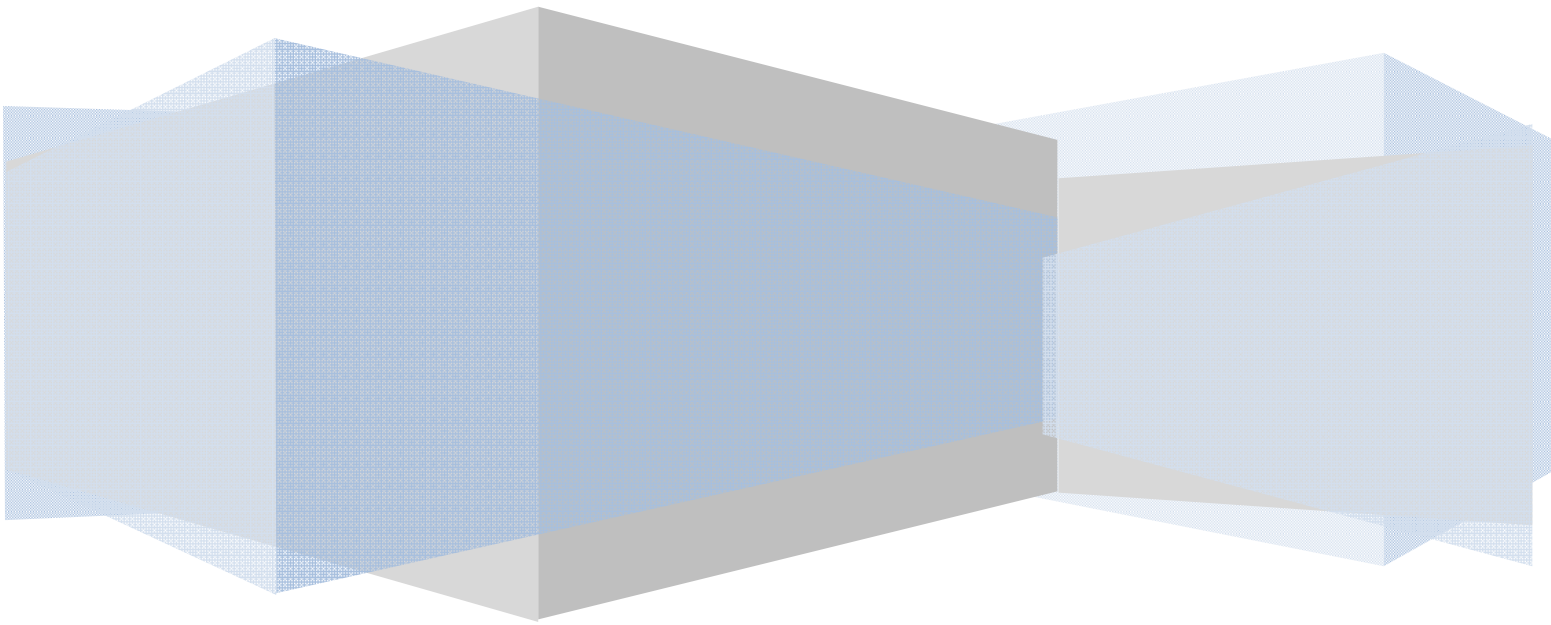
Used Oil Management: Collection & Recycling



Contents

1. Executive Summary:

The sub-working group has reviewed relevant data, viz., base oil supply-demand balance, Indian lubricant market & its segmentation, current practice/ regulations for disposal/reclamation of used oil, technology employed for recycle, end use of recycled oil, associated problems, international practices, etc. to study the issue of used lube oil recycling.

As advised in the 2nd meeting of the above Working Group, held at MoP&NG on 6th October 2016, a survey amongst the Petroleum Re-refiners Association of India (PRAI) members was carried out and a consultative conference among OMCs, PRAI and CHT was held on 25th October 2016 in New Delhi for collection of more data and to understand the present scenario of the used oil recycling business.

A group from OMCs & CHT visited Bengaluru on 18th November 2016 for interaction and study of the KarRecycle Centre LLP, which is the first SPCB authorized collection centre of used lube oil in India.

The sub-group has also held 3 meetings, one at CHT on 30th June, 2016 and the other two in Mumbai on 12th & 25th November 2016.

The draft report was further discussed with the representatives of PRAI at Mumbai on 30th Dec, 2016. Subsequently PRAI has sent their comments on Recommendations along with financial issues post GST vide letter dated 17th Jan, 2017.

The report has been presented in various chapters as under;

1. **Base Oil Manufacturing Process:** This chapter describes the historical perspective on changing technologies in refineries used for producing Lube Oil Base Stock (LOBS), API classification for LOBS and the reasons for shift in quality from Gr-1 to Gr-II/ III.

2. **Base Oil supply-demand balance:** This chapter brings out LOBS supply demand in India

3. **Lubricants market in India with sector-wise breakup and recyclability:** This chapter discusses market segmentation and recyclability potential from used from various sectors. The total lubricant market in 2015-16 was 2.8 MMT, including Process oils, white oils, transformer oils, grease etc., which are used in once through applications or mainly as Top Up. It is concluded that about 1.4 MMT is recyclable, of which we could aim recycle oil availability of ~ 1.0 MMTPA, based on best case scenario, prevalent in any of the country outside.

4. Current practice/ regulations for disposal/ reclamation of used oil in India

5. Technology employed in reclamation of used oil
6. Summary: Recycler Survey
7. **Issues in reclamation of oil:** This chapter discusses various issues in reclamation and need for hydroprocessing for production of re-refined base oil, particularly needed for automotive application keeping with present day advances in vehicle technology
8. International practice for used Oil reclamation
9. Proposed model for used oil collection
10. New Developments
11. **Recommendations**

3rd meeting of the working group was held on 8th May, 2017 at MoP&NG under the chairmanship of Joint Secretary (Refineries) to deliberate and finalise the recommendations (copy of MoM attached). Accordingly, Meeting was held with Lube group of OMCs, IOC R&D centre and representatives of PRAI on 1st June at Mumbai to finalise the report.

