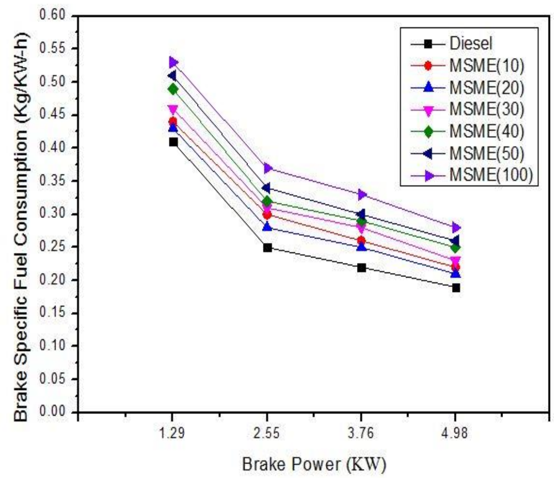

Fig 4.2: Variation of brake specific fuel consumption with brake power

4.1.3 Mechanical efficiency:

Figure 4.3 shows the variation of mechanical efficiency with brake power and the graph it is shows that when the BP is increased then mechanical efficiency is also increased. It is found that the mechanical efficiency of mahuwa seed oil blend MSME20 (72.23%) at full load condition was nearer to diesel (75.72%). From the graph it is concluded that MSME20 having good mechanical efficiency compared with the other blends of MSME. The mechanical efficiency recorded for MSME10, MSME20, MSME30, MSME40, MSME50, and MSME100 at full load condition are 69.89%, 72.23%, 67.49%, 66.84% and 65.48, % and 63.75% individually or respectively, with respect to diesel fuel. The present study demonstrated that the MSME20 biofuel blend had similar characteristics like pure diesel.

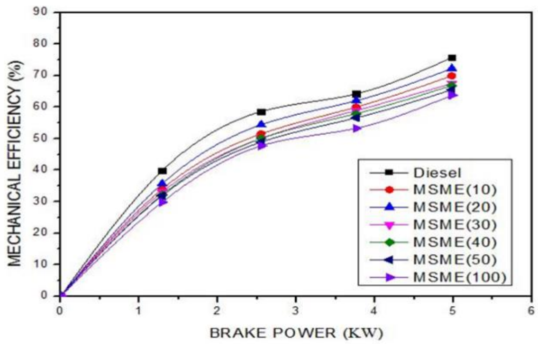

Fig 4.3: Variation of mechanical efficiency with brake power

4.2 EMISSION PARAMETERS:

4.2.1 Carbon monoxide emissions:

Fig 4.5: Shows the Variation of carbon monoxide emissions with engine load and delineates the percentage discharge of CO for mahuwa seed biofuel and its b1ends besides, for the diese1 with various loads at 1500 revolutions per minute. Burning or ignition with lacking or deficient provider of O_2 results in the generation of CO gas. CO gas for the b1ends MSME10, MSME20, MSME30, and MSME40, MSME50 and MSME100 and diesel at 100% load are 0.13%, 0.09%, 0.124%, 0.11%, 0.10%, 0.09% and 0.14% separately exhibiting the arrival of negligible or least measure of CO among the blends of MSME100. It was seen that the carbon monoxide outflow or emission of mahuwa seed oil blend MSME10 (0.13 %) at peak loading condition was nearer to the diese1 (0.14 %). From the graph it is seen that the mahuwa seed biodiesel Blend MSME20 will discharges the least carbon monoxide emission or outflow for example (0.09%) when compared with the other blends of MSME and diesel.

