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# Effective Utilization of Plastic Oil on Petrol Engines a Comprehensive Scrutiny

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**Abstract**

Demolition of waste plastic targeting land and water has become thus crucial from the resource utilization purpose of reading. The strength gift within the waste plastic taken out suggests that of a chemical reaction referred to as chemical action transmutation; through this try one will realize a far better thanks to substituting the plastic oil effectively and with efficiency, to run the SI engines. the most objective behind this comprehensive review is to summarize all the experimentation carried over on plastic oil alongside additives to this point in terms of performance, combustion, emissions, etc. chemical action transmutation instant a renewable account waste plastic authorities, because the divergence among world waste plastic fabrication and waste plastic utilization, direct grow, work plastic oil in hydrocarbon engines moderately successively utterly. Silica, Alumina, ZSM-5, and kaolin were passed down as reactants. Through that, we will receive eightieth plastic oil. Finally, it's finished that plastic oil in one in all the appropriate different fuels for the graceful running of hydrocarbon engines while not abundant modification within the existing style.

**Keywords;** waste plastic, SI engine, additives, emissions, reactants.

## I. INTRODUCTION

### 1. Details about WPO:

A well-known fact about PO is the synthetic formation, nature, as well as volume of the PO formed by pyrolysis procedure calculated with the help of certain circumstances related to plastic oil feedstock, a stimulant employed, and returns temperature (Brebu et al. 2004). Among consideration to the feedstock, polystyrene transports the longest oil harvest among different plastic feedstock's through the pyrolysis process (Wu et al. 2014). PP, PET, and PVC accord an intermediate oil turnout moment HDPE furthermore LDPE transport the minimum coat yield (Siddiqui et al. 2009). Plastics are known as non- ecological polymers principally accommodate carbon, hydrogen, and also more lean ingredients. Bestow to a countrywide review organized in India during the period 2000 almost six thousand tons of waste plastic feedstock misuse were set up every workday and alone sixty percentage of it was converted. However, the thermal deterioration of plastics has a large scale deficiency such as much immense commodity territory and requires a large temperature. The straightforward catalytic crashing pick up recycled extensively because of few gains, predominantly in terms of the ability, performance, practice of the activator, and the dwelling hour. Furthermore, straightforward association beside plastic wastes will form stimulant disband promptly compensation to the removal of carbonaceous elements as well as the injured event of supplementary ingredient and contamination such as chlorine, sulfur, also nitrogen involving divisions that may be available in the plastic wastes. Nonetheless, the explicit stimulant damage of plastic feedstock's experienced many imperfections that



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have blocked its profitable accomplishment. The early uncover is troublesome to grab back the catalyst after the process, which hike the functioning worth. Waste plastic is the manufacturing rate is 5.6 million metric tons annually, whereas municipal solid waste plastic secured the third position. The annual growth of municipal solid waste plastic is about 8% to 12% from recent surveys it is forecasted that it'll move from 9 % to 13% by the end of 2025. Up-to-date from the land base solely 9% of the waste plastic is utilized by the usage methods. For the past ten years, across the world 225 million metrics of plastic wastes were obtainable. The outcome of various surveys suggested that 50% the plastic waste is obtainable interior and ocean. An outsized portion of municipal solid wastes is originated from plastic materials used for packaging purpose. E-waste contributes 21% with synthetic resin terephthalate, high-density synthetic resin, and low-density synthetic resin; plastic is prime sources of plastic waste. When put next with all alternative plastic sources cinnamons shown the most effective conversion rate, plastic, PET, and PVC moderate conversion rate, HDPE, LDPE is stood at rock bottom. When put next with all alternative plastic sources cinnamons shown the most effective conversion rate, plastic, PET, and PVC moderate conversion rate, HDPE, LDPE is stood at rock bottom. REY water softener is that the best agents for the shift with superior analysis measure (RON) of 67 yet as a petroleum fuel output of 48%wt yuletides, seventieth come back of gas and liquid proportions.

