a. Field of invention

This invention is related to the "Hydraulic fluid. A hydraulic fluid is the power transfer medium for hydraulic machineries. Ancient hydraulic systems used were water and the mineral oils etc.. Hydraulic systems will work most efficiently if the hydraulic fluid used has zero compressibility. The final outcome of our blended oil is to overcome the problems faced by the other hydraulic fluids with respect to higher cost and reliability. Also it is easier to maintain, operate and spot leakages in a hydraulic system. The developed oil is more biodegradable, eco-friendly, organic and also has attained the higher viscosity.

b. Novelty of the invention

The novelty of the project is the production of a contamination free, biodegradable hydraulic fluid by treating industrial waste water preferable from food industry at an affordable cost. By adopting blending of the extracted oil having low viscosity with appropriate blending agents at a suitable proportion, the viscosity of the extracted oil can be produced having the qualities on par with standard hydraulic fluid. The final blended oil is environment friendly since it is absolutely free from impurities as they are removed by the centrifugation process carried out at the initial stage. Also, its production cost is less compared to the cost of the standard hydraulic fluid available in the market. The hydraulic fluid produced out of this process can be widely used in all hydraulic machines. Also, this may lead to reuse of waste which is one of the essential key factor in solid waste management.

c. Innovation features

1. Castor oil: It is an inedible vegetable oil mainly used as bio resource material for the synthesis of lubricants, biodegradable polymers. It is used in biofuels, cosmetics etc...

India is known as the world leader in castor seed and oil production and leads the international castor oil trade. Castor oil production in this country usually fluctuates between 250,000 and 350,000 tons per year. Castor oil is used as a blender to the centrifuged oil to improve the viscosity nature of the fluid. Blending capacity is high in case of castor oil and its cost is too low which is 140 rupees per litre.

2. Effective waste water usage: In many industries waste water is directly exposed to the atmosphere or nearby stream, rivers. This waste water is collected and it is kept undisturbed to settle it for 24 hours. And then the scum is extracted from it and after that the

centrifugation process has been carried out. Then the oils viscosity is tested. The collected sample is compared with the standard hydraulic fluid. As the viscosity is too low, blending agents are added to improve the oils viscosity to meet the requirements of standard hydraulic fluid.

3. Biodegradable Hydraulic fluid : Ecologically delicate applications (for example ranch tractors and marine digging) may profit by utilizing biodegradable pressure driven liquids dependent on rapeseed (Canola) vegetable oil when there is the danger of an oil slick from a burst oil line. Normally these oils are accessible as ISO 32, ISO 46, and ISO 68
Determination of oil as per ASTM benchmarks ASTM-D-6006, Guide for Assessing Biodegradability of Hydraulic Fluids and ASTM-D-6046, Standard Classification of Hydraulic Fluids for Environmental Impact are significant. As the waste water is collected mostly from food industry, it would not be a major harm to the environment.

Keywords: hydraulic fluid, servo 68, viscosity, preliminary treatment, skimming tank, scum.

d. Background of the invention

We are trying to reduce the impact of waste water by removing the scum from it and using it again. The wastewater from Industries contains a large amount of scum, which can be collected during preliminary treatment from skimming tanks. The scum can be collected from the skimming tank and by altering few necessary properties it can be used as a hydraulic fluid.

The present invention helps us to reduce the waste water directly getting exposed to the atmosphere or else discharged into the rivers, streams, etc... Castor oil is widely present in India. It can be used as a blender in our extracted oil to make it high viscous. It paves way to the ecofriendly environment.

Castor oil which is a low cost vegetable oil could be used as feedstock in biodiesel production. The resulting fuel is superior for cold winters, because of its exceptionally low cloud and pour points. Initiatives to grow more castor oil crops for energy production compared to other oil crops needs to be motivated by social considerations. Tropical subsistence farmers would gain a cash crop.

e. Existing state of art and problems to be solved

US4159949A CONTAMINANT REMOVER:

In this patent, a system is provided for continuously removing contaminants from a fluid stream on a high volume basis. This invention relates to a system for removing, on a high volume, continuous basis, contaminants from a fluid stream to provide a purified fluid. The patents filed earlier in the similar domain provides but one vessel which acts as a filter and is not directed to a system such as applicant's having a plurality of components which provide a high volume, continuous flow of purified oil in an inexpensive and expedient manner.

