General Guide of Lubricants Recycle

This paper is a discussion on waste/used lubricating oil recycling.

For Equipment & Solution Enquiry: solution@wpenvironmental.com

For More Information: www.wpenvironmental.com

Whatsapp: +8618380127983
**Table Content:**

Abstract...........................................................................................................3
How waste/used lubricating oil generated...........................................3
General used lubricants recycling process.................................4
Settlement........................................................................................................4
Centrifugal Separation..............................................................................4
Filtration..........................................................................................................5
Water washing................................................................................................5
Adsorption......................................................................................................5
Distillation.....................................................................................................6
Solvent refining.............................................................................................7
Neutralization.................................................................................................7
Emulsification and Demulsification...................................................8
Flocculation.....................................................................................................8
Hydrogenation...............................................................................................9
Abstract
Lubricant is a viscous liquid used to lubricate the moving parts of an engine and a machine. In general, after the removal of impurities, resin and asphaltene, polycyclic aromatic hydrocarbons, wax in crude oil, the lubricating oil is produced.

However, since crude oil is limited, the crude oil reserves are drastically reduced worldwide, thus, the recovery of lubricant oil has been pressing.

During the use of lubricants, when the loss of chemical additives, lubricating agents contaminated or lubricating oil aging, the lubricant cannot continue to maintain its performance and become waste lubricants. In the United States Environmental Protection Agency (EPA), the "waste lubricating oil" definition is the use the words "used oil" rather than "waste oil". In fact, the study of waste lubricants shows that lubricants turns to be waste after use, only covers around 10% of its total volume. After a proper process, the recovery rate can reach up to 50%.

How waste/used lubricating oil generated?

1. Improper storage or improper use, which makes the gradual change of waste lubricating oil. In the storage process, poor sealing, oil mixed into with impurities, water, dust, acid, alkali, emulsion matters, etc., will make the lubricating oil into waste oil.
2. Machine in the process of running, the friction generated by mechanical parts, making the thermal decomposition of lubricating oil, accelerated aging. In addition, the damaged
mechanical powder will pollute the lubricating oil. In the course of long-term use, due to the impact of temperature, oxidation of air, which increase the formation of oxidized gum, asphaltene, organic acid.

**Recovery process of waste lubricating oil**

In a variety of waste oil recycling process, the commonly used technologies are:

1. **Settlement**
   Utilize density difference to remove the water and impurities.

This is one of the simplest method, the mechanical impurities and suspended water droplets diameter between 0.05 ~ 10μm, the sedimentation rate is subject to Stokes law. The larger diameter of water droplets and impurities, the greater density difference from the oil, the easier to settle. With greater viscosity of the oil, the settlement is more difficult. Heavy oil with high viscosity and density can be heated as a solution in order to ease the settlement. Generally, oil temperature rise every 10 ℃, oil auto-oxidation rate doubled. However, the oil viscosity changes small while the temperature stays higher than 80 ℃. Thus, in the sedimentation process, the oil temperature is generally not more than 80 ℃.

2. **Centrifugal Separation:**
   With the external driving force, that is, centrifugal force generated by high-speed rotation. Due to the density difference between the different phases, we can separate water, oil and solids.
3. **Filtration**
Liquid go through the filter medium, suspended solids, solid particles and other impurities are retained. Filter media include: Filter paper, dense textile; blankets, asbestos, cotton yarn head; Metal mesh. Filtration rates are inversely proportional to the viscosity of the used oil. In order to obtain the necessary filtration rates, heat treatment is usually required. Depending on the quality of the oil, the heating temperature will vary, but generally not more than 140 °C.

4. **Water washing:**
In order to get rid of water-soluble acid generated by oxidation reaction or flocculation to remove some of the suspended carbon ions from the waste oil. In some cases, we need to wash the waste oil. A good choice is to use distilled water in order to prevent saponification or emulsification. Water temperature usually control at 60 °C.

5. **Adsorption:**
It's a kind of refining on waste oil by using adsorbent in order to remove the non-ideal components, such as organic acids, glial and asphaltenes etc. It also brings bleaching and deodorization effects.
Often used adsorbents are clay, activated clay, diatomaceous earth, alumina, silica gel, activated carbon and the exchange resin. The temperature has a great impact on the adsorption efficiency, to increase temperature and lower viscosity can increase the adsorption rate.