Table 1 Summary about Pyrolysis Ratnakiran. D et al. (2017)

| Types of Pyrolysis | Sable Dwelling Period (sec) | Melting standard ($^0$K/s) | Molecule Magnitude (Millimeters) | Abs. Temp (K) | By- Products | | |
|---|---|---|---|---|---|---|---|
| | | | | | Oil | Char | Vapor |
| Moderate | 450-550 | 0.1-1 | 5-50 | 550-950 | 30 | 35 | 35 |
| Rapid | 0.5 - 10 | 10-200 | <1 | 850-1250 | 50 | 20 | 30 |
| Spark | < 0.5 | >1000 | <0.2 | 1050-1300 | 75 | 12 | 13 |

Table 2 Plastic oil properties derived from various plastic sources (D. Damodharan, et.al 2019)

| Source | Catalyst | $R_t$ | $\rho$ | $\upsilon$ | CV | FP | FIP | CP | PP |
|---|---|---|---|---|---|---|---|---|---|
| MWP | Silica | 350/400 | 830 | 2.64 | 44200 | 40 | 44 | . | . |
| HDPE | Acid deal with Kaolin | 450 | 790 | 2.1 | 40170 | -2 | 5 | 12 | < - 7 |
| Waste Polyethylene | Sodium Aluminums | 400 | 788 | 2.34 | 45468 | < 100 | . | . | -45 |
| | Kaolin | 500 | 777 | 2.27 | 47095 | < -12 | < -12 | < -45 | . |



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$R_{t:}$ Reaction temperature ($^0$C) $\rho$ : Density (kg/m$^3$) $\rho$ : Density (kg/m$^3$) FP: Flash Point ($^0$C) , $\upsilon$ : Kinematic viscosity m /sec (m /sec) CV: Calorific Value (KJ /Kg) FIP: Fire Point ($^0$C)

Table No 3 Summary on PO Blends

| Author | Main Fuel | Blend | Additives | Blend's Composition (Based on Volume Fraction ) |
|---|---|---|---|---|
| Ahmet Necati Ozsezen 2015 | Gasoline | Ethanol | Methanol | 95% PF+ 5%M<br>90% PF+ 10% M<br>90% PF+ 5%E<br>90% PF+ 10%E |
| Vijaya.K Kareddula et al. 2016 | Gasoline | DPPO | | 90% PF+ 10%DPPO<br>80% PF+ 20%DPPO<br>70% PF+ 30%DPPO<br>60% PF+ 40%DPPO<br>50% PF+ 50%DPPO |
| Vijaya.K Kareddula et al. 2017 | Gasoline | PPO | Ethanol | 85% PF+15% PPO<br>80% PF +15% PPO+ 5%E |
| Vijaya.K Kareddula et al. 2017 | Gasoline | PPO, DPPO | | 90%PF+10%PPO<br>90%PF+10%DPPO |
| Vijaya.K Kareddula et al. 2018 | Gasoline | PPO | Ethanol | 90%PF+10%10PPO<br>85%PF+10% PPO+5%E |
| Vijaya.K Kareddula et al. 2018 | Gasoline | PPO | Ethanol, Methanol | 65%PF+25%PPO+5% E<br>65%PF+25%PPO+5% M<br>75% pf+25%PPO |
| Kareddula Vijaya Kumar et al. 2019 | Gasoline | PPO | Methanol | 90%PF+ 10PP0<br>80%PF+20% PPO,<br>85%PF+10%PPO+5%M<br>75%PF+20%PPO+5%M |

## 2. Significant risks of plastic waste

Accumulation of plastic waste with the ocean, the system was disturbed plenty and it's created a disturbance to the aquatic system. Selling of waste plastic on earth goes to make an associate adverse result on the organic phenomenon and groundwater



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pollution. The concentration of plastic waste already disturbed the families of plant and Pico planktons that are major sources for the marine organic phenomenon system.

Combustion of plastic waste on outdoor and earth's surface manufacturing dangerous gassy like dioxins, furans, and mercury. In tiny proportions, grain size plastic materials are already entrapped into the material body. A number of the plastics are created with the assistance of harmful reactants so they all direct confusion with the body and harm the cells. All told most, the foremost toxicant components all told plastics are PVC, vinyl benzene, polymer, and polycarbonate which can have an effect on the system.

The WPO whatever accessed through the conversion approach possesses a few deficiencies like large viscosity, small dryness sticking side effect along with carbon debris impose a nay shock on the engine conduct, radiations gritty. Thus, ahead practicing plastic oil as supplement fuels the viscosities should be as low as possible. Specific delightful practice to control the viscosity sprays production to be followed.