2. Base Oil Manufacturing Process

2.0 What is Lube Oil?

Base Oil is the name given to lubrication grade oils initially produced from refining crude oil (mineral base oil) or through chemical synthesis (synthetic base oil). Base oil is typically defined as oil with a boiling point range between 285 and 565^0C, consisting of hydrocarbons with 18 to 40 carbon atoms. Base Oils are complex mixture of hydrocarbons (paraffins, aromatics and napthenes) and comprised of Carbon, hydrogen and hetero atoms such as Oxygen, Nitrogen and Sulfur.

The specifications of various base oils are primarily governed by API base oil specification covering composition parameters (saturates and sulfur) and Viscosity index. The other physico-chemical properties of base oils are defined based on the end application of the particular base oil e.g., base oil suitable for engine oil application includes: Colour, Kinematic viscosities, Viscosity Index, flash point, pour point, CCR, Noack volatility, Saturates, Sulfur; base oil suitable for turbine / hydraulic oils: Colour, Kinematic viscosities, Viscosity index, flash point, pour point, CCR, Demulsibility, Air Release Value, Saturates, Sulfur (Demulsibility & Air Release Value included in place of Noack Volatility). So, base oil manufacturers provide specifications of their base oils in such a way that it comprises more properties for wider acceptance.

Each Base Oil receives a number which is loosely based on its kinematic viscosity in SUS @ 100^0F. The higher the number means the given base oil is more viscous. The term "N" refers to the word "Neutral" and is a throwback to the early days of refining when residual acidity from the process had to be neutralized. The refinery manufacturers a variety of lubricant base oils with different viscosities depending upon the process configuration and feedstock characteristics. Commonly, the refineries produce the following base oils under various API categories:

API Group I Base Oils: 70N, 100N, 150N, 500N, 850N and Bright Neutral
API Group II Base Oils: 60N, 70N, 100N, 150N, 350N, 500N, 650N
API Group III Base Oils: 65N, 100N, 325N

The lubricant blender's usage combination of base oils to manufacturer desired grade of lubricants. Most commonly used viscosity classifications for various grades of automotive and industrial lubricants are governed by different standards

The actual composition of Base Oils is influenced by the refining processes used for manufacturing of base oil. API group I base oils are produced by using conventional refining processes and also termed as Solvent Refined Base Oils. API Group II and III base

oils are produced by unconventional processes such as hydrocracking, hydrotreating, iso-dewaxing etc. API Group II and III base oils are cleaner as compare Group I base oils.

Gr-II plus Base Stock exhibits wide temperature operability (improved thermal stability), excellent oxidation stability, lower volatility, improved environment friendliness, and better performance and more reliable service. There is market shift from Gr I to Gr II Plus Base Stock and future specs of lubricants being set based on Group II and higher quality base oils.

LOBS quality
API Classification

	Grade-I	Grade-II	Grade-III
Saturates %	<90	>90	>90
Sulphur % wt.	>0.03	<0.03	<0.03
VI	80-120	80-120	>120

Grade-IV - Poly Alpha olefin

Grade-V - Which does not fall in above

2.1 Additives

Many years ago, it was not uncommon for lube base oil to be used directly as lubricating oil. But over the years, the demands imposed by modern high performance engines have led to new formulas that require supplemental chemicals to be added to the base oil. That's why today, lubricating oil is made up of different chemical additives that improve the performance of the lubricant. Thus, Lubricants comprise of Lube Oil Base Stocks (LOBS) and chemical additives, which improve its performance w.r.t. extending the operating temperature range (help the oil maintain its lubricating quality at very high or low temperatures), reducing deposit formation and keeping solids in suspension. Some of the additives help to bond to water molecules to prevent the formation of rust.

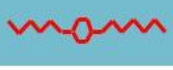
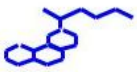
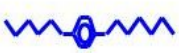
Types of Additives

Antioxidant	**Dispersants**
Extreme Pressure	**Friction Reducers**
Detergents	**Corrosion Inhibitor**
Antiwear	**Viscosity Index Improvers**

The additives may vary from 10-15% in automotive lubricants to 0-5% in industrial lubricants.

Transformer Oil, Process oils, White oils are not additised & certain industrial oils are sparsely additised.

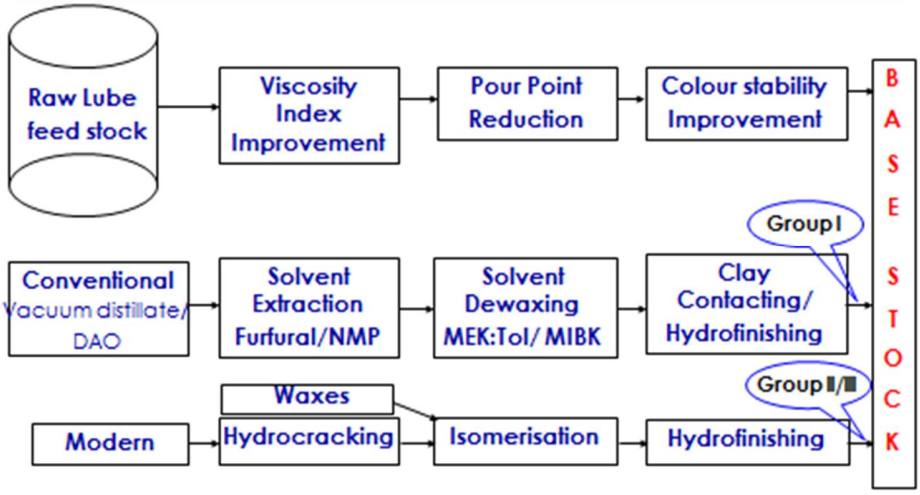
Chemistry in Lube Refining

Chemical Type	Structure	VI	Pour	Oxidation	Toxicity
n-Paraffin (Wax)		Very High ~175	Solid @50°C	Excellent	Low
iso-Paraffins with Branched chains		High ~150	Good	Excellent	Low
iso-Paraffins with highly branched chains (PAO's)		Good ~130	Good	Excellent	Low
cyclo-Paraffin-single ring with long chains		Good ~130	Good	Good	Low
Naphthenes, polycondensed		Poor ~60	Good	Medium	Low
Monoaromatics, long chains		Poor ~60	Good	Medium	Medium
Polyaromatics		Very Poor <0	Good	Very Poor	Very High

2.2 Virgin Base Stock Manufacturing Technology used in Refinery

The conventional process was based on solvent extraction process to extract aromatics (to improve Viscosity Index), extract waxes (to improve flow properties- pour point reduction) followed by and clay contacting / Hydrofinishing (to improve colour stability). The conventional process route is based on "subtraction" therefore the yields are low. It also has the disadvantage that only Gr-I base stocks can be produced. Further the process requires processing of lube bearing crude oils. On the contrary, modern processes follow conversion route, wherein hydrocaracker bottom/ waxes are isomerized to convert paraffins to iso-paraffins, which have excellent flow properties. Thus the yields are higher and the processes are crude independent.