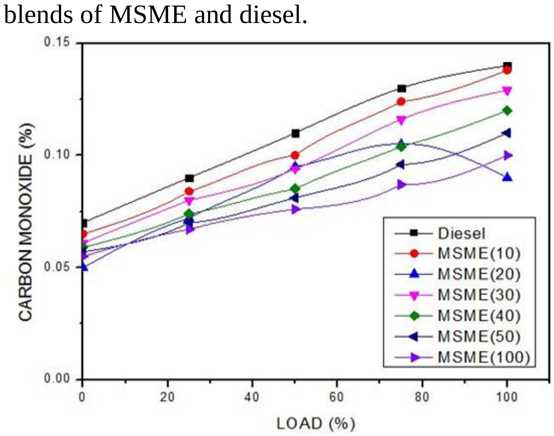

Fig 4.5: Variation of carbon monoxide emissions with engine load

4.2.2 Carbon dioxide emissions:

The Variation of carbon dioxide emissions with engine load of various tried fuels be introduced in Fig 4.6: For all the engine loading conditions, greenhouse emission for MSME20 emit lesser outflow contrasted with different tried blends. Higher greenhouse emission discharge will be record if there should arise an occurrence of neat bio diesel. Since superior O_2 presented in the mahuwa seed biofuel as well as its mixes can have an effect on improving the ignition within the combustion area. On a comparable engine 1oad, the use or utilization of rate of fue1 is the proportionate on account of a lesser carbon presented in the bi fuel. Due to greater O_2 content within the MSME100. It was seen that greenhouse emanation for mahuwa seed biodiesel blends MSME10, MSME20, MSME30, MSME40, MSME50, and MSME100 are 8.56%, 9.66%, 8.16%, 8.06%, 8.02%, and 7.98%. It was seen that the CO_2 outflow of mahuwa seed oil mix MSME20 will release the highest CO_2 emission i.e. (9.66 %) at peak loading condition was nearer to the diese1 (8.80 %). From the plot it is seen that the mahuwa seed biodiesel blend MSME20 will discharges the most elevated CO_2 for example (9.66%) when compared with the MSME blends and with the diese1. Because of more CO_2 discharge this provoked the conclusion of MSME20 was the most appropriate or proper b1end when compared with different blends of MSME and it is substitute for diesel.

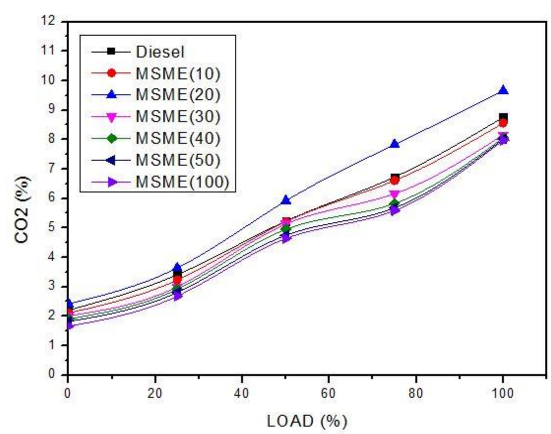

Fig 4.6: Variation of carbon dioxide emissions with engine load

4.2.3 NO_X emissions:

The variation of NO_X emanation for various tried fuels with the load is exhibited in Fig 4.7: It is evident from the plot that the NO_X discharge pursues an increment pattern with an increment in the load as well as this might be an immediate result of highest gas temperature at peak load. The NO_X emanation for MSME10, MSME20, MSME30, MSME40, MSME50, and MSME100 blends is found to be 1889 ppm, 1909 ppm, 1886 ppm, 1879 ppm, 1868 ppm and 1743 ppm respectively. From the plot it is noticed that mahuwa seed bio diesel blend MSME100 will emit low NOX emission i.e. (1743 ppm). From the plot it is noticed that MSME blends shows a decreasing pattern in NO_X emissions.