## 3. Plastic oil and its management

The conversion method is the simplest route for the assembly of waste plastic oil from all types of waste plastic feedstock. Transmutation is a method that doesn't need element for the combustion process additional over the combustion is done at giant heat conditions within the range of 4000C to 4500 C. Transmutation method the utmost conversion rate is 79% without the usage of any chemical agents. To enhance the formation of plastic oil from the waste plastic feedstock. Thermo deterioration, silicon dioxide ($SiO_2$), aluminum oxide ($Al_2O_3$), silicon dioxide aluminum oxide, Zeolites, the fluid stimulant was advised. The influencing factors for changing any waste plastic into helpful plastic oil are the character of plastic, components concerned, volume, concentration, condition, agent applied throughout the transformation method, and heating temperature.

Table No 4 Summary on PPO Properties

| Property | Ahmet Necati Ozsezen 2015 | Vijaya.K Kareddula et al. 2016 | Vijaya.K Kareddula et al. 2017 | Vijaya.K Kareddula et al. 2017 | Vijaya.K Kareddula et al. 2018 | Vijaya.K Kareddula et al. 2018 | Vijaya.K Kareddula et al. 2019 |
|---|---|---|---|---|---|---|---|
| Density (kg /$m^3$) | 750.8(PF)<br>809.9(E)<br>796.0(M)<br>752.8 (E5)<br>755.4(E10)<br>751.9(M5)<br>754.1(M10) | 720(PF)<br>820(PPO)<br>780(DPPO) | 740.82(PF)<br>830(PPO) | 740.82(PF)<br>830(PPO)<br>795(DPPO) | 740.82(PF)<br>830(PPO) | 741(PF)<br>830(PPO)<br>789(25PPO)<br>779(25PPO5E)<br>778(25PPO5M) | 740.82 (PF)<br>830(PPO) |
| KV ($m^2$ /sec @ 40°C) | 4.94× e-7(PF)<br>1.221×e-6(E)<br>5.96×e-7(M)<br>4.94×e-7 (E5)<br>5.72×e-7(E10)<br>5.29×e-7(M5)<br>5.45×e-(M10) | 0.5×e-6(PF)<br>2.52× e-6(PPO)<br>0.7×e-6(DPPO) | 5×e-7(PF)<br>2.54×e-6(PPO) | 0.5×e-6(PF)<br>2.64×e-6(PPO)<br>7.8×e-7(DPPO) | 5×e-7(PF)<br>2.54×e-6 (PPO) | 0.5×e-6(PF)<br>2.54×e-6(PPO)<br>1×e-625(PPO)<br>1.037×e-6(25PPO5E)<br>1.007×e-6(25PPO5M) | 5×e-7(PF)<br>2.54×e-6(PPO) |
| H.V (kJ /kg) | 42600(PF)<br>26700(E)<br>19850(M)<br>41799(E5)<br>40969(E10)<br>41462(M5)<br>40268(M10) | 43953(PF)<br>42808(PPO)<br>46817(DPPO) | 43449.7(PF)<br>42807.5(PPO) | 43440(PF)<br>42800(PPO)<br>44410(DPPO) | 43449.7(PF)<br>42807.5(PPO) | 43400(PF)<br>42800(PPO)<br>42900(25PPO)<br>36500(25PPO5E)<br>36900(25PPO5M) | 43449.7(PF)<br>42807.5(PPO) |



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**4. Survey on PPO and DPPO**

The revision envelops the investigations of varied researchers' works within the fields of combustion, emission and performance characteristics of the hydrocarbon engines surpass plastic oil swimmingly and with success. Most of the researchers thought of pure plastic oil as an instantaneous fuel, generally, researchers have chosen in distilled kind, and few of them during a combined kind with fuel and ethanol on a set volume basis. Only a few of them thought of distilled plastic oil-immersed with fuel and ethanol on a set volume basis.

Kareddula.Vijayakumar et al. (2016) thought of waste plastic oil that was ready by the transformation method, with a combustion chamber temperature of 450°C to 550°C, distillation temperature of 900C to 1600C. Commixture of gasoline was through with distilled plastic oil starting from 10% to 50% on a volume basis. The oil mixture is preserved for 15 days under careful examination, the overall efficiency raised in terms of brake thermal potency, CO, and NOX, equally decrease in brake specific consumption, UHC proportion.

The on tops of results are derived from a 4stroke water-cooled single-cylinder gasoline engine. Density as well as heating amounts of the synthesized natural plastic oil and refined plastic oil increments with increments in the plastic fraction, as they are solid than base gasohol and also have greater heating content.

CO discharges rose lightly with raise in the amounts of the pure plastic oil as well as refined plastic oil combinations, because of the un-successful ignition of fuel neither because of incompetent oxygen or conflagration dampening. NOx ejections likewise change along with air fuel ratio.

It can be noticed that to an inline temperature of the engine cylinder being adjacent or down the H2O2 disruption temperature, where reformers discharged from accelerated H2O2 disruption motive HC particles to disruption to form CO. Reduced temperatures usually cause bigger radiations of uncharged HCs and CO; nonetheless in that matter, there are positive temperature territories where HC radiations upturn while CO downturn.

Meanwhile, the temperatures are near or below 1000 K; limited decay of HCs towards CO no more execution thereby provoking greater ejections of HCs and diminished ejections of CO. This might be because of in-line cylinder temperatures being closer in other words down the $H_2O_2$ disruption temperature, where reformers discharged in distinction to accelerated $H_2O_2$ disruption motive HC particles to disruption to model CO.

**5. Survey on PPO and DPPO along with alcoholic blends**

Kareddula.Vijayakumar et al. (2017) at first thought of combos of pure plastic oil with 85% of gasoline later they considered a mix of 80% pure petrol with 5% yuletide fermentation alcohol on a volume basis. In-terms of brake specific consumption, CO, and Roman deity emissions the simplest combination is 15%PPO +85% Petrol+ 5% yuletide fermentation alcohol.

The on top of results are derived against a Maruti 800 engine (3 cylinder 4S SI engine with a running speed of 1500 revolutions per minute with variable masses. engine dimensions: bore equals to 68.5 millimeters and stroke equals to 72 mm compression quantitative relation is eight.7:1 for cc of 796).Kareddula.Vijayakumar et al. (2017) experimented on the proportion of pure plastic oil and distilled plastic oil with gasoline fuel.

They thought of the mix of 10% PPO+ 90% PF. The opposite combos are 10% DPO+90% PF. In-terms of emissions the simplest combination could be a combination of distilled plastic oil with pure gasoline fuel. The on top of results are derived against a Maruti 800 engine (3 cylinder 4s SI engine



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with a running speed of 1500 revolutions per minute and with variable masses. engine dimensions: bore equals to 68.5 millimeters and stroke equals to 72 mm compression quantitative relation is eight.7:1 for cc of 796.

The designated logic can endure due to better heating content of DPPO fuel and this enhanced calorific amount endorses the flame propagation set side by side to PPO fuel activity. BSFC reduced for 10DPPO heightened than PF because of the heating amount of DPPO fuel higher correlated to PPO fuel. The CO ejections of 10PPO along with 10DPPO fuel exercise declined related to PF.Kareddula.Vijayakumar et al. (2018) experimented on a proportion of 10%PPO+95% PF with an addition of 5% of fermentation alcohol on a volume basis.

Upon completion of their work, they expressed that the addition of a 5% fermentation alcohol additive has shown a major approach in terms of the BTE potency and CO emission is down when correlated beside neat gasohol. The on top of results are derived against a Maruti 800 engine (3 cylinder 4s SI engine with a running speed of 1500 revolutions per minute and with variable masses. engine dimensions: bore equals to 68.5 millimeters and stroke equals to 72 mm compression quantitative relation is eight.7:1 for cc of 796. The inclusion of ethanol authorized to diminish the calorific amount and reciprocal burning temperature that therefore lowers the ejections of nitrogen oxides Gireeshan et al. (2015).. Because of freezing enforcement and growing dampen amounts of ethanol in the ignition cubicle, the HC radiations continuously upgraded. Kareddula.Vijayakumar et al. (2018) experimental work continuing on plastic oil with a proportion of 25% pliable transformation oil + with and while not alcohol additives each alcohol and ethanol at 5% the quantity basis. In-terms of performance addition of alcohol to the twenty-fifth of plastic oil have shown improvement. In-terms of HC emissions while not the addition of alcoholic blends shown higher results. The on top of results are derived against a Maruti 800 engine (3 cylinder 4s SI engine with a running speed of 1500 revolutions per minute and with variable masses. engine dimensions: bore equals to 68.5 millimeters and stroke equals to 720 mm Compression quantitative relation is eight.7:1 for cc of 796. By adding the PPO to PF at 25 %, entire payload circumstances, the engine will absorb higher combustible 25PPO combination than petrol, to deliver equivalent energy gain, because of the lesser octane total of PPO. Thus, consistently to inflect the BSEC, alcohol supplements are complemented at 5 % by amount. Since the extension of preservatives develops the oxygen content in the combine, the ignition nature is revised as well as lowers the BSEC. Finally, it is recorded a well-known fact the energy utilization percentage is cut down among methanol together with ethanol supplements. Kareddula.Vijayakumar et al. (2019) experimental work continuing on 10% and 20% plastic transformation mixed with pure gasoline oil with and while not 5% alcohol additive at a volume basis. On completion of their work finally, they all over that in each the cases once ten% and 2 hundredth plastic oil mixtures mixed with ninety and try and 2 hundredths gasoline has shown a rise in BTE capability and cut down in CO, HC ejections. An enormous number of a researcher, (Bayindir, Yucesu, and Aydin 2010 tested the reply of liquid alcohols, gasohol combinations on the supervised disable ejaculations in case of a spark-ignition engine. Many analysts proved such a way that alcohol gasoline combinations ensure devaluation in CO, un-buried HC ejections. Nonetheless, the response to NOx never showed a fair tendency Gireeshan et al. (2019). On the condition of employing alcohol gasoline combinations utilized larger amounts of fuel is consumed to achieve equal or higher engine energy output. These results caused the higher BMEP and higher wheel power output with the use of alcohol gasoline blends in proportion to pure gasoline. It was seen that the IMEP of alcohol gasoline pair is larger than that of pure gasoline blends. The mass burn ratio of alcohol



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gasoline combinations is larger than that of petrol fuel.

Table No 5 Summary on Research set up

| Author | Engine type | Cy.V ( $cm^3$) | CR | D & L (mm) | CH | Speed | Maximum Torque Nm | Maximum power kW |
|---|---|---|---|---|---|---|---|---|
| Ahmet Necati Ozsezen 2015 | Water Cooled 4S - MPI | 1398 | 10.4 | 75 × 79 | 16 Valves | 7600 rpm | 130 at 4300 rpm | 66 at 5600 rpm |
| Vijaya.K Kareddula et al. 2016 | One Cylinder, 4S Air-Cooled | - | - | - | - | - | - | - |
| Vijaya.K Kareddula et al. 2017 | 3 Cylinder Maruti 800 Water Cooled | 796 | 8.7:1 | 68.55 ×72 | 3 Valves | 1500 | - | - |
| Vijaya.K Kareddula et al. 2017 | 3 Cylinder Maruti 800 Water Cooled | 796 | 8.7:1 | 68.55 ×72 | 3 Valves | 1500 | - | - |
| Vijaya.K Kareddula et al. 2018 | 3 Cylinder Maruti 800 Water Cooled | 796 | 8.7:1 | 68.55 ×72 | 3 Valves | 1500 | - | - |
| Vijaya.K Kareddula et al. 2018 | 3 Cylinder Maruti 800 Water Cooled | 796 | 8.7:1 | 68.55 ×72 | 3 Valves | 1500 | - | - |
| KareddulaVijayaKumar et al. 2019 | 3 Cylinder Maruti 800 Water Cooled | 796 | 8.7:1 | 68.55 ×72 | 3 Valves | 1500 | - | - |

Table No 6 Summary on PO Performance and Emissions

| Author | Blends | $CO_2$ | CO | $NO_x$ | UHC | BSFC | BTE | FC |
|---|---|---|---|---|---|---|---|---|
| Ahmet .NecatiOzsezen (2015) | 95% PF+ 5%M | ↓ | ↓ | ↑ | ↓ | - | - | - |
| | 95% PF+ 5%E | ↓ | ↓ | ↓ | ↓ | - | - | - |
| | 90% PF+ 10 %M | ↓ | ↓ | ↑ | ↓ | - | - | - |
| | 90% PF+ 10 %E | ↓ | ↓ | ↓ | ↓ | - | - | - |
| | 50% PF+ 50%DPPO | - | ↑ | ↑ | ↓ | ↓ | ↑ | - |
| VijayKumarKareddula | 85% PF+15% PPO | - | ↓ | ↓ | ↑ | ↓ | ↑ | ↓ |



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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| et al. 2017 | 80% PF +15% PPO+ 5% E | - | ↓ | ↓ | ↑ | ↑ | ↓ | ↓ |
| VijayKumarKareddula et al. 2017 | 90%PF+10%PPO | - | ↓ | ↑ | - | ↓ | ↓ | - |
| | 90%PF+10%DPPO | - | ↓ | ↓ | - | ↓ | ↑ | - |
| VijayaKumarKareddula et al. 2018 | 90%PF+10%10PPO | - | ↑ | ↑ | ↑ | ↑ | ↑ | - |
| | 85%PF+10% PPO+5%E | - | ↑ | ↑ | ↑ | - | ↓ | ↓ |
| VijayaKumarKareddula et al. 2018 | 65%PF+25%PPO+5% E | - | ↓ | ↓ | - | ↑ | ↑ | - |
| | 65%PF+25%PPO+5% M | - | ↓ | ↓ | - | ↑ | ↑ | - |
| | 75% PF+25%PPO | - | ↓ | ↑ | - | ↑ | ↓ | - |
| KareddulaVijayaKumar et al. 2019 | 90%PF+ 10PPO | - | ↓ | ↑ | ↓ | ↓ | - | - |
| | 80%PF+20% PPO | - | ↓ | ↑ | ↓ | ↓ | - | - |
| | 85%PF+10%PPO+5%M | - | ↓ | ↑ | ↓ | ↓ | - | - |
| | 75%PF+20%PPO+5%M | - | ↓ | ↑ | ↓ | ↓ | - | - |

**Conclusion**

The comprehensive paper in the main stressed the in-depth experimental investigations of varied researchers within the case of waste plastic oil utilized in single yet as multi-cylinder SI engines. The efforts unbroken by all the researchers have explained a number of the key problems regarding the plastic utilization method, and their effective utilization through the shift method.

When put next with all alternative plastic sources cinnamon shown the most effective conversion rate, plastic, PET, and PVC moderate conversion rate, HDPE, LDPE is stood at rock bottom. The comprehensive paper in the main stressed the in-depth experimental investigations of varied researchers within the case of waste plastic oil utilized in single yet as multi-cylinder SI engines.
The efforts unbroken by all the researchers have explained a number of the key problems regarding the plastic utilization method, and their effective utilization through the shift methods are coming back within the temperature zone of 3500 C and therefore the molten material is ascertained with higher paraffin's, lower aromatics, olefins, and gas. The most edges offered by chemical change shift over alternative routes are smart contraction time, the oil transformation takes place comparatively at an occasional temperature, and this method conjointly eliminates the event of unwanted by-products. From the investigation purpose of reading, the properties of plastic oil are nearly a dead ringer for hydrocarbon fuel.

All SI engines will be replaced with plastic oil with no modifications. However, within the future, there's a requirement and scope to analyze to beat the defects gift within the catalysts shift method particularly in terms of the political economy concerned in the choice of catalysts, and utilization problems with catalysts.

**Notations**



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| | | | |
|---|---|---|---|
| WPO | Waste Plastic oil | PO | Plastic Oil |
| HDPE | High Density Polyethylene | LDPE | Low Density Polyethylene |
| PP | Polypropylene | PET | Poly Ethylene Terephthalate |
| PVC | Polyvinylchloride | K | Kelvin |
| Abs. Temp | Absolute Temperature | PF | Petrol Fuel |
| M | Methanol | E | Ethanol |
| RON | Research Octane Number | PPO | Plastic Pyrolysis Oil |
| DPPO | Distilled Plastic Pyrolysis Oil | CO | Carbon monoxide |
| $NO_X$ | Nitrogen Oxides | UHC | Un-Burnt Hydro Carbons |
| BSFC | Brake Specific Fuel Consumption | BTE | Brake Thermal Efficiency |
| HC | Hydro Carbons | BSEC | Brake Specific Energy Consumption |
| BMEP | Brake Mean Effective Pressure | Cy.V | Cylinder Volume |
| CR | Compression Ratio | $CO_2$ | Carbon-di-Oxide |
| SI | Spark Ignition | $H_2O_2$ | Water Content |
| D | Diameter | L | Stroke |
| CH | Cylinder Head | IMEP | Indicated Mean Effective Pressure |

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