US2015013987A1 METHOD FOR REDUCING SULFIDE IN OILFIELD WASTE WATER AND MAKING TREATED:

A process for recycling oilfield waste water includes combining the oilfield waste water and hydrogen peroxide, the oilfield waste water comprising sulfide; oxidizing the sulfide to sulfur; forming a precipitate comprising a colloidal sulfur precipitate, a bulk sulfur precipitate, or a combination comprising at least one of the foregoing; removing the precipitate from the oilfield waste water to form treated water.

KR20060081714A PRODUCTION OF BIODIESEL AND OTHER VALUABLE CHEMICALS FROM WASTE WATER TREATMENT PLANT SLUDGES:

In this patent, a process for producing biodiesel has been invented by first extracting lipids from the sludges generated during primary and/or biological treatment of municipal, agricultural, and industrial wastewaters using primary, secondary, and tertiary treatments followed by the trans esterification of the extracted lipids using trans esterification conversion into alcohol-based esters. The resulting products from this process include biodiesel, glycerol, lipid-free proteins, various other useful chemicals and an aqueous-based substrate well suited for optimized digestion within subsequent biological digestion (either aerobic or anaerobic)

US2013284677A1 WASTEWATER HYDROCARBON EXTRACTION AND ENVIRONMENTAL TREATMENT METHOD AND SYSTEM:

In this patent the applicants developed a Method and system for extracting and recovering hydrocarbons from wastewater and treating the water to improve its condition. A series of specific unit operations result in the extraction of hydrocarbons, solids and contaminants and the treatment of water to a condition which is fit for re-use or environmentally sustainable discharge. Phase separation between the water and hydrocarbons is effected using flotation techniques followed by collection of the hydrocarbons using a movable collection surface. The aqueous phase is processed by multiple filtration steps.

EP2711344A2 WASTEWATER TREATMENT SYSTEM AND PROCESS:

The present invention provides a system and method for treating wastewater in which the majority of solids and biological oxygen demand compounds are separated from the wastewater feed using a primary separation process, to produce a solids phase and a water phase. The solids phase is irradiated to reduce the level of pathogens such that it is safe to use as a soil substitute and/or additive so that the solids can thus be disposed of in an environmentally-friendly manner. The liquid treatment system can include a high flux adsorbent material treatment system integrated with a low flux adsorbent material biological regeneration reactor.

US4151075A SEPARATION OF COMPONENTS OF A FLUID:

In this patent, the applicants made an attempt in which Fluid mixtures containing a carrying liquid as water and solid particles or oil, or both may be separated in a settling treatment by being passed through channels between plates which are tilted so that one side of all plates is lower than the other, whereby the more dense phase concentrates on the lower side to discharge therefrom as a stream containing at least most of the solid particles, if that represents the more dense phase; and clear water discharges substantially free of particles from the upper side of the channels. While accomplishing the separation of phases the process may simultaneously and rapidly destroy organic materials in waste liquors, such as sewage waters, by utilizing an oxidation process.

US2015376033A1 METHODS AND SYSTEMS FOR TREATING PRODUCED WATER:

In this patent, produced water from a crude oil or natural gas production process is purified using a membrane purification system for petroleum production, agricultural, commercial and domestic uses. The produced water is pretreated to remove, at least, particulates and oil from the produced water. The minimally pretreated water is then purified in a membrane purification system that is operated at conditions such that membrane scaling is reduced or prevented. In particular, the membrane purification system is operated to maintain the turbidity of clarified water feed to the system or intermediate aqueous streams that are cascading through the membrane purification system.

US2004178149A1 REMOVING METALS FROM SOLUTION USING METAL BINDING COMPOUNDS AND SORBENTS THEREFOR:

In this patent rremoving metals from metal containing acidic solutions, such as contaminated waters and industrial wastewaters, is described. An amphipathic, heterocyclic, metal-coordinating compound (an extraordinary ligand) and a sorbent are added to a solution, such that the addition, at a specific acidic pH of the solution, causes at least some of the metal-coordinating compound to bind with some of the metal cations and at least some of the metal-coordinating compound sorbs to the sorbent, along with any metal cations bound therewith.

