International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249 – 8958, Volume-5, Issue-4, April 2016

Waste Engine Oil Characterization and Atmospheric Distillation to Produce Gas Oil

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Abstract: ***Two type of used engine oil (A and B)has been characterized along with a fresh sample of each type and hence the properties changes and degradation was observed. The samples (A and B) subjected to a batch atmospheric distillation process. The distillation product analyzed and the results show that the product specifications are similar to the gas oil.***

Keywords: ***Used engine oil, characterization, atmospheric distillation, gas oil***

I. INTRODUCTION

The treatment of wastes has become one of the most important concerns of modern society to protect the environment[1]. Petroleum derived base oils currently account for about 97% of the total lubricant production ,the recycling of waste lubricant oils into chemical feedstock or fuel oil may be suitable option for protecting the environment from hazardous waste.[1] Used lubricant oils are by-products of oil use in vehicles and machinery ,they must be replaced on a regular basis in all operating equipment due to the contamination from dirt, water, salt, metals[2]

The worldwide demand for lubricant oils is about 40 million metric tons per annum. The waste generated oils represent more than 60% of used lubricant oils. Therefore, waste oils are one of the more abundant pollutant residues that are generated nowadays, reaching the value of 24 million metric tons per year [3] .Many studies have confirmed that used petroleum-based lubricants collected from oil-change are slow in degradation and highly toxic to human health, [4] It is considered a harmful waste because of their high content of pollutants (thermal degradation products from the base oil and additives and combustion products from the fuel and lubricant) , nevertheless, the used oil still contains a large proportion of valuable base oil that may be used to formulate new lubricants if undesirable pollutants are separated from the oil by an appropriate recycling procedure.[5] Thus, not only environmental but also economic reasons justify the waste oil regeneration process[5]. For all cases of direct contact between lubricants on one side and human beings and the nature on the other side the compatibility has to be checked.[6] The gaining necessity for environmental compatibility tests has to be understood by all those who are working in the fields of production, application, and disposal of lubricants[6] Used oil contains valuable resource of recoverable base oil [7]. The composition of waste oils changes with the use, Since some contaminants are present in the virgin oil but most of them are a consequence of the processes in which the oil is involved.

[8] All lubricants are characterized by some properties, [9] like viscosity index, cloud point, flash point, pour point, total base number (TBN), ash content, water content, corrosive properties, relative density, insoluble, total acid number (TAN) etc.[9]

During the time of oil inside the engine, the properties of the lubricating oil gets reduced due to the continuous addition of heat.[7] The additive gets degraded and goes into the oil in the form of sludge along with metal wear parts.[7] Water goes into the oil as a result of combustion and finally the oil becomes unfit for use in the automobile engines and needs replacement..[7] Used oil has been re-refined using many techniques such as chemical (acid/clay) treatment, physical treatment by distillation and thin film evaporation and solvent extraction [10].

II. MATERIALS AND METHODS

2.1 Sampling: 6 samples of two types of waste engine oils (of the same working conditions) were collected randomly plus one fresh sample of each type.
2.2 Pretreatment (water and sludge removal)
2.2.1 The used oil samples were kept for 24 hours to allow solids impurities to settle down by gravity and then were filtered.
2.2.2 The filtered samples in 2.1.1 heated up to 120 ˚C to boil off any emulsified water.
2.2Atmospheric distillation**:**
2.2.1 Test method: ASTM D86.
2.2.2 Materials: 100ml of used lubricant oil.
2.3.3 Apparatus: D86 – atmospheric distillation unit (batch unit) with thermometer (400 ˚C) and receiving flask.
2.4Viscosity at 40˚C and 100˚C:
2.4.1 Test method: ASTM D 445-06.
2.4.2 Equipment: K.V viscosity tester.
2.4Flash point:
2.4.1 Test method: ASTM D 93 – 02.
2.4.2 Equipment: Flash point tester.
2.6 Pour point:
2.6.1 Test Method: ASTM D97.
2.6.2 Equipment: pour point refrigerator.
2.7 Total base number:
2.7.1 Test method: ASTM D4739.
2.8 Density @15 ^{0}C:
2.8.1 Test method: ASTM D1298.