Base Stock Manufacturing Technology

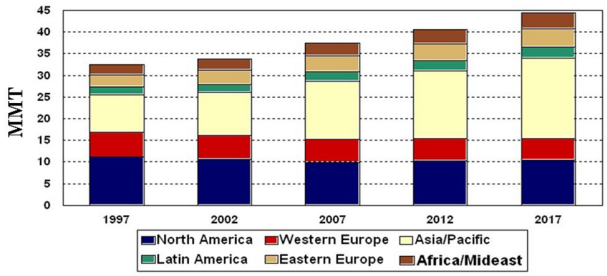


- Conventional Process produces Group-I, has low yield & requires processing of Lube bearing crude oils
- Modern Process produces Group-II/III, has high yield & crude type independent

3. Base Oil supply-demand balance

World Lube Market: Region wise

WORLD LUBRICANT DEMAND BY MARKET, 2017 (39.1 MMT)



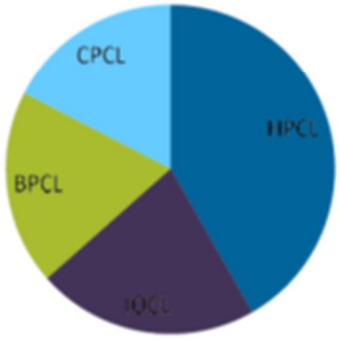
Source: The Freedonia Group, Inc.

- With advancement in engine design and improvement in quality of lube oils, the drains intervals have been prolonged substantially.
- Strong demand for high-performance, long-lasting, high-quality lubricants in developed countries
- Adoption of stringent environmental and health regulations
- The mature lubricant markets of North America and Western Europe are fairly stagnant
- Western Europe is expected to continue a gradual decline in demand
- Growth expected in Asia Pacific and Africa / Middle East regions

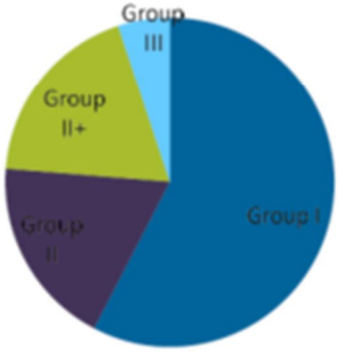
In the country, there are 4 refineries producing LOBS with total capacity of 1.16 MMTPA (475 TPA Gr-I and 685 TPA Gr-II/III) in addition to 0.2 MMTPA of process oils, which are used as once through application. The naphthenic Base oils with very low pour point (-40^{o}C) are used for transformer and refrigeration oils and are mostly imported. White oils, used in application like cosmetic, pharmaceuticals, hair oils, etc. are also mostly imported

Lube base Oil Manufacturing capacity in India

Lubricant Basestock Production Capacity by Refiner, 2015



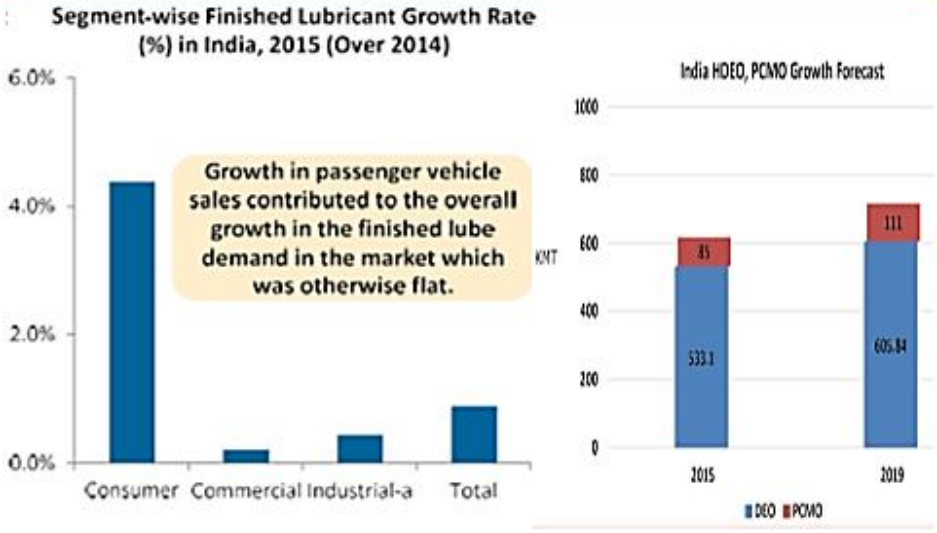
Lubricant Basestock Production Capacity by API Groups, 2015



Lube base Oil Manufacturing capacity

Company	Base Oil, TMTPA		Extract, TMTPA
	Group I	Group II/ III	
IOCL- Haldia	0	180	
CPCL, Chennai	220	-	60
HPCL, Mumbai	255	225	120
BPCL, Mumbai	-	280	-
Total	475	685	180

Lubricant Growth Rate India



Note: Industrial Oils include process Oils

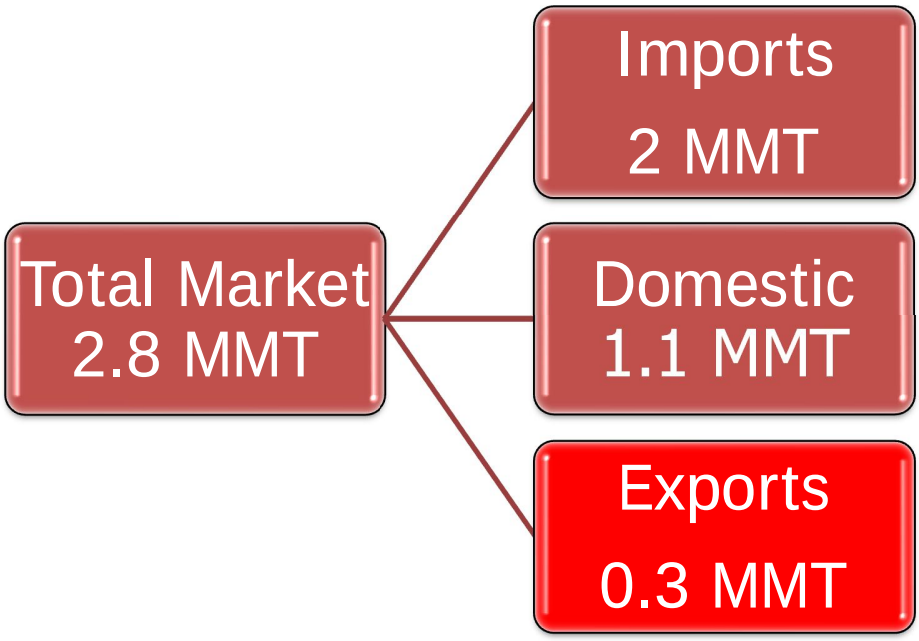


Fig: Base Oil Supply Demand (2015-16)