6. Distillation:
A method of separating according to the different boiling point of the compound. In the waste oil regeneration process, we can remove light hydrocarbons by distillation dehydration. Asphaltene, galatine, additives and other residues shall remain in the left residual solids which the base oil is produced and separated. Normally, distillation includes atmospheric distillation and vacuum distillation. Atmospheric distillation needs high oil temperature, while there are compounds in the oil likely to be damaged by high temperature. Therefore, vacuum distillation is more widely used.
7. Solvent Refining:
Solvent refining is a process to get rid of impurities and non-ideal components by extraction. The solvent refining process in waste oil regeneration involves the use of a low-molecular-weight (LMW) hydrocarbon solvent to precipitate the relative high-molecular-weight (HMW) compounds or flocculated ash products and additives, as well as the use of polar solvents to extract aromatic hydrocarbons and polar materials. Propane refining is the first story in industrial production, It has a good performance to remove waste oil additives, metal salts, oxidation condensation products, gum, asphalt, etc..

8. Neutralization:
Neutralization is a method using inorganic base to neutralize with acid inside the oil before refining or neutralizing the acid oil after sulfuric acid refining. Salt or soap and water are produced. Commonly used inorganic bases include sodium hydroxide, sodium carbonate, sodium phosphate and hydrated lime etc.. Organic amines (mainly used for waste engine oil) are more diverse, from relatively low molecular weight ethylamine to higher octadecylamine, aliphatic amines, aromatic amines, alkanolamines, and polyamines. Generally, alkali liquor is to be added in the process. Alkali concentration, temperature principle: generally in ensuring emulsification does not occur, try to choose high concentrations and low temperature conditions. Neutralization is commonly used in combination with water washing, demulsification, and adsorption.
9. Emulsification and Demulsification:
Alkaline washing and washing process often encounter emulsification with which the oil and water will form an emulsion. Generally in pre-alkaline washing process, due to the existence of alkaline earth metal, naphthenate or sulfonate and colloidal, it forms a "water-in-oil" emulsion; In process of neutralizing sulfuric acid refined oil, due to existence of sodium, sodium sulfonate and fatty acid sodium, it forms a "oil-in-water" emulsion. There are two main ways of emulsion breaking, thermal demulsification and chemical demulsification. The efficiency of thermal demulsification depends on the temperature, the higher the temperature the higher the efficiency. Generally, the light emulsification degree can be efficiently decreased by thermal demulsification method in the process of waste oil treatment. For the more serious emulsification, which often requires chemical demulsification, for the water-repellent emulsion, often need to add sulfuric acid, dodecyl sulfonic acid or sodium naphthenate, etc.; for aqueous favoring emulsion, often joined with cationic inorganic Compounds, such as hydrochloric acid, Sodium Chloride, calcium chloride.

10. Flocculation:
Flocculation is a way to gather or larger the suspended solids in the oil in order to ease the settlement for the purpose of solid-liquid separation.
Many waste lubricants contain a clean dispersant agent, resulting in a number of solid particles colloidal steadily dispersed in the oil. The particles in the dispersant agent are small, and not easy to be separated by filtration and sedimentation or centrifugation. Therefore, flocculation is one of the most effective methods to remove solid particles before distillation process, which is more effective than mechanical separation. Flocculation is generally used in conjunction with the mechanical methods mentioned above. Flocculants are divided into inorganic and organic flocculants. Inorganic flocculant can be acid, alkali or salt. Organic flocculants including phenyl, diethanolamine, cationic polymer fatty acid salt, alkyl quaternary ammonium salt, arylamine etc.. Organic flocculants price is relatively expensive, it’s better to use in combination with inorganic flocculants.

11. Hydrogenation:
To refine waste oil in high temperature and pressure with catalyst. Oxygenated compounds in waste oils (mainly carboxylic acids, carboxylates, aldehydes, ketones, alcohols, phenols, and peroxides, etc. produced during the oxidation of waste oils) Sulfur compounds (additives or contaminants introduced) Halogenated compounds (Additive or contamination) Nitrogen-containing compounds (from base oils or additives) and olefins (from base oils or high temperature applications), etc. can be refined by the hydrogen technology. Hydrogenation is usually the last step in the regeneration process. In the environment of high temperature and high pressure, the leakage of hydrogen from the hydrogenation
device in the plant would mix with air and easily lead to an explosion. Moreover, the design, installation, operation, and maintenance of hydrogenation unit have strict requirements. Therefore only for a large-scale waste oil recycling plant may be possible to go to the hydrogenation process.