From the above patent search, it is found that many patents were filed and granted in connection with treatment of municipal waste water (sewage) and industrial waste water (effluent) to remove the contaminants in general from various industries and in particular from oil industries using novel and innovative techniques. After treatment, the treated waste water is made useful for domestic and industrial applications. But our project is different from the earlier patents filed in the sense that our aim is to extract the oil from the industrial waste water more particularly from food industry, oil, automobile industries etc. during the preliminary treatment of waste water by providing a skimming tank fabricated for this purpose. The extracted oil is centrifuged to remove the impurities present in the oil. Subsequently, the viscosity of the oil is determined in the viscometer device and compared with the viscosity of a standard fluid being used in hydraulic machines. As the viscosity of

the extracted oil is found to be very low, a suitable blending has been tried with different blending agents to choose the best one. Also the optimum proportion in which this agent can be blended with the extracted waste oil has been determined by adopting standard procedure. After this sequential process, finally the viscosity of the extracted oil is made on par with the viscosity of standard oil which is used in various hydraulic machines.

f. Detailed Description:

There are mainly three methods for transmitting power. Mechanical transmission is done by shafts, gears, chains, belts, etc. Electrical transmission is through wires, transformers, etc. Fluid power is through liquids or gas in a confined space. Fluid power deals with the generation, control and transmission of forces and movement of mechanical element or system with the use of pressurized fluids in a confined system. Both liquids and gases are considered fluids. Fluid power system includes a hydraulic system (*hydra* meaning water in Greek) and a pneumatic system (*pneuma* meaning air in Greek). Pressurized liquid petroleum oils and synthetic oils, and pneumatic employ compressed air that is released to the atmosphere after performing the work.

The first power through pressure liquid, going back to the hour of antiquated Egypt, was water. Starting during the 1920s, mineral oil started to be utilized more than water as a base stock because of its inalienable grease properties and capacity to be utilized at temperatures over the breaking point of water. Today most water driven liquids depend on mineral oil base stocks.

Natural oils such as rapeseed (also called canola oil) are used as base stocks for fluids where biodegradability and renewable sources are considered important.

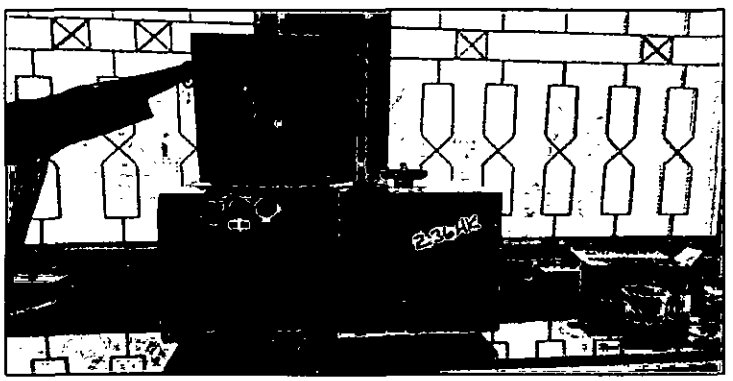
Other base stocks are used for specialty applications such as for fire resistance and extreme temperature applications. Some examples include: glycol, esters. Organophosphate ester, polyalphaolefin, propyleneglycol and siliconeoils. By the expression "liquid" we allude to air or oil, for it has been indicated that water has certain disadvantages in the transmission of pressure driven force in machine activity and control.

In the situations where the pressure driven framework is shut (i.e., the one with an independent unit that serves one machine or one little gathering of machines), oil is usually utilized, in this manner giving, notwithstanding power transmission, advantages of oil not managed by water just as expanded life and effectiveness of packings and valves. It ought to be referenced that in some uncommon cases, solvent oil weakened with water is utilized for wellbeing reasons.

The utilization of liquid force is restricted distinctly by the inventiveness of the fashioner, creation architect or plant engineer. In the event that the application relates to lifting, pushing, pulling, cinching, tilting, constraining, squeezing or some other straight line (and numerous rotational) movements, it is conceivable that liquid force will meet the prerequisite.