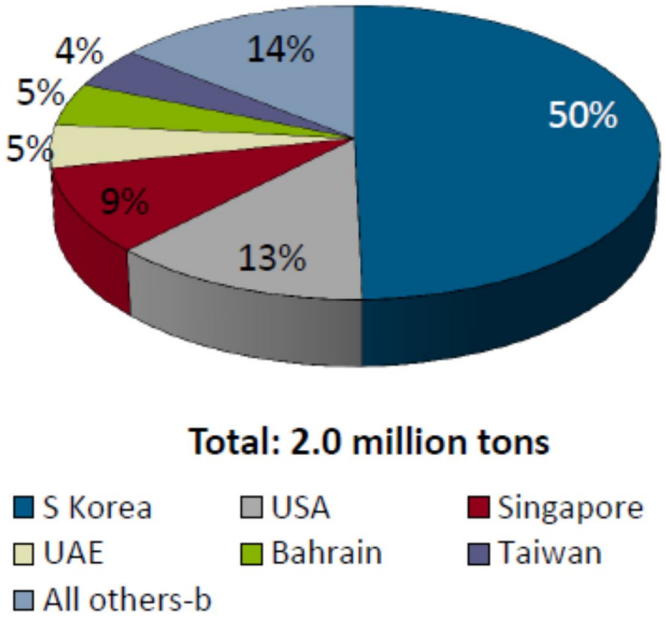
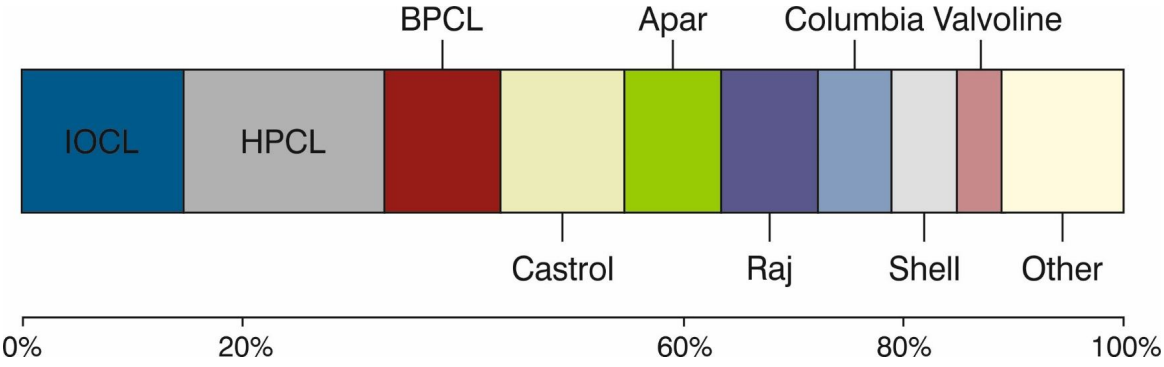
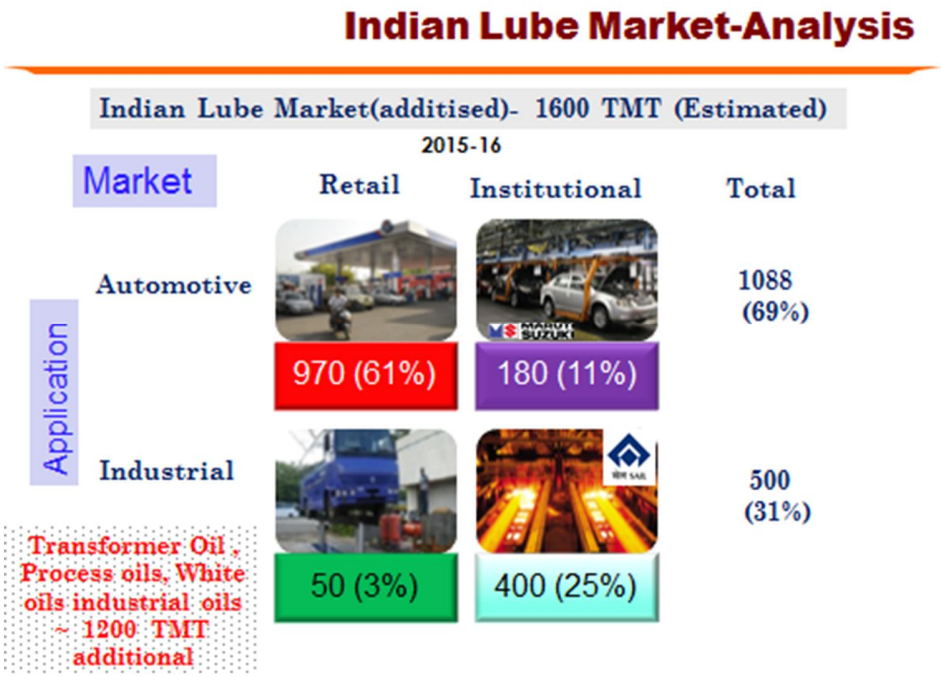


Fig: Base oil Import country wise (2015-16)

4. Lubricants market in India with sector-wise breakup and Recyclability

India's lubricant market is estimated to be about 1.6 MMTPA (excluding process oils, transformer oils and white oils). Until 1993, it was a highly regulated with a clear dominance of the Public Sector Companies. In recent years, with the advent of the increasing number of multinationals in the Indian market there is a growing presence of private companies. Companies like Exxon-Mobil, Castrol, Elf Total-Fina, Gulf, and Shell Oil have made their presence felt in the market making Indian Lubricant market very competitive. PSU Companies like IOCL, BPCL and HPCL hold ~ 38 % of the market share. The market share of major players of Indian lubricant market is given under (Sept., 2013);





