



Used Oil Management in Turkey and Turkey's first Hydro-Treatment Re-Refinery Technology at a Glance

New Regulation on Used Oils in line with EU Legislation

Turkey used oil management regulation complies with laws of modern countries with most restrictive environmental agenda. Turkey gives the priority to refining (recycling) of used oil over energy recovery and incineration. The **Regulation On Management Of Used Oils** published by From the Ministry of Environment and Urbanization in Official Gazette Number: 30985 on December of 21st of 2019.

It is prohibited to discharge used oils to soil, drainage systems, internal surface waters, ground waters, coastal waters, or any similar environment or to mix with liquid fuels, to use or permit to be used as liquid fuel or to recover,

incinerate and/or dispose of by using inappropriate means and methods.

Used oils must be collected and stored only temporarily and separately at source, where appropriate.

Used oils shall only be collected and transported by authorized organizations/collectors. It is prohibited for any unauthorized persons to collect, transport, refine, recover and/or dispose of used oils.

Oil producers, authorized organizations and those who are involved in activities regarding the temporary storage, collection, transportation re-refining, energy recovery and disposal of used oils shall be jointly and severally liable for any loss resulting from environmental pollution and degradation caused by used oils.

In order to produce high efficiency base oils from



used/waste lubricating oils (i.e. re-refining), only those clean production technologies which do not cause additional pollution can be employed.

Vehicle owners must change the vehicle's engine oil at a engine oil change station holding a valid permit issued by the relevant provincial directorate.

Turkish Lubricant Market is one of The Biggest in Europe but Registered Collection is fall behind...

Turkish lubricant and base oil market data estimates published by PETDER "Petroleum Industry Association". Lubricant consumption of PETDER members, which was 464.635 tons in 2017, decreased by 14% in 2018 and totaled **410.579 tons. Turkey's total demand of lubricants is given as 593.617 ton in 2018.** Turkey is one of the biggest market in terms of Base oil consumption in Europe.

EU demand on base oil is about 3.7 million ton/year. %83 of base oil supplied by Crude Oil Refining, %17 of Base Oil is supplied by used oil Re-Refining. Collectable used oil amount is 2.1 million ton/year and %88 of collected properly in EU.

Turkish legislation is in line with the European Union procedures about used oil management but on the other hand behind for collecting and incentives for the re-refining. On the contrary, only 13% of potentially collectable used oil is legally and registered collected. %87 of potentially collectable used oil is illegally collected.

Since, there is a huge openness in Turkey about registered collection, refining of waste mineral oil almost all of the used oils collected is processed with simple methods and the "output" is sold as "molding or textile oil". This unstandardized "oil output" consumed as fuel/diesel.

Base Oil Production Methods from Used Oil Re-Refining

Used oil is a hazardous material that is primarily "generated" from lubricating oil in car and truck engines, hydraulic systems, and industrial machinery, is contaminated by physical or chemical impurities.

During normal use, the internal combustion process in engines, lubricating oil becomes contaminated with impurities such as dirt, water, metal scrapings or different type of chemicals due to friction, high temperature and exposure to reaction products of the combustion process.

Moreover, lubricating oil becomes contaminated in hydraulic systems as the oil comes in contact with foreign elements. Contaminated used lubricating oils must be replaced with clean oil periodically as part of routine maintenance.

In our modern society of advanced technology, the increase in the number of systems in terms of power generation, for several services, requires an increasing



amount of lubricants. In general, lubricating oil consists of 71-96 wt.% base oil and additives 4-29 wt% . The main purpose for re-refining is to recover the lubricating oil base oil from the used lubricating oil.

The yield in base oil production from crude oil is between 1-3%. It is possible to obtain more than 70% base oil by refining used oils that have completed their useful lifetime and this shows the importance and promise of re-refining.

Re-refining is a process of "recycling*". During the re-refining process, used oil undergoes a range of complex treatment steps that lead a final base oil product that is equivalent in quality to virgin base oil. After these steps, the re-refined base oil can be blended again with additives, thus creating a closed loop recycling process and starting the life-cycle of the lubricating oil all over from the beginning.

Most Advanced Used Oil Re-Refining Technology of the Current Age: Hydro-Treatment

In the last decades, the hydro-treatment technology modern catalysts have been developed which are able to hydrogenate feeds with high concentration of contaminations (e.g. high metal content refining residues, used engine oils). These catalysts are applied in so called guard reactor before hydrogenation and/or hydrocracking of residues due to their large pore size. The table describes advantages and disadvantages of different process methods under selected four issue.

TAYRAŞ Hydro-Treatment Plant Technology at a Glance

TAYRAŞ building a state of the art technology Re-refinery in Bilecik having 60.000 ton/year used oil

re-refining capacity with a 400 million Turkish Lira investment value. Refinery is going to start operation by the end of September 2020. Refinery output will be Group II+ Base Oil. Process steps of the Re-Refinery given below.

Distillation Process Steps

- **Dehydration:** Removal of contaminated water, glycols and fuel fraction (gas oil)
- **Low Vacuum Evaporation Section:** recovery of Light Distillate Oil form dehydrated oil by evaporation
- **High Vacuum Evaporation:** Recovery of Heavy Distillate Oil by evaporation and removal of spent additives i.e. Asphalt
- **Oil- Water Separation:** Separation of fuel oil from waste water by using density difference and use it as secondary plant fuel

Water, glycols, solvents, fuel fraction and a light base oil fraction present in oil are evaporated at about 230-240°C and 200-250 mm Hg (abs) in Dehydration Vessel. Heated oil from the shell & tube heat exchanger is recycled back to this section for providing heat to this section. The vapors are routed to condenser. The oil and water (aqueous) phases are separated in a specially designed oil-water separator. Dry used oil is sent to the second stage of the plant – the first oil evaporation section.

Dry used oil feedstock is heated to approximately 280°C in under moderate vacuum (10-15 mm Hg- abs) in a specially designed vertical heat exchanger to evaporate a light base oil fraction from used oil. The oil from the moderate vacuum evaporation section is sent to a standard shell & tube heat exchanger and then further heated in a second evaporator which operates at higher vacuum (2-3 mm Hg abs) and temperature (290°C). Almost all remaining lubricating oil is evaporated from spent additives in the second evaporator. Hot thermal fluid is circulated thorough jackets of the two evaporators and the shell & tube heat exchanger. Spent additives are removed from the bottom of the second evaporator as residue. This re-refining residue is a saleable product as asphalt flux or can be blended into heavy fuel oils. The evaporated oil fractions are condensed and sent to tanks for storage. Uncondensed vapors are pulled by vacuum system and discharged at ambient pressure to an abatement device such as a thermal oxidizer.

Hydrotreating Process Steps

- **Hydrotreating Section:** Removal of sulfur, chlorine, nitrogen and reduction of aromatics
- **Fractionation Section:** Separation of heavy base oil, light base oil and fuel fractions the distilled oil fractions are pressured 125 bar-g, heated to over 280 °C and mixed with hydrogen gas. The hot mixture of oil and gas is passed through a series of reactors.

Hydrotreating process involves reaction of hydrogen-rich gas with oil, in this case distillates from used



lubricating oil, under calculated conditions of pressure and temperature in presence of proprietary metallic catalysts. After the reactions are carried out in specially designed reactors, the high-pressure gas is recycled back to the reactors.

Make-up hydrogen is added to compensate for losses. The oil (liquid) under high pressure is depressurized, stripped to remove light hydrocarbons (naphtha) and dissolved gases, cooled and sent to storage tanks. The fuel byproduct is used as fuel in the process plant. The off-gas containing H₂S, mercaptan-like sulfurous compounds and very light hydrocarbons is sent to a thermal oxidizer or another abatement device.

Output Product of the Hydrotreatment Refinery, output is "Group II+ Base Oil" with the yield of %73 and low sulphur, high viscosity index and high saturates.

Conclusion

- Used oils are dangerous for environment and human health if disposed improperly.
- Used oils are not wastes. Used oils are feedstock for the Base Oil Re-Refineries.
- Vacuum Distillation combined with Hydrotreatment technology is the most advanced technology for Re-Refining used oils to high value added base oil.
- Turkey has 600.000 ton/year lubricant consumption and has no Re-Refinery and misuse of used lubricants as a diesel is very common.
- For the base oil production; Used oil Re-Refining provides better advantages in terms of energy saving, high yield and efficient use of natural resources over Crude Oil Refining
- TAYRAŞ is the Turkey's first Refinery having Hydro-Treatment Technology to process used oils.