International Journal of Scientific Engineering and Research (IJSER)
ISSN (Online): 2347-3878
Index Copernicus Value (2015): 62.86 | Impact Factor (2015): 3.791

Treatment and Recycling of Used Lubricating Oil

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Abstract: ***This research is about the recycling of used lubricating oil. Two different types of lubricating oil which were ACCEL ULTRA and MACH5 which were used as engine oil were covered by the study .Physical testing was conducted on the two samples before and after the treatment in order to compare the result of analysis. Two different kinds of solvents were used in the treatment of the used oil which started by filtering the oil then extracting the oil by solvent extraction technique at 70C°. Followed by distilling the oil at 140C° -170C° In order to separate the solvent from the oil so as to be used again. At this stage the oil was ready for testing. The tests included: kinematics viscosity at 40C ° and 100C°, viscosity index, specific gravity, flash point, insoluble matter, water content and total base number. This results obtained revealed that treatment has improved and enhanced the physical properties of the used lubricating oils, the comparison between treated and untreated data revealed appositive impact associated with viscosity at 100C° for oil .for Mach5, Accel Ultra the viscosity before treatment was 18.3 , 16.9 and 15.03 while the viscosity after treatment was 15.03 , 19 and 17.2 respectively .The recommendation of the study is to demark certain areas for collection and recycling of oil.***

Keywords: lubricating oil, treatment, solvent, extracting, recycling, viscosity

1. Introduction

Lubricating oils are the composites which used to facilitate the mechanical movement of engines and different cars, to reduce friction, save energy and fuel, accelerate the performance, and protect the equipments from corrosion and wild. And contribute to reduce operating temperature of these equipment.[1]Lubricating is divided into two types: first one, engine oils which are also two types; oils of diesel engines and gasoline engines. Also there is a type of oils that accompanied the two kinds of engines according to the special composition of those oils.[2]The second type is; lubricating oils used in numerous industrial fields, the mills, drilling machines, and hydraulic machines, and all different kinds of gears and iron casting molds, etc..These oils form of the essential mineral oils which extracted from petroleum after re distillation under low pressure. In addition to those essential oils there're performance enhancements were added called additives, which different in chemical composition according to the purpose used for and the required function. Vary sources of oils [3] from petroleum, plants, and animals, are utilize in different lubrication purposes, and as result of these uses becomes an useable either for changing characters or contamination by natural or chemical imperfects, or mixing with water. These oils consider a hazards' on the environment and general health, beside the problems of deteriorate, the retention or the storage of used lubricating oils . In barrels or barrages or special containers, after that it has been destroyed by several ways, such as burning, infusion in sewage, infusion in vacate areas, infusion in abandoned wells, infusion in the sea, etc.. and that's interpret to the environment pollution. In case of reliant on the recycling technology of used lubricating oils which returns to 1920 when it was containing a few or none of the chemical additives. Internationally there are another technicians to recycling consuming oils such as; re-industrialization: it is a physical / chemical process involved removal of contaminants to reuse it again by the precipitation and removing the water (Flash Evaporation), filtration, and center fusion.[4] the main object is cleaning the oil to a certain degree not to reproduce an oil that had same quality of the original. Although this method is not beneficial in case of mixed oils, thereby the process of separating the oil based on type. At the beginning it is an important factor. Also this process depends on some ways or another on the quality of consuming oil, especially if its contain a high concentrations of substances that make the; re-industrialization process difficult, such as heavy oil or chloral hydrocarbons.[5] this type used for industrial purposes as fuel could be used in factories and etc.. generally the minimum of the required physical treatment is done to retain the price difference between this fuel and the other fuel sources, and we don't have to remove the dangerous contaminants from the consumed lubricating oils which needs another expensive chemical treatment and just . By physical treatment to maintain a fuel had physical properties similar to the oil fuel in the Enthalpy, the viscosity, flash point, and precipitants amount. The refinement process requires modern and …..operations which is considered highly expensive, taking all environmental and health considerations upon operating. Including treatment of consumed oils to be used it to obtain new lubricating oil.This process extend the life of the oil, and consider one of the best alternatives available to deal with the oils environmentally. The refinement process rely on cleaning the oil from contaminants such as, dirties , water, and heavy oil, and other additives by distillation and then hydrogenation to remove any chemical contaminants. Finally mixing the refined oils with cretin additives to option final product of lubricating oil. Although the economical cost ofre-industrialization of consumed oils depended on its type. And the values differs from country to another depends on prices of the raw materials, consumed oils, and the life level and income which differs wages of labors and other expenses. The references illustrated that the refinement process of consumed oils reliable in term of consuming energy which needs almost third the energy required to refine the pure oil to obtain the same amount of lubricating oils. Regardless of any economical considerations, the technology of lubricating oils refinement widely depends on the quality of consumed oils specially with existence of concentrations of heavy fuel oil ,thereby effecting the