Institutional lubricant Market

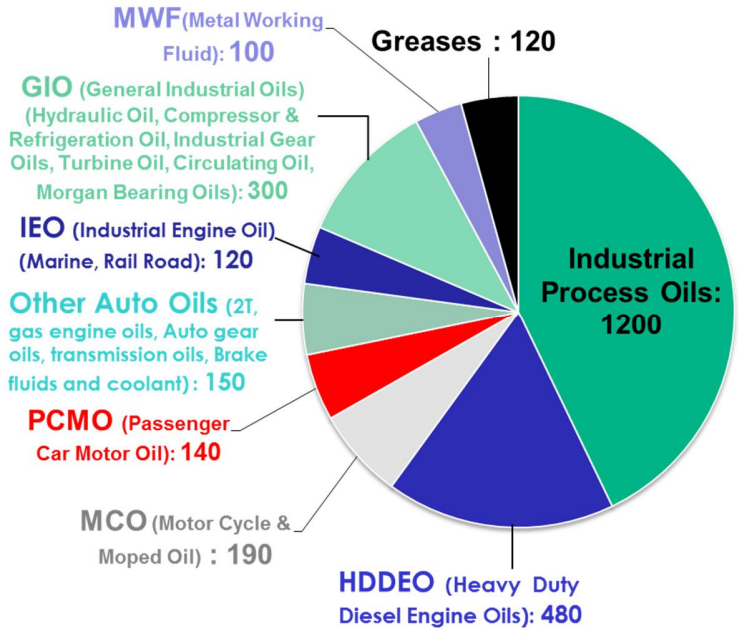
Industrial

1. Steel & related industries
2. Cement
3. Power generation
4. Railways
5. Defence
6. Mining
7. Infrastructure including construction & roads
8. Fertilizer
9. Rubber
10. Automotive

Market Segmentation

Figs in TMT

Total Domestic Market: 2.8 MMTPA



Industrial Process Oils:
RPO – 200
TO – 450
Others - 550
(White Oils, Petroleum Jelly, Ink Oils etc)

Recyclable Lube Oil from various segments

4.2.1 PO – Process Oils: 1200 TMT (Recyclable: 225)

Process Oil / white oils and greases used as once through. Transformer Oils may be recycled 3-4 times after simple treatment of removal of moisture and polar components, which are generated during its usage and follow separate recycling path.

- **Transformer Oil (450 TMT)**: As these are mostly topped up, some can be considered as recyclable (estimated at about 50%). BIS has set-up a sub-committee to bring out standard for re-refined transformer oil
- **White oils and Rubber process oils (750 TMT):** Used in final product and do not come back and hence not recyclable

4.2.2 HDDEO & PCMO & MCO: 810 TMT (Totally Recyclable)

This segment represents majority of oils which can be entirely recycled. However, out of 810 TMT, only 61 TMT is of group-I type. Rest 749 TMT is of Gr-II/ III quality, which require hydroprocessing.

Category	Base Oil	Total	Recyclability
HDMO			
Low SAPS	Group II	3	
CI4	Group II	52	
CF-4	Group II	203	
CH-4	Group II	161	
CF & below	Group I/Group II	61	
Total HDMO		**480**	**480**
PCMO	Group II/III	140	**140**
MCO	Group II/III	190	**190**
Total		810	**810**

4.2.3 IEO: 120 TMT (Recyclable: NIL)

- Only 4 stroke marine oils & Rail Road Engine Oils are collectable
  - Collection of used marine oils is an issue
  - Railways already approached by PRAI Members

4.2.4 Other Auto Oils: 150 TMT (Recyclable: 50)

- About 100 TMT is two stroke oils. Declining and once thru application.
- Balance comprises gas engine oils, automotive gear oils, auto transmission oils, brake fluids & coolants

4.2.5 GIO: 300 TMT (Recyclable: 300)

- Mostly used by large core sectors – SAIL, CIL, L&T, TATA, BIRLA, Reliance, etc.
- PRAI members have tie-up with major corporates as all are having ISO 14001, OHSAS 180001

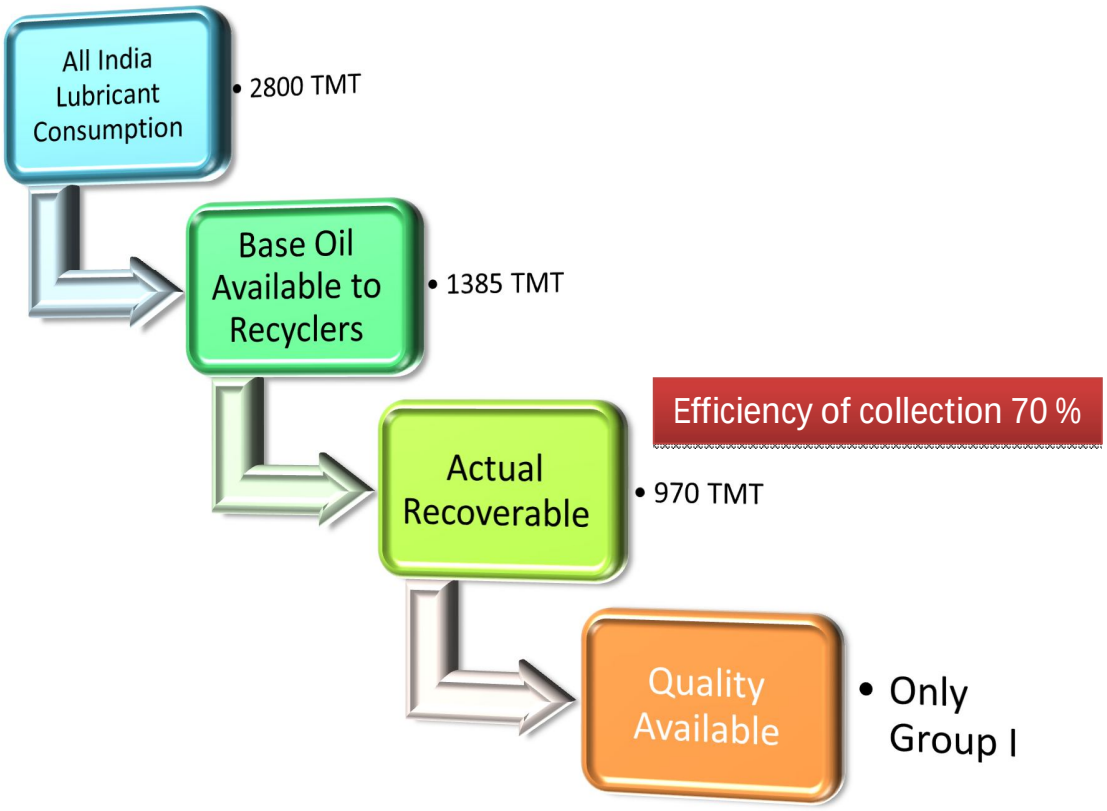
4.2.6 Metal Working Fluid or MWF:100 TMT (Recyclable: NIL)

