Re-Refining
The Green Solution for Base Oil Supply

Evergreen Oil has operated a used oil re-refinery in Newark, California since 1986. This facility was an early pioneer in the re-refining industry and is one of the few facilities capable of producing base oil that meets API Group II specifications. Engine certification testing performed on Evergreen’s base oil has demonstrated that it is equivalent in quality to virgin base oil. Evergreen’s base oil is certified for use in GF-3, GF-4, CI-4 and CJ-4/SL formulations.

The process developed and operated by Evergreen Oil is licensed to third parties by Evergreen’s technology affiliate, Chemical Engineering Partners (CEP). The CEP re-refining process is “Green”. When compared to the alternative of burning used oil and replacing it with base oil derived from virgin crude oil, re-refining used oil requires less energy and has less of an impact on the environment. Used oil can be re-refined more than once thereby compounding the environmental and energy benefits.

There is a reduction in overall energy consumption when base oil is produced from used oil instead of virgin crude oil because the base oil content of used oil is much, much higher than the base oil content of virgin crude oil. Used oil contains about 75% recoverable base oil. Our calculations show that producing base oil from used oil requires only half the energy required to produce base oil from virgin crude oil. Similar findings on the energy savings from re-refining were reported by the US Department of Energy (DOE) and European Association of the re-refining industry (GEIR). The energy savings from re-refining are further increased when synthetic base oils are present in the used oil because it requires more energy to produce synthetic base oil than conventional base oil.

The environmental benefits from re-refining depend upon the alternate use for the used oil. There is still a surprising amount of used oil that is not being handled in an environmentally acceptable manner. It goes without saying that re-refining is a better approach than dumping used oil on the ground and in landfills and waterways. A significant amount of used oil is also burned as fuel. Used oil contains more contaminants than other fuels so burning used oil can lead to increased emissions. The DOE and GEIR have also reported that overall environmental emissions are reduced if used oil is re-refined rather than used as a fuel.

The first step in the process is feedstock analysis and selection. Regulatory requirements prohibit the processing of used oil with excessively high levels of Polychlorinated Biphenyls or Chlorides. Each load of used oil is tested before being accepted by the re-refinery.

The second step of the process is chemical treatment to reduce fouling in the process equipment. Used oil is difficult to process. The presence of additives and contaminants make it very difficult to employ conventional petroleum processing techniques without accelerated fouling and coking in process vessels and heat exchangers. During the initial operating period, the Evergreen plant experienced many problems with fouling and coking of process equipment. A technology development program was initiated to address these problems and proprietary technology has been developed to minimise fouling and coking. As additives packages and lube oil properties have evolved we have adjusted our processing techniques to maintain good performance.

The third step in the process is to remove water and light hydrocarbons such as fuel that has been picked up by the used oil.

The process includes several steps as shown on Figure 1.

![Figure 1: Chemical Engineering Partners Re-Refining Process](image)
The fourth step of the process is removal of catalyst poisons. Some additives and contaminants in used oil are detrimental to the hydrotreating catalyst required to produce base oil that meets API Group II specifications. Rapid deactivation of the hydrotreating catalyst occurs when these poisons are present. Extensive research and analysis was conducted to identify the compounds that contribute to catalyst deactivation. Proprietary technology was then developed to remove the catalyst poisons and extend catalyst life.

The fifth step of the process is to separate the base oil from the additives and high boiling hydrocarbons. A thin film evaporator operating under vacuum is used to achieve this separation. The vacuum allows separation at temperatures below oil cracking temperatures. The lower temperatures and short residence time in the thin film evaporator minimises coking that occurs in other types of distillation equipment.

Once the base oil is separated from all other contaminants, two or three hydrotreating reactors are used in series to reduce sulphur to less than 300 ppm and increase saturates to over 90%, meeting the key specifications for API Group II base oil.

Recent process development efforts have been focused on improvements to on stream availability, reduction of energy consumption, and further extending catalyst life. Pilot plant tests have confirmed the benefits from these improvements and they are being incorporated into projects currently under development. New projects under development include an expansion to the Evergreen plant in Newark, California, a new plant in Finland, and two new plants in the USA.

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