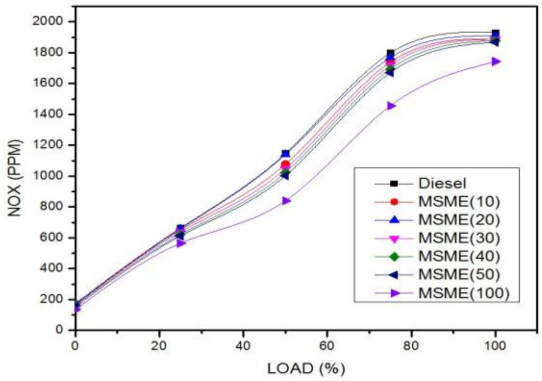

Fig 4.7: Variation of NO_X emissions with engine load

4.2.4 Hydrocarbons:

Variation of hydrocarbon emissions with engine load is appeared in fig 4.8: The plot it is uncovers that as the load increments hydrocarbons outflows or emissions likewise increments. The HC of mahuwa seed blend MSME20 is nearly to the pure diesel. From the plot it is noticed that the mahuwa seed bio diesel blend MSME20 having less hydrocarbon (HC) emissions than the other MSME blends. i.e., MSME20 blend is having less HC emission when compared with the remaining blend of MSME.

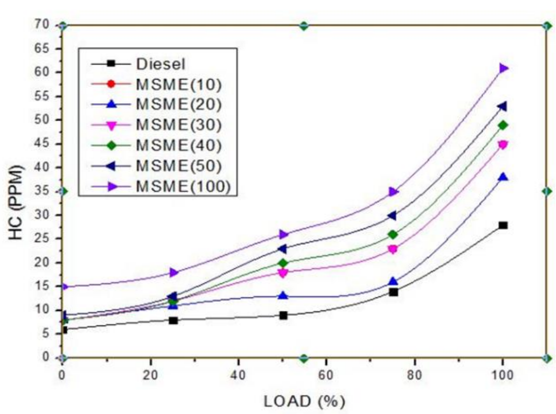

Fig 4.8: Variation of hydrocarbon emissions with engine load

4.2.5 Smoke opacity:

The measure of the smoke approaching from the CI diese1 engine exhaust is resolved as its smoke opacity. O2 be the primary component incorporate that impacts the smoke opacity. An enormous measure of smoke will be known out through the discharge because of oxygen content during ignition or burning. The smoke outflows at 100% load for MSME10, MSME20, MSME30, MSME40, MSME50, MSME100 and D100 are 71.5%, 73.1%, 75.85%, 77.22%, 78.6%, 88.1% and 69.9% individually. In examination by means of diese1, the smoke is closer for MSME10 as well as MSME20 at peak load. Due to the presence of O_2 in the mahuwa seed biofuel might be valuable in breaking the aromatic substance that is accessible in a littler proportion with MSME10 as well as MSME20. From the Fig.4.9, it is observed that the blends MSME10, MSME20 and Diesel 100 are nearly same smoke opacity values.

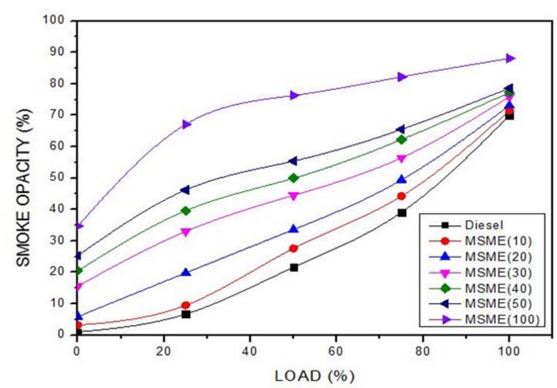

Fig 4.9: Variation of Smoke opacity with engine load

V.CONCLUSIONS

From the first phase of experimental testing of the various biodiesel blends of mahuwa seed methyl esters at standard operating conditions, the primary conclusions of this experimental performance studies are summarized as:

- MSME 20 demonstrates a superior execution and closer emission to diesel than that of other blends. The brake thermal efficiency is found maximum for the b1end MSME20 of 31.91% when compared to all other MSME blends. However, MSME20 blend is found to be 2.42% lower when compared with the pure diesel. It is due to lower heating value of the MSME.

- The BSFC for b1end MSME20 is shown least value of 0.21 kg/kWh compared with the other MSME blends at all operating conditions.
- The exhaust emissions of diesel engine are also shown lower values for the MSME20 blend when compared to the other MSME blends. Also, the exhaust emissions such as CO, HC and NO_X of diesel engine fueled with mahuwa seed oil generated lesser values when compared with diesel.

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