treatment efficiency of this process. Subsequently, the ability to produce lubricating oils nor any other good quality products.[6]

2. Research Objectives

- Recycling of used oils to reuse it and develop good methods to refine oils in terms of the safety of the environment.
- Count the source of used lubricating oils and evaluate the quality of the oils specifications.
- Knowing which best application for the tempered oils.
- Studying the economic advantageous of some commercial refinements methods and the economical benefits of the consumed oils.
- Reduce the environmental impact of the consumed oils.

3. Problem Statement

To get rid of the recurrent oils has become a huge environmental problem in terms of riddance places and procedures. Which all leads to environmental disasters and pollution of water, air and soil because these oils contain a lot of poising chemicals and heavy metals. Also the riddance cost of these oils considerably high according to a number of economical studies that carried out in many countries, found that the cost of recycling lubricating oils from the consumed oils is less than the riddance cost of these oils.

Treatment of the reused oil:

This study holds on two types of lubricating oil , and they are:

1-MACH5 20 W50: which is a multi viscosity metallic oil, suitable for all gasoline engines , specially those who works in fuel injecting systems, and function in the most difficult operating circumstances, and in a high temperatures.

Standard specifications

API SM
SAE20W50

Advantages

- Increase of precipitants control by 10% then other oils.
- High resilience of viscosity allowing the smooth operating in different temperatures.
- A long replacement period extend from 5000 to 6000 km depended on the operating circumstances.

2-ACEEL ULTRA 20W50: It is a multi viscosity metallic oil, suitable for gasoline and diesel machines, and works with the specifications of modern engines, and provide high protection to the engine and prevent corrosion in the engines due to the additives .

Standard specifications

API SL/CF
SAE20W50

4. Experimental:

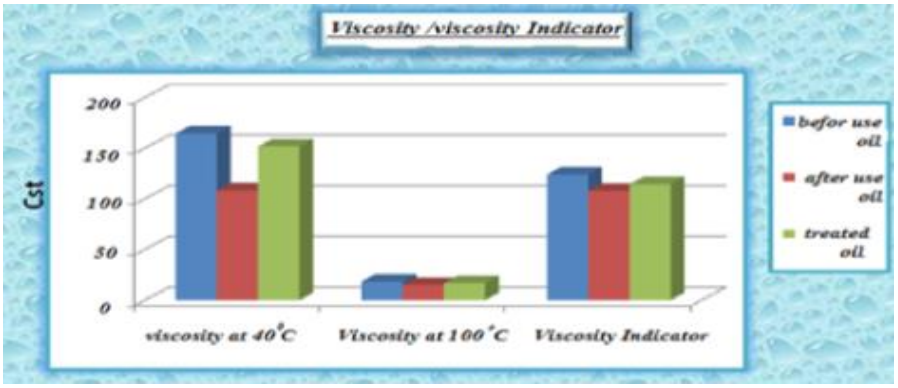
1) Filtration: the oil intended to be treated was filtered to remove imperfects and dirt that's accrued during usage period, a simple laboratory assemble was used of bokhnr funnel and low pressure pump with pressure measurement, and beaker. The filtration process done at 400mm/ Hg and another filtration done at 700mm/Hg after distillation to separate the solvent from the extracted oil to remove asphaltic and resins substances stick with it.
2) Extraction: two samples of lubricating oils were prepared after filtration to proceed extraction by solvent mixture of n-butanole and probanole2 for the sample MACH5 by taking 200ml of the oil sample and 200ml of n-butanole and 200ml of probanole2.The second sample ACCL ULTRA the solvent was methyl ethyl ketone and n-butanole and probanole2. 200ml of the oil sample were taking and 100ml of methyl ethyl ketone, and 100ml of n-butanole, and 200ml ofprobanole2.
3) Distillation: after completing extraction process the use solvent separated from filtered oil by distillation system, the distillation temperature was upon 120-140ºC.After this process several laboratory tests were proceed to estimate the effect of the treatment process on the physical and chemical characteristics of the treated oil.

5. Results

The first sample **MACH5**

Table 1: Showed Viscosity and Viscosity Indicator of MACH5

The experiment	Oil before use	Oil used	Treated oil	unit
Viscosity at 40ºC	164.5	108.4	151.9	cst
Viscosity at 100ºC	18.3	15.08	16.9	cst
Viscosity Indicator	124	107.94	114.5	cst

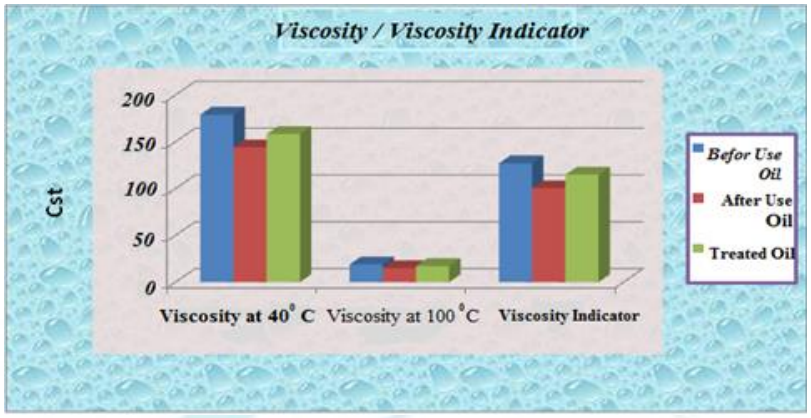


Scheme 1: ShowedViscosity and Viscosity Indicator of MACH5

The second sample **ACCEL ULTRA**

Table 2: Showed Viscosity and Viscosity Indicator of ACCEL ULTRA

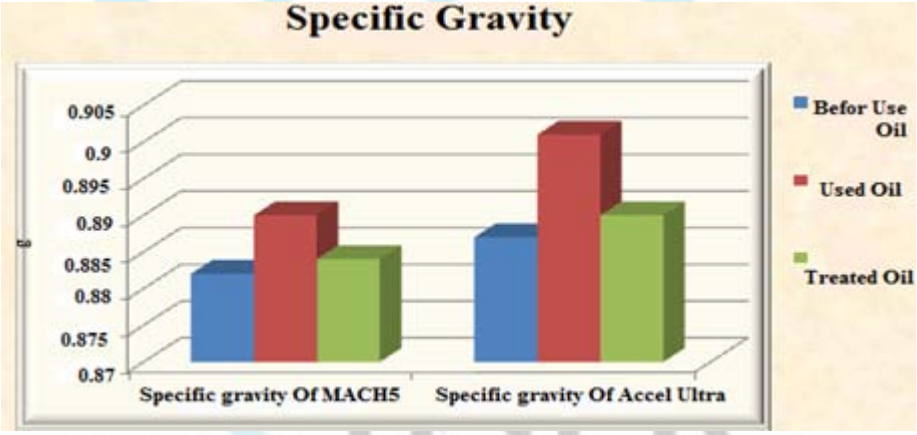
The experiment	Oil before use	Usedoil	Treated oil	unit
Viscosity at 40ºC	179	144.1	158.2	cst
Viscosity at 100ºC	19	15.03	17.2	cst
Viscosity Indicator	127	100.4	114.9	cst



Scheme 2: Showed Viscosity and Viscosity Indicator of ACCEL ULTRA

Table 3: Showed specific gravityof MACH5 and ACCEL ULTRA

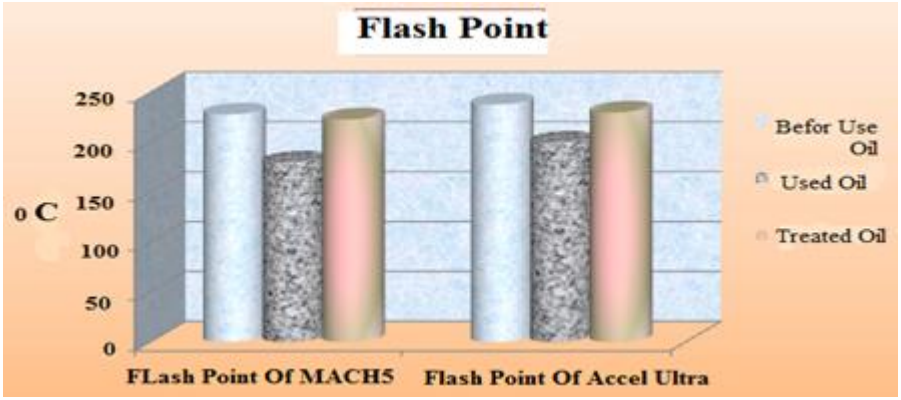
The experiment	Oil before use	Usedoil	Treated oil	unit
Specific gravity of MACH5	0.882	0.890	0.884	g/cm³
Specific gravity of ACCEL ULTRA	0.887	0.901	0.890	g/cm³



Scheme3: Showed specific gravityof MACH5 and ACCEL ULTRA

Table 4: ShowedFlash pointof MACH5 and ACCEL ULTRA

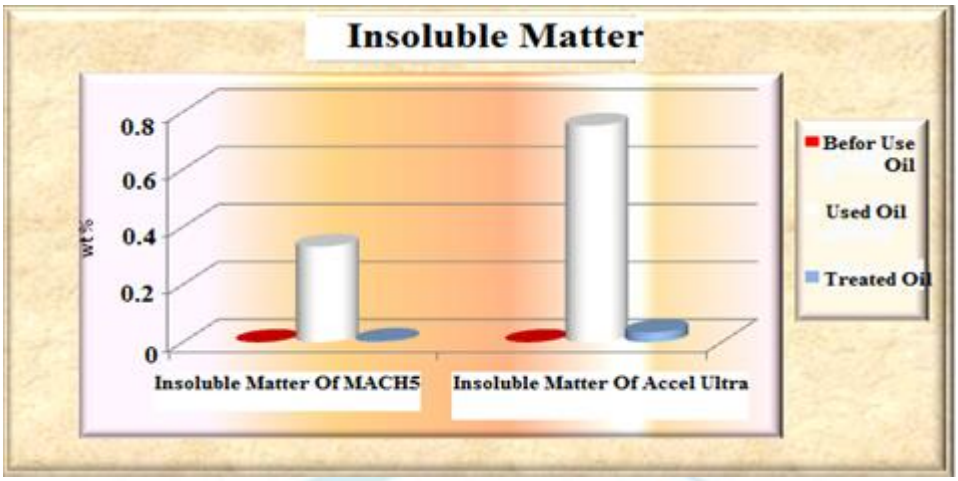
The experiment	Oil before use	Usedoil	Treated oil	unit
Flash point of MACH5	228	180	223	ºC
Flash point of ACCEL ULTRA	238	200	230	ºC



Scheme 4: ShowedFlash pointof MACH5 and ACCEL ULTRA

Table 5: ShowedInsoluble Matterof MACH5 and ACCEL ULTRA

The experiment	Oil before use	Usedoil	Treated oil	unit
Insoluble Matter of MACH5	0%	0.332%	0.0045%	Wt%
Insoluble Matter of ACCEL ULTRA	0%	0.752%	0.034%	Wt%



Scheme 5: Showed Insoluble Matterof MACH5 and ACCEL ULTRA

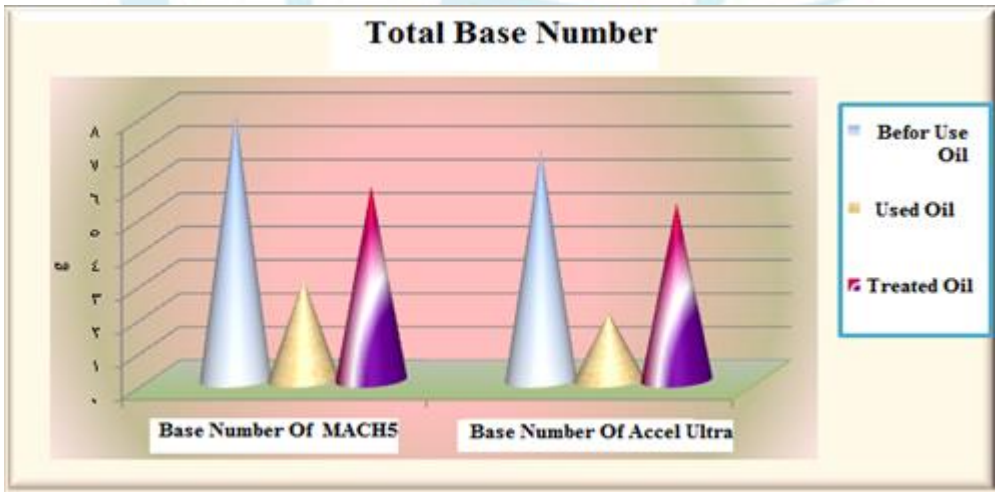
Table 6: Showed Water Contentof MACH5 and ACCEL ULTRA

The experiment	Oil before use	Usedoil	Treated oil
Water Content of MACH5	ND	ND	ND
Water Content of ACCEL ULTRA	ND	ND	ND

ND= No Detected

Table 7: Showed Total Base Numberof MACH5 and ACCEL ULTRA

The experiment	Oil before use	Usedoil	Treated oil	unit
Base Number of MACH5	8	3	5.8	g
Base Number of ACCEL ULTRA	6.9	2	5.3	g



Scheme 6: Showed Total Base Numberof MACH5 and ACCEL ULTRA

6. Dissection

- Comparison of the results obtained from the treated oil with the original oil, we find that the treatment has raised the rates of all the tests which carried out in this study.
- Two types of solvent was used in the treatment process which leads to different results which indicates that the solvent choice is important in the refinement process.
- We noticed increase in the viscosity and viscosity indicator due to the decrease of carbon ratio and decrease of precipitants amount and imperfections in the treated oil.
- The increase of oil density after the treatment due to the decrease of insoluble matter ratio specially the Carbone ratio.
- The Increase in the flash Pointe of the treated oil evidence on decreasing volatile substances and the light compounds, and that the oil is free of imperfects.
- The presence of insoluble matter in the selected sample which is inorganic salts resulted from neutralization of sulfur gases with the minerals in the additive, and after the treatment process caused decrease of insoluble matter ratio due to the filtration.

- Notice an increase in the base number of treated oil comparing with used oil due to impurity decrease in the treated oil ,also we added base number enhancer, which led to increase of base number of treated oil sample.
- We could use the treated oils for the same previous use because of the similarity of its specifications with the original oil, but the use limit is less than the third. Or it could be used for the same purpose but for less modern machines.
- Generally engines oils properties should be in the limits of standard tests values, and this oils most be totally free of water, suspense's matter, precipitants, dirt, and any other impurities, also the oils should match the operating tests of the top selected oils in the standard ways.

7. Recommendations

Recurrent lubricating oils are real environmental problem and necessarily to be dissolved by cycling, thereby we recommend the following:

- Remark a certain areas for collecting it based on type, and then …. In the right ways such as recycling.
- Propagate the environmental awareness between citizens about the oil's dangerous on the environment, and how to collect it and encourage them to do so.
- Build recycling stations on scientific feature.
- Change the engines oils every time after expiration to not affecting the engine life.
- Using the high technology to get the best standard specifications of liberating oils.
- Encourage the studies in the lubricating oils field to unravel more efficient ways to reduce the pollution caused by these oils.

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