- Highly segmented & categorized and difficult to recycle using process available with PRAI members

Summary of recyclability

Category	Quantity	Base Oil Recoverable				
		Group I	Group II	Group III	Naphthenic	Total
Process Oil/ Transformer Oil	1200	0	145	0	80	225
HDDEO, PCMO, MCO	810	61	719	30		810
IEO	120					0
Other Auto	150	50				50
GIO	300	150	150			300
MWF	100					0
Grease	120					0
TOTAL	**2800**	**261**	**1014**	**30**	**80**	**1385**

Of the 1.4 MMT recyclable oil, 70% i.e. 1.0 MMT could be considered for recycling, based on successful best example of France, where 75% used oils are recovered. Whereas, the market has shifted from Gr-I to Gr-II/ III grade, the recyclers possess non hydro-processing based technologies, which can only produce Gr-I grade of oils, not suitable for engine oils, which is the major segment with potential for recycling. Therefore, recycled oil with presently available technologies, can be used for low end applications only, like Metal Working fluids and Industrial Oil / Shuttering Oil, hydraulic, gear oil / automotive & industrial lubricants and general purpose lubricants, light load greases.


All India Lubricant Consumption
• 2800 TMT
Base Oil Available to Recyclers
• 1385 TMT
Efficiency of collection 70 %
Actual Recoverable
• 970 TMT
Quality Available
• Only Group I

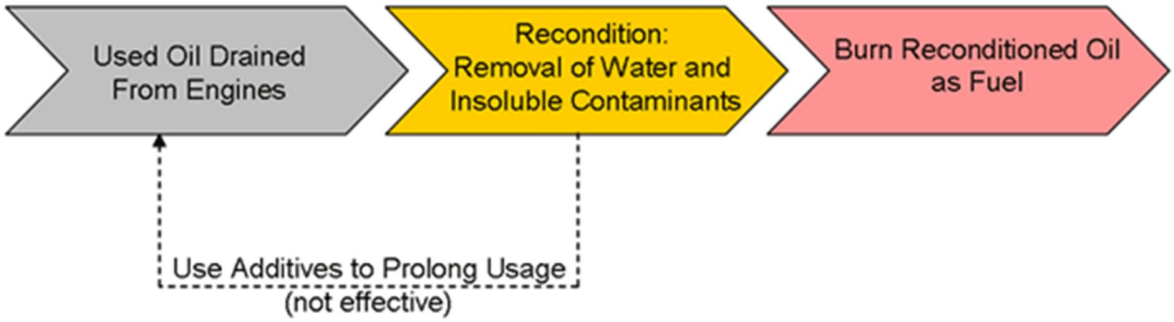
5. Benefits of Re-refining and Current practice/ regulations for disposal/ reclamation of used oil in India

5.1 Why Re-refining

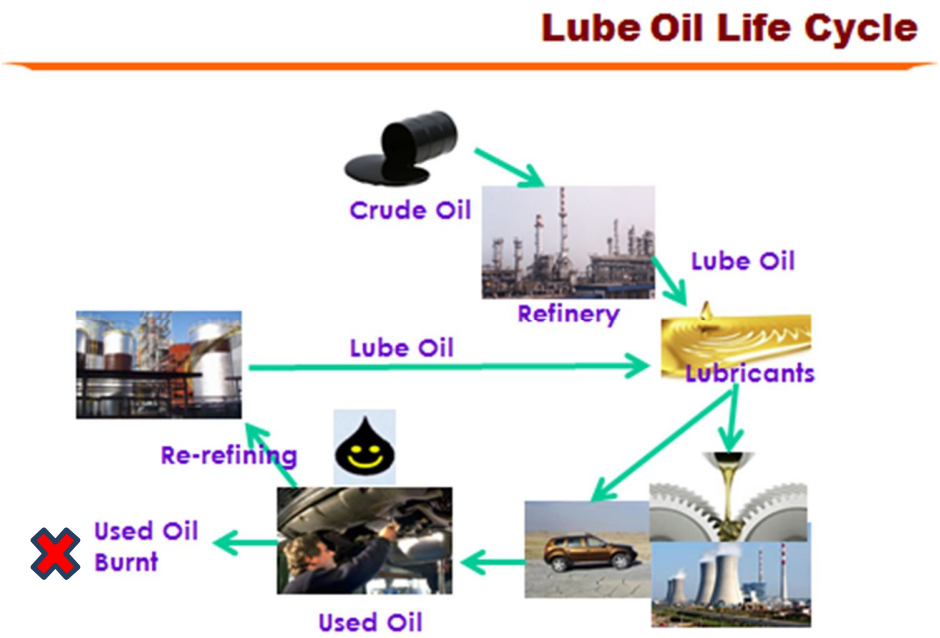
As the lubricating oil is used in an engine, the additives break down, and the oil becomes contaminated by components such as carbon and fuel. Eventually oil is changed to make sure that the lubricant has the capability to continuously protect the engine.

However, the base oil component of the used oil is still valuable. The challenge is to remove the contaminants and recover and purify the lube base oil. A generation ago, this wasn't easy to do; therefore major industries used this oil as energy source for boiler/ furnaces. The used oil was processed to remove water and particulates so that it can be burned as fuel to generate heat or to power industrial operations. It is not a preferred form of recycling now, because it enables the oil to be reused only once and the value of the oil is lost.

In the lube oil industry, the term "recycling" is very different from "re-refining." The term "recycling" generally means to use it for a different purpose, most commonly to be burnt as fuel. In the lube oil industry, "reconditioning oil" is most commonly referred to using commercial filtration systems to remove insoluble impurities. This method, however, does not remove any of the soluble contaminants. This form of recycling might not restore the oil to its original condition but it prolongs its life. In some cases, reconditioned oil is mixed with additives in order to prolong its usage. This is practised for Turbine/ hydraulic oils. Reconditioned oil is not suitable for use in automobiles.



Re-refining is a preferred option since the oil may be used for number of times. The key is – base oil does not wear out; it can be recycled over and over again - Resource Conservation. Today, many technologies are available to accomplish this task consistently and reliably.



5.2 Benefits of recycling

Utilizing Used oil as a boiler fuel, releases harmful emissions, and the possibility of using the used oil again is lost. Burning used oil as a boiler fuel potentially releases the following into the atmosphere:

- Polycyclic Aromatic Hydrocarbons (PAHs).
- Nitrogen Oxides (NOx).
- Sulfur Dioxide (SO2) emissions which are a precursor to acid rain and atmospheric particulates.
- Chlorinated organics, heavy metals and organic compounds such as PCB's and dioxins.
- Heavy metal emissions from burning used oil

Re-refining has been developed over many years. It removes all impurities, both soluble and insoluble, and returns the oil to a quality suitable for automobiles. Re-refined oil has quality that is equal to or better than some virgin base oils. In fact, when re-refining using hydrotreating process, the product base oil can meet API group II specifications. In addition, the re-refining process is less severe than the refining of crude oil and uses less energy.

Re-refining is a strong economic incentive for environment protection and energy saving.

- Environment Protection & Petroleum conservation
- Re-refining is energy efficient as the energy consumption is lower than for virgin base oil production
- High quality products
- Strategic as dependence on imported oil/ LOBS is reduced
- Provides direct and indirect employment.

5.3 Re-Refined Oil Quality

Technological advancements for re-refining used oil since the mid-1990's, have resulted in superior quality base oils and lubricants in the market today that can meet the most stringent standards for automotive engine oil specifications.

Re-refined base oils meet the American Petroleum Institute (API) and Society of Automotive Engineers (SAE) specifications, and they are equivalent to the performance standards of base oils produced from crude oil.

The International Lubricant Standardization and Approval Committee (ILSAC) and the American Petroleum Institute (API) have both certified that re-refined motor oil is approved for use by most major auto manufacturers and will not void engine or transmission warranties.

5.4 Re-refining of Motor Oils

Used Motor Oils (after completing its service life) include Vehicle Crankcase Oil, Engine Lubricating Oil, Transmission Fluids and Gearbox Oils. These used oils need to undergo an extensive re-refining process to remove contaminants such as dirt, fuel, water, oxidized products and degraded additives to produce as good as new base oil, as there can be no compromise in the quality of re-refined oil.

5.5 Re-Refining of Industrial Oils

The various types of industrial oils are Hydraulic oils, Compressor oils, Turbine oils, Bearing oils, Gear oils, etc. Being in large quantity, available at single site, steps are taken to extend life by reconditioning, however, after end of the life these must be recycled.

5.6 Transformer Oil

These oils follow separate recycling path to evaporate moisture followed by simple filtration to get relatively clean products after which they are also mostly topped up.

Used Oil Contaminants

Contaminant	Hazards	Source
Lead	Metal fatigue	Gasoline, Bearings
PNAs/PAHs	Carcinogenic	Combustion
Metals (Zn, Cd, Cr, Ni, Cu, As, etc.)	Toxic	Additives& Engine Wear
Halogenated Cleaning solvents	Flammable	Solvents
Polychlorinated biphenyls (PCBs)	Toxic	Insulating Oils
Particulates	Breathing Problem	Combustion sediments

Components	Wt% (approx)
Water	5-9
Light ends	2-4
Gas oil	4-7
Base oil	75-64
Residue	13-17

5.7 Current framework in India for Re-refining of used lubricating oils

MoEF, New Delhi has categorized used lubricating oil as hazardous product and to be handled/ disposed off as per HW Rules. Specifications for used oils suitable for Re-refining/Recycling in India are listed as below [Notified in hazardous waste (Management and Handling) Amendment Rules 2003, Schedule 5 & 6]

As per the last survey CPCB of 2010, which is the only authentic source of available data, there are about 400 authorized recycler, licensed by CBCB/ SBCB, with combined capacity of 1.23 MMTPA. There may be equal number of unauthorized collector/ recyclers, with unknown capacity. Recyclers mostly have small capacity of 360 to 10,000 KLPA with only 7 having capacity between 10,000 to 20,000 KLPA and none with large capacity of more than 20,000 KLPA. These recyclers are distributed across 124 districts spread over 19 states. More over, very few are serious & active. Recyclers have primitive technology comprising of filtration & distillation and none have hydroprocessing, essential for base oil

for engine oil application due to lack of hydrogen treatment facility with indian Re-refiners. As per CPCB, about 781 KLPA of used oil was generated in the country.

Unauthorized recyclers avoid paper work and paying taxes and thus are able to pay higher for the used oil. This also leads to very low capacity utilization of authorized recycler of only 10-15%. This is posing challenges to this industry, as they get oil only from big users.

In India, the used oil can be used as fuel in furnace for energy recovery, if it meets the specifications laid down in Part B of Schedule V of Hazardous Wastes Rules 2008 either as such or after reprocessing. The Government of India has provided the specifications of waste oils under The HW (Management, Handling and Trans boundary Movement) Rules, 2008 Schedule V [Rule 3(ze) and (zf)] Part A (Table 1) & Part B (Table 2)

Specifications of fuel derived from used/waste oil

S. No	Parameter	Maximum Permissible Limits
1	Sediment	0.25%
2	Lead	1000 ppm
3	Arsenic	5 ppm
4	Cd+Cr+Ni	500 ppm
5	PAH	6%
6	Total halogens	4000 ppm
7	PCBs	<2 ppm
8	Sulfur	4.5% wt
9	Water Content	1%

According to the rules, any waste oil which does not meet the above mentioned specification has to be incinerated or can be put to cement kilns. In order to derive value from Used Oils, it is proposed as under;

1. Separate sub-rules may be made for used oils under Hazardous Waste Rules
2. Re-refining of used oils may be made mandatory and bottoms after re-refining may be allowed to be incinerated or used as fuels for cement/ brick kilns.
3. The specification for used oil suitable for re-refining is already available, under schedule-5. Further, separate specification for re-refined oil is not required as these have to necessarily meet specification of virgin oils.

Specs for used oil suitable for Rerefining (Schedule-5)

S. No	Parameters	Maximum permissible limit
1.	Colour hazen units	8
2.	Water	15%
3.	Density	0.85-0.95
4.	Kin. Viscosity	1.0-32.0 (cSt @ 100 ^{0}C)
5.	Diluents	15% vol
6.	Neutralization No.	3.5 (mg KOH/g)
7.	Saponification value	18(mg KOH/g)
8.	Total halogens	4000, ppm
9.	PCBs	ND
10.	Lead	100, ppm
11.	Arsenic	5 ppm
12.	(Cd + Cr + Ni)	500 ppm
13.	Polyaromatic Hydrocarbons (PAH)	6% (v/v)

Specs for waste oil suitable for Recycling (Schedule-6)

S. No.	Parameters	Maximum permissible limit
1.	Sediment	5%
2.	Heavy metals, (Cd + Cr + Ni + As +Pb)	605 ppm
3.	Polyaromatic Hydrocarbons (PAH	6% (v/v)
4.	Total Halogens	4000
5.	Polychlorinatedbiphenyls (PCBs)	ND

Waste oil: Unsuitable for re-refining, but can be used as fuel in furnaces, if meets specifications laid down in Schedule-6

Current Practice

Hazardous Waste generated in India – 6.23 MMT by 36165 industries
As per first National Inventory prepared by CPCB in Feb 2009

- Recyclable waste 49.55%
- Land Disposable waste 43.78%
- Incinerable waste 6.67%

Spent Oil
45% of Recyclable Waste
1674139 KLA ~ 1.39 MMT

- Used Oil 46.67% ~781.279 KLA
- Waste Oil 53.33% ~902.86 KLA

Details	Definition
Used Oil	Oil derived from crude oil or mixtures containing synthetic oil including used engine oil, gear oil, hydraulic oil, turbine oil, compressor oil, industrial gear oil, heat transfer oil, transformer oil etc.
Waste Oil	Oil which includes spills of crude oil, emulsions, tank bottom sludge and slop oil generated from petroleum refineries installations or ships

Ref: Selvi etal, Procedia Environmental Sciences, 18(2013), 742-755 – Paper of CPCB

Recycling Units in India

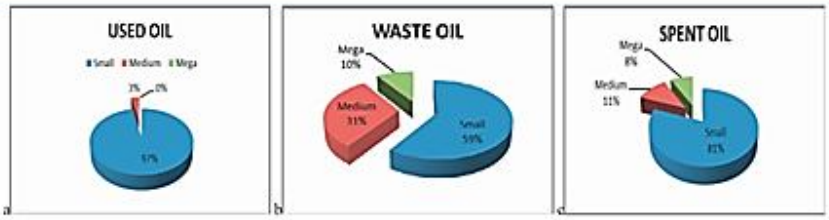


Fig. 4. Distribution of Small, Medium and Mega units with reference to Used, Waste and Spent Oil Reprocessors.

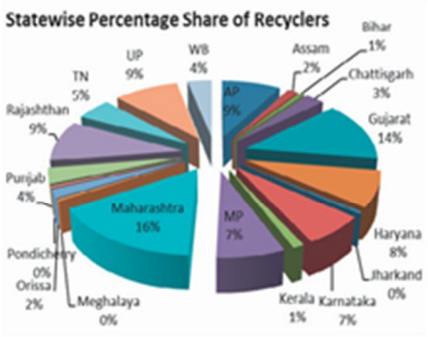
Table 5. Classification of recycling units based on their Capacities.

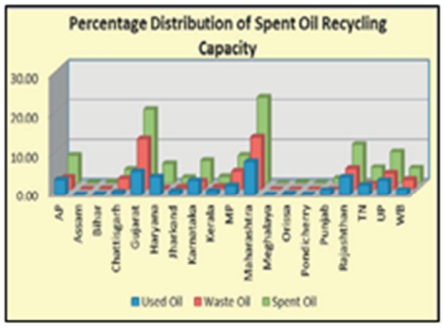
Oil type	Range of Used Oil Recycling Capacity			Remarks
	Small ≥ 360 to ≤ 10000 KLA	Medium ≥ 10000 to ≤ 20000 KLA	Mega ≥ 20000 to ≤ 60000 KLA	
Used Oil	216	7	Nil	No used oil recycling units belonging to large category i.e. > 20,000KLA
Waste oil	56	29	9	No Waste Oil Units in Meghalaya, Orissa, Pondicherry, Punjab

Small recyclers are more

Ref: Selvi etal, Procedia Environmental Sciences, 18(2013), 742-755 – Paper of CPCB

Recycling Units in India





257 spent oil registered recycling facilities distributed across 124 districts spread over 19 states

Ref: Selvi etal, Procedia Environmental Sciences, 18(2013), 742-755 – Paper of CPCB

6. Technology employed in rerefining of used oil

Used oil re-refining is the process of restoring used oil to new oil by removing chemical impurities, heavy metals and dirt. The technologies used for oil reclamation are fairly established and have evolved over a period of time.

Among the technologies licensed for used oil, acids and acid clay based technologies are on way out as they are not environmental friendly processes, Clay treatment generate significant amounts of residues, such as sludge from sedimentation, acid tars, filter cake from bleaching earth and wastewaters, which contained high concentration heavy metals or sulfuric acid. This process is therefore not considered environment friendly and not permitted any more, besides the quality of reclaimed oil is very poor. Rest of the process based on vacuum distillation and extraction are established and many plants are being operated. In the recent past, clean membrane based processes have emerged which seems to be promising. But only few units have been commercialized and therefore require thorough assessment before selection.

6.1 Steps in Re-refining

- The first step in the re-refining processes, is to test the used oil to determine suitability for re-refining
- Waste Oils is pre-treated with a basic solution containing ammonium hydroxide and/ or potassium hydroxide for neutralization of undesirable compounds. After which it is dehydrated and the water distillate is treated before being released into the environment. Dehydrating also removes the residual light fuel that can be used to power the refinery, and additionally captures ethylene glycol for re-use in recