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Production of Gas Oil From Used Engine Oil

Abstract

Various types of Lubricating oils are used to meet different requirements. These oils can be classified as engine oils, gear oils, hydraulic oils, turbine oils, etc. Engine oils are used to reduce friction between moving surfaces of engine parts. The another functions of these oils are also to remove heat, remove wear debris, created by moving surfaces and debris created by combustion of fuels, and protect metal surfaces from corrosion. Lubricating oils are prepared by blending different base oils derived from suitable crude oil and then blending them with required proportion of additives.

Converting used lubricating oil to gas oil is an intelligent option for any country, more so for India, as it would conserve the natural resources as well as save the foreign exchange. The conversion of used oil to gas oil is useful due to economic, environmental, public health reasons.

In this work, an attempt has been made to study the possible process to convert used lubricating oil to gas oil which can be used as a fuel. Various facts about hazardous nature of used oils are also discussed in this paper.

Keywords : Used Engine Oil**,** Thermal Cracking**,** Combustion Products, Petrochemicals, ASTM, API, Environmental Pollution.

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Introduction

The current lube oil demand in India is more than 10 lakh tonnes per year. Out of this, almost 60% is consumed as engine oils and the remaining 40% is consumed as industrial lubricants. In India entire lube oil production is based upon imported lube bearing crude oils.

After a certain period of useful life, the lubricating oil loses its properties and cannot be used and needs to be replaced by fresh lubricant. Thus large volume of used engine oil is generated yearly which poses threat to the environment. But if handled and used properly, it can be regarded as an important source of energy and/or feedstock for petrochemicals.

Facts about Hazardous Nature of Used Oils

1. Used oils themselves are not toxic, but the contaminants such as additives, degradation products, etc. make them so hazardous.
2. They have high potential to cause damage to the environment by virtue of their persistent nature and potential to spread over large surface areas on land and water.
3. Films of oil prevent light and air from reaching to life forms of all types on land and water.
4. One liter of oil can render one million liters of fresh water unusable.

Contaminants of Engine Oil

1. Free and emulsified water.
2. Light hydrocarbons, i.e. gasoline and gas oil.
3. Dust, rust and soot.
4. Metals (iron, copper, zinc, lead, calcium, phosphorus, etc.) resulting from engine wear and corrosion.
5. Products of thermal degradation, i.e. carbon, unsaturated hydrocarbons, polymers and asphaltenes.
6. Complex compounds from gasoline/diesel and lube additives packages.

Reasons for Converting Waste Oil To Valuable Petroleum Products

1. When used oil is dumped, it is capable of seeping into ground and surface water.
2. Just one liter of used oil can render one million liters of water undrinkable.

3. It is also a serious threat to plant and animal life.
4. Marine species can be adversely affected by oil concentrations as low as one ppm.

Experimental Procedure

In this study, used engine oil from petrol engine is used as a sample. The used engine oil is filtered and then heated to 150°C for one hour to eliminate water. This filtered and dehydrated used engine oil (FDWO) is used as feed for experimental run. Basic tests of this sample are done, e.g. Redwood viscosity, pour point, viscosity index and CCR. The results of these tests are shown in Table-1.

Table-1: Properties of Filtered and Dehydrated Waste Engine Oil

S. N.	Property	Observations
1.	Redwood Viscosity	a) at 40°C--- 424 seconds. b) at 100°C---61 seconds.
2.	Specific Gravity at 29°C	0.8885
3.	API Gravity at 29°C	27.7589°API
4.	Pour Point	-24°C
5.	Flash Point By Clevland Open Cup Method	193°C
6.	Fire Point By Clevland Open Cup Method	252°C
7.	Conradson carbon Residue (wt%)	0.9088%

1200ml (1090.5gms) of feed is cracked in the batch reactor at 440°C temperatre. The reactor is made of cooker (volume:3litres) with required modifications.As the reaction reached to completion, vapours stopped coming out of the reactor, heating stopped and allowed the reactor to cool. 861.4 gms of distillate is collected and 125.0 of residue is collected from the reactor. Total material balance on reactor indicates that 104.10 of feed is gasified.

Table-2: Material Balance of An Experimental Run.

S.N.	Cracking Temp. °C→	440
1.	Liquid product obtained, (gms)	861.4
2.	% (wt) Liquid product obtained	79.00
3.	Residue formed, (gms)	125.0
4.	% (wt) Residue formed	11.45
5.	Feed gasified, (gms)	104.10
6.	% (wt) Amount of feed gasified	09.55
7.	Total Amt. of product formed, (liquid+gases) gms	965.50
8.	% (wt) Total conversion	88.54

Liquid products and residue formed in the experiments were measured for the material balance and the liquid products were subjected to various tests.

ASTM distillation characteristics of the product obtained from this experiment shows that around 11.5 %(vol) material falls in the naphtha range (<200°C), 73.5 %(vol) material falls in the gas oil range (200-390°C) and around 13.5% (vol) material boils in the range of 390°C-410°C. Details of the ASTM distillation characteristics of liquid products obtained are shown in Table-3.

Table-3: ASTM Distillation Characteristics of Distillate Obtained From Experiment

S. N.	Temp.°C	% Volume Distillate	Observations
1.	41	---	Heating Started
2.	81	---	I.B.P.
4.	186	10	Foaming Observed
6.	272	20	
8.	325	30	
10.	338	40	
12.	350	50	
14.	375	60	
16.	382	70	
18.	387	80	
20.	403	90	
22.	410	98.5	Final Boiling Point

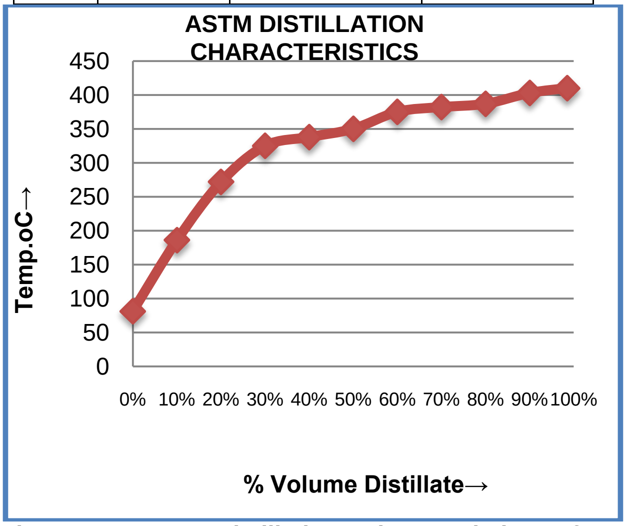

Figure-1: ASTM Distillation Characteristics of Distillate Obtained

Table-4: Properties of Cracked Liquid Product

S.N.	Cracking Temp.°C→ Properties↓	440
1.	Redwood viscosity, Seconds (at 40°C)	53.00
2.	Specific gravity, (at 29°C)	0.8519
3.	API Gravity, °API (at 29°C)	34.5993
4.	Aniline point, (°C)	87.0
5.	Flash point by Clevland open cup method, (°C)	76
6.	Fire point by Clevland open cup method, (°C)	88
7.	Conradson carbon residue, (wt%)	0.0250
8.	Pour point, (°C)	-05
9.	Bromine number	15.61
10.	Acid value, mg KOH/gm	0.7517

Conclusions

The thermal cracking of used engine oil at 440°C yields 9.55% (wt) hydrocarbon gases, 79.00% (wt) liquid products and 11.45% (wt) residue. All the contaminants accumulate in residue, the liquid and gaseous products obtained are free from all type of contaminants. So these products forms high value refinery streams which can be further processed with suitable refinery streams or can be used directly as a fuel. It should be noted that the problems related to used oil treatments by vacuum distillation, such as fouling of heating and distillation equipment can be avoided by thermal cracking of these oils.

This can be very good option to conserve the valuable oil and reducing the rate of depletion of crude oil. So used oil may again be source of fuels. Converting used engine oil to gas oil doesn't just slow the depletion of number one resource; but it also saves energy and reduces the pollutions of land, water and air.

Mismanagement of used lube oil is a serious environmental problem. Almost all types of waste oil have the potential to be recycled safely, saving a precious non-renewable source and at the same time minimizing environmental pollution. If used oil is properly processed, it can be a significant saving on fresh crude oil.

Disposal of used lubricating oil into the eco-system creates environmental hazards. Tough laws are being enacted throughout the world for the disposal of waste petroleum products and every genuine effort should be made for its re-use.

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