Revised Version Manuscript Received on March 07, 2016.
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III. RESULTS

Table (1): Atmospheric Distillation for Used Lubricant Oil, (Sample A)

Test	Result (°C)		
	A_1	A_2	A_3
IBP	190	190	191
5% Recovered	331	320	335
10 % Recovered	347	337	350
20 % Recovered	362	360	366
30% Recovered	369	365	372
40 % Recovered	377	371	380
50 % Recovered	379	378	384

Table (2): Atmospheric Distillation for Used Lubricant Oil, (Sample B)

Test	Result (°C)		
	B_1	B_2	B_3
IBP	201	199	201
5% Recovered	315	317	320
10 % Recovered	340	338	335
20 % Recovered	356	355	360
30% Recovered	362	362	372
40 % Recovered	373	374	380
50 % Recovered	380	380	384

Table (3): Properties of Used Lubricant Oil, Sample (A)

Test	Result			
	A_1	A_2	A_3	A_{Fresh}
Kinematic viscosity at 40 °C (Cst)	158	158	158	165
Kinematic viscosity at 100° C (Cst)	21.6	21.4	21.4	24
Viscosity index	100	100	100	110
Flash point (°C)	93	92	93	**150**
Pour Point (°C)	-10	-10	-10	-18
Total base number	11.5	11.8	11.0	18
Density @15 °C (Kg/m³)	900	910	900	700

Table (4): Properties of Used Lubricant Oil, Sample (B)

Test	Result			
	B_1	B_2	B_3	B_{Fresh}
Kinematic viscosity at 40 °C (Cst)	139.9	145.9	145.9	150
Kinematic viscosity at 100 °C (Cst)	14.12	16.75	16.75	18
Viscosity index	80	81	81	90
Flash point (°C)	101	100	102	**160**
Pour Point (°C)	-8	-8	-8	-16
Total base number	13.5	13.5	13.5	20
Density @15 °C (Kg/m³)	900	970	970	800

Table (5): Properties of the produced heavy gas oil (distillate)

Property	Result
Kinematic Viscosity at 40°C (Cst)	12.9
Kinematic Viscosity at100°C (Cst)	2.91
Flash Point (°C)	82
Pour Point (°C)	-7
Density	900

IV. DISCUSSION

The viscosity of used lubricant decreased and this is almost of the work or operational conditions which involves oxidation at high temperature and contamination with water, fuels and insoluble matters. The flash point of the used lubricants decreased and this is due to the cracking of the oil to small parts of light ends as a result of high temperature beside the formation of volatile impurities in the used lubricant. The pour point also affected by the contamination of the used lubricant, so it has been decreased clearly. The density of the used lubricant is found to be higher than the fresh lubricant and this mainly of the existence of the contaminants and the sludge in the used lubricant in addition to the direct effect of the heat of the combustion. The distillation main product can be used as gas oil depending on its properties while the bottom product can be again utilized as lubricant base oil.

V. CONCLUSION

It is well known that the lubricant (engine oil) loses its characteristics gradually depending on the work conditions and the initial properties of the oil itself that means its quality. From the characterization obtained results, it is clear

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that considerable changes happened regarding the lubricant properties and this is mainly due to the degradation of the additives in the lubricant engine oil. The treatment process by atmospheric distillation resulted in a product with specifications similar to the specifications of gas oil and it can be used as a heating fuel. Further treatment processes can be applied to the bottom product such as vacuum distillation to reuse it for production of lubricants again.

REFERENCES

1. Bhaskar, T., et al., Recycling of waste lubricant oil into chemical feedstock or fuel oil over supported iron oxide catalysts. Fuel, 2004. **83**(1): p. 9-15.
2. Hamad, A., E. Al-Zubaidy, and M.E. Fayed, Used lubricating oil recycling using hydrocarbon solvents. Journal of environmental management, 2005. **74**(2): p. 153-159.
3. Fuentes, M., et al., Pyrolysis and combustion of waste lubricant oil from diesel cars: decomposition and pollutants. Journal of Analytical and Applied Pyrolysis, 2007. **79**(1): p. 215-226.
4. Fan, W.T.-C., Regeneration of used petroleum-based lubricants and biolubricants by a novel green and sustainable technology. 2010: University of Southern California.
5. Rincon, J., P. Canizares, and M.T. Garcia, Regeneration of used lubricant oil by ethane extraction. The Journal of supercritical fluids, 2007. **39**(3): p. 315-322.
6. Bartz, W.J., Lubricants and the environment. Tribology international, 1998. **31**(1): p. 35-47.
7. Kannan, S., et al., Studies on Reuse of Re-Refined Used Automotive Lubricating Oil. Research Journal of Engineering Sciences ISSN. **2278**: p. 9472.
8. Nerın, C., et al., Behaviour of different industrial waste oils in a pyrolysis process: metals distribution and valuable products. Journal of Analytical and Applied Pyrolysis, 2000. **55**(2): p. 171-183.
9. Udonne, J., A comparative study of recycling of used lubrication oils using distillation, acid and activated charcoal with clay methods. Journal of Petroleum and Gas Engineering, 2011. **2**(2): p. 12-19.
10. Emam, E. and A. Shoaib, Re-Refining of Used Lube Oil, I-by Solvent Extraction and Vacuum Distillation Followed By Hydrotreating. Petroleum & Coal, 2013. **55**(3): p. 179-187.

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