CENTRIFUGATION PROCESS:

Centrifugation uses a centrifuge, or a device that can rapidly spin, to speed up this process. Imagine we put the mixture into test tubes, and those tubes into the centrifuge. The centrifuge holds the top of the tubes, and the bottom is allowed to angle out. As it spins, the larger particles would get flung out farther, and smaller particles would stay close to the center. 6 test tubes are placed and it is closed by a lid. The rpm is set to 700-3000 to find the optimum speed. The temperature is set to 10 deg celsius.



4.6 REDWOOD VISCOMETER

Viscosity can be measured by redwood viscometer.

PROCEDURE

Set the instrument using sprit level. Clean the oil cap & fill it with oil up to the tip of the wire inside the cup. Close the cup, fill the bath with water & then insert the thermometer in corresponding sockets. Connect the instrument heating coil to the mains through the autotransformer. Heating the bath, observe the temperature of oil & keep difference between the two a minimum by stirring. Place the 50cc flask directly below the orifice in the cup. Open the orifice with ball valve & note the time of flow for 50 cc of oil. This tends to be the viscosity number in redwood sec. Repeat the same for different temperature & record the readings.

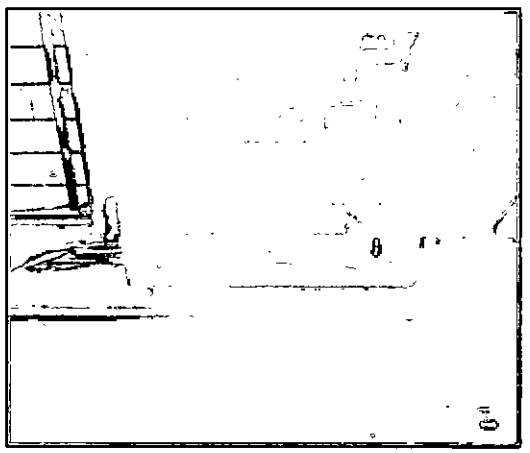


Fig 4.7 Redwood viscometer

TEMPERATURE VS TIME FOR THE OIL COLLECTED

From the following tables we can find out how the temperature affects the flow of the oil. We can see that as the temperature increases the time taken to flow decreases.

Table 4.1 Viscometer Reading for Oil Collected

No of trials	Temperature in (deg. Celsius)	Time in Sec
1	40	32
2	50	10.95
3	60	9.445
4	70	8.135

TEMPERATURE VS TIME FOR STANDARD HYDRAULIC FLUID

Table 4.2 viscometer reading for servo68

No of trials	Temperature in (deg. Celsius)	Time in Sec
1	30	102.75
2	40	38.39
3	50	26.28
4	60	16.88
5	70	12.88

We found that the viscosity cannot be found from this equipment because the calculations showed negative value and we found that it is a low viscosity measuring device and the calculated value was different for the standard hydraulic fluid for which the viscosity is known at 40 degree Celsius. Hence, we concluded that the viscosity must be tested in medium viscosity device and we opted for rheometer. From the above tables we can interpret that as the temperature increases the time taken for the liquid to flow into the beaker decreases. Which is the case for both the liquids and we can also conclude that we have to add a liquid into the oil that was centrifuged because the difference in the time taken to fill the beaker is large between both the liquids. Only by adding another thicker liquid we can get the required result.

4.1 RHEOMETER

We referred various sources and we found that the dynamic viscosity can be calculated using rheometer, which is advanced digitalized equipment. It requires only 16 ml of the sample to calculate viscosity and the time consumed in finding the readings is also less. A graph is generated pertaining to the fluid placed in it.

We found the viscosity for the oil obtained after centrifuge and also for the standard hydraulic fluid and result obtained for the former oil was similar to a sine curve and the dynamic viscosity found was 48 Cp. The graph generated for the hydraulic fluid was moderately linear, after a particular distance it became constant. The viscosity readings for the standard hydraulic fluid matched with the values in the datasheet. The dynamic viscosity for the servo 68 at 30 deg C is 124 Cp.

The graph below is plotted between viscosity and time. From the graph we can see that the viscosity standard hydraulic 124 centipoise.

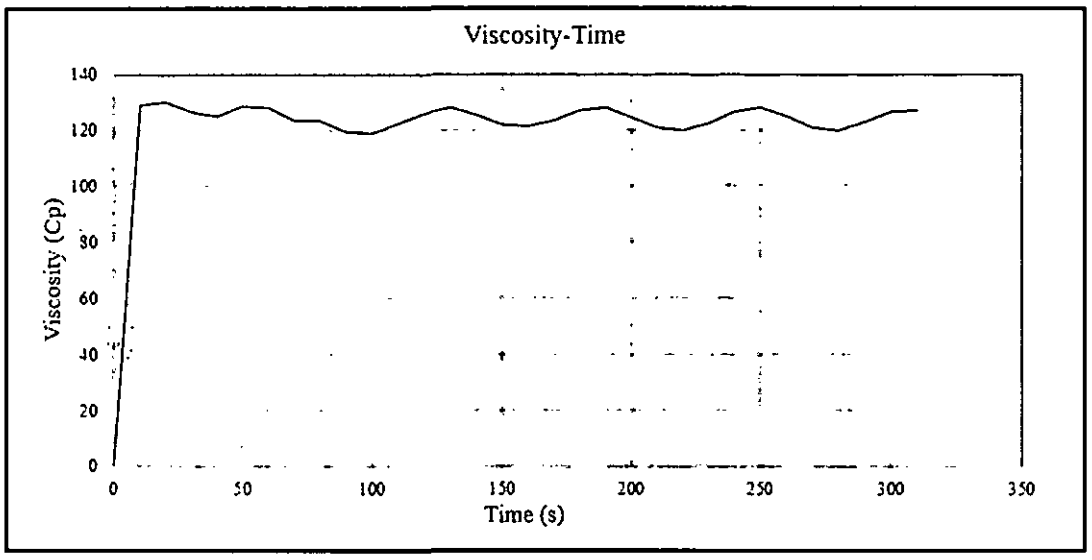


Fig 4.8.1 Viscosity – Time plot for standard hydraulic fluid

The sine curve indicates the presence of impurities in the oil. The viscosity of the oil is 48 centipoise.

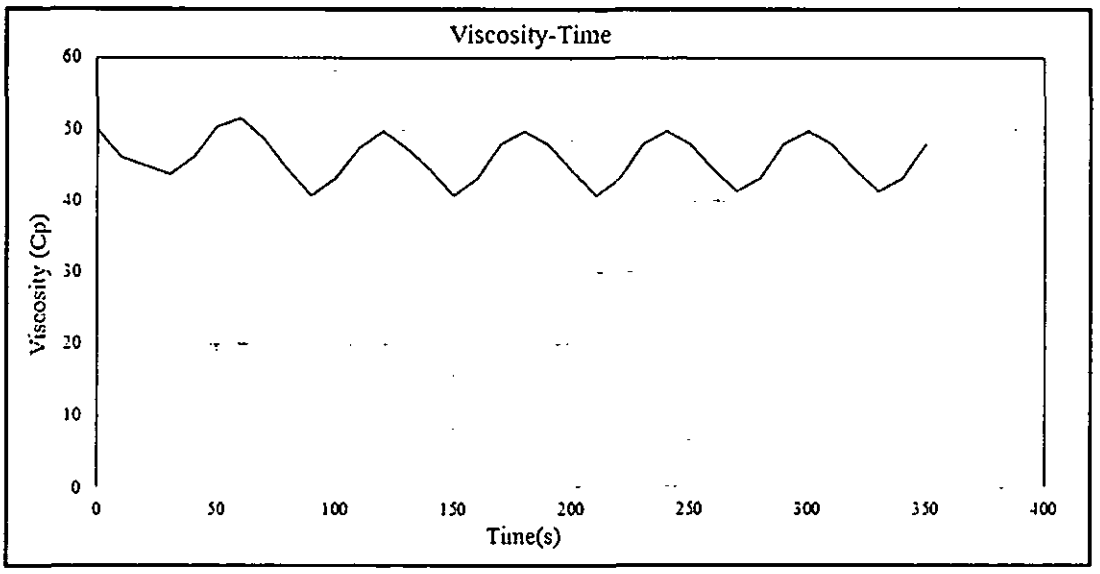


Fig 4.8.2 Viscosity – Time plot for the oil collected

4.1. STUDY TO FIND OUT THE RIGHT OIL FOR BLENDING

Many types of oil have been comparatively studied in order to find the best oil. There are wide ranges of oils with suitable viscosity but it must also satisfy many other properties such as

- The main criterion is that the oil must be biodegradable for a sustainable future.
- It must be able to blend with the oil.
- It must be easily available.
- It must be cheap.
- It should not separate after few hours.
- Must satisfy all the desirable characteristics necessary for a hydraulic fluid.
- From the above tests using rheometer it is evident that the viscosity of the oil should be very high, it is the only way to reach the required standard viscosity.

Based on the above points and with the help of some literature review and other sources **castor oil** is the best choice and it is very easily available. It has high flash point and fire point. It is organic and hence can blend very well. The cost per litre is 140 rupees.

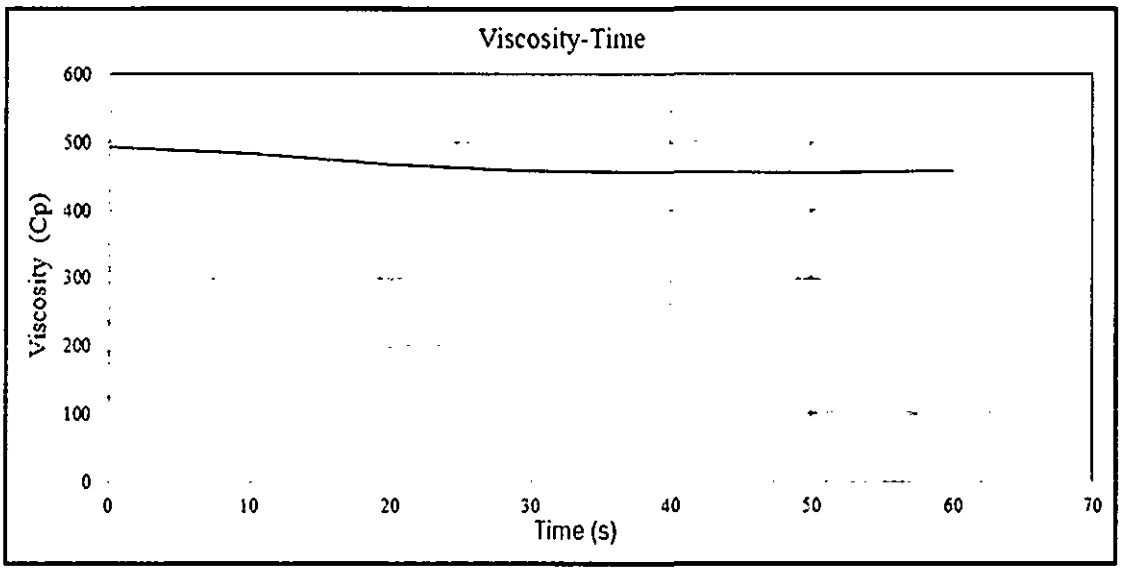


Fig 4.9.1 Viscosity – Time plot for Castor oil

Hence we found the viscosity of the castor oil using rheometer which was 500 centipoise. The percentage blend is calculated using the blending equation.

4.2. VISCOSITY BLENDING EQUATION TO FIND THE RATIO OF BLEND

In the petroleum industry, empirical or proprietary blending equations are common. The best known are the double logarithmic equation of Refutas and the cubicroot equation of Kendalland Monroe .The Refutas equation calculates the viscosity, $\mu 12$, of the binary blend from viscosities and weight fractions of the components by introducing the so called viscosity blending index (ASTM D7152).

Blending should be carried out in the ratio of waste oil (54 %) castor oil (46%).

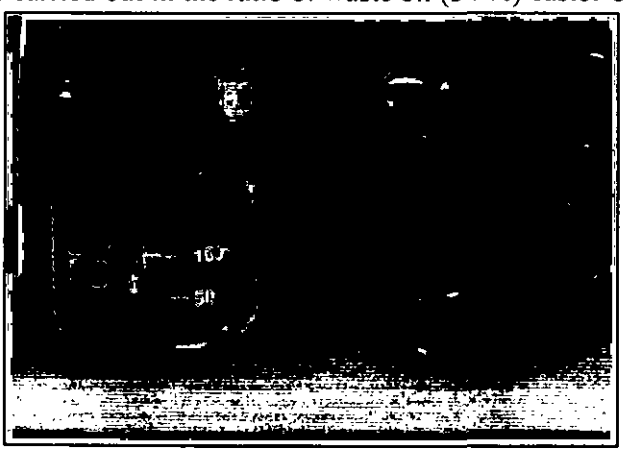


Fig 4.9.2 castor oil and waste oil

Fig 4.9.3 blending the oil

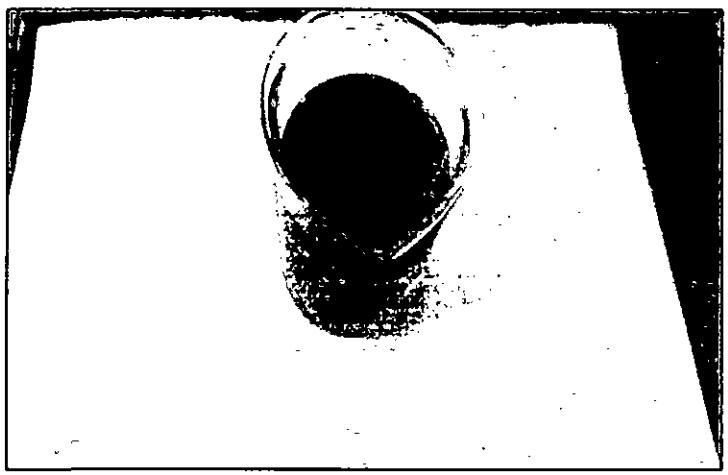


Fig 4.9.4 Blended oil

THE OIL OBTAINED AFTER BLENDING

Viscosity Vs time graph for the blended oil. The viscosity has increased to a considerable extent after blending. The viscosity has now increased to 113 centipoise.

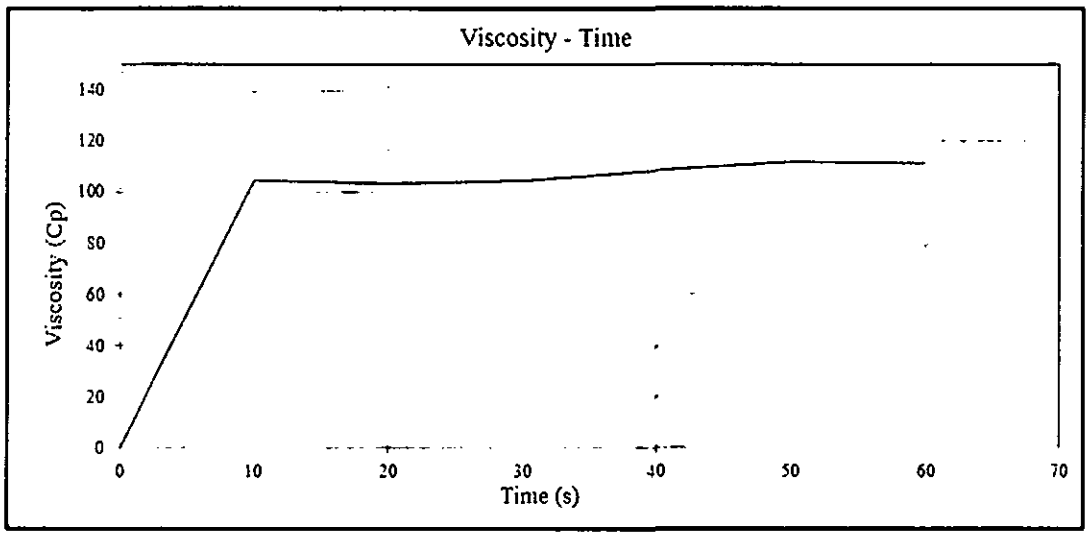


Fig 4.9.5 Viscosity after blending the oil

A graph has been plotted to compare the viscosity of extracted, blended and hydraulic fluid.

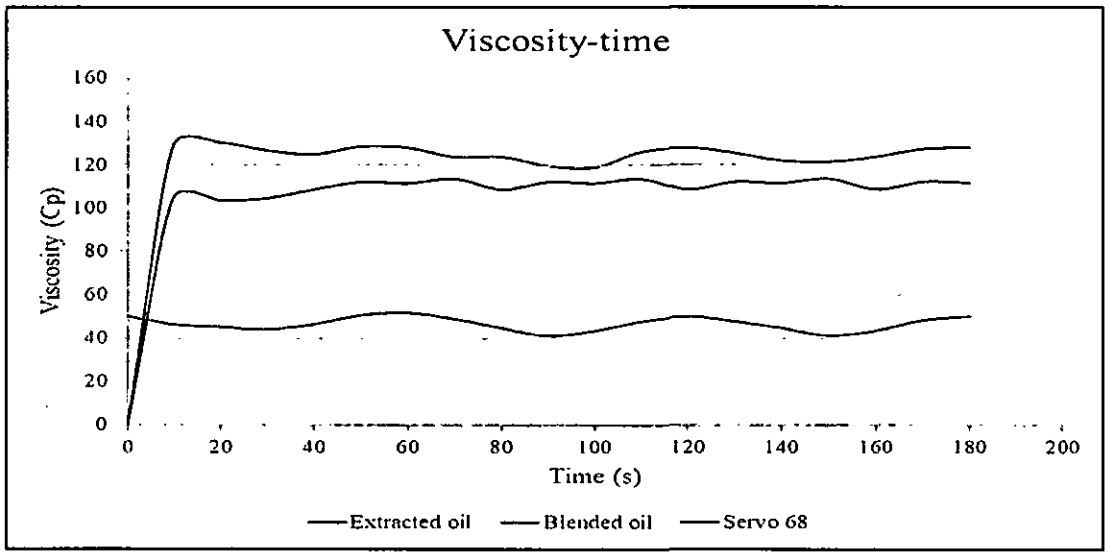


Fig 4.9.6 Viscosity for the Extracted oil, blended

From this graph, we can conclude that the extracted oils viscosity is found to be 48 centipoise, hydraulic fluids viscosity is measured as 124 centipoise and after blending the extracted oil with the castor oil we finally arrived at the viscosity of 113 centipoise. Blended oils viscosity is more or less equal to that of the viscosity of the standard hydraulic fluid. So we can conclude that the blended oil can be used as a hydraulic fluid for the lubrication purpose.

Patent Citations:

1. US4159949A CONTAMINANT REMOVER
2. US2015013987A1 METHOD FOR REDUCING SULFIDE IN OILFIELD WASTE WATER AND MAKING TREATED
3. KR20060081714A PRODUCTION OF BIODIESEL AND OTHER VALUABLE CHEMICALS FROM WASTE WATER TREATMENT PLANT SLUDGES
4. US2013284677A1 WASTEWATER HYDROCARBON EXTRACTION AND ENVIRONMENTAL TREATMENT METHOD AND SYSTEM
5. EP2711344A2 WASTEWATER TREATMENT SYSTEM AND PROCESS
6. US4151075A SEPARATION OF COMPONENTS OF A FLUID
7. US2015376033A1 METHODS AND SYSTEMS FOR TREATING PRODUCED WATER
8. US2004178149A1 REMOVING METALS FROM SOLUTION USING METAL BINDING COMPOUNDS AND SORBENTS THEREFOR

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(g) BRIEF DESCRIPTION FOR FIGURES:

Figure 1 – Model Skimming Tank

Figure 2 – Scum Absorbing Arrangement

Figure 3 and 4 – Centrifuging Process

Figure 5 – Waste oil before centrifuge

Figure 6 – Filtered oil with impurities settled at bottom

Figure 7 – Clear waste oil free from impurities

Figure 8 – Standard Hydraulic fluid (SERVO 68)

Signature of the Applicant:

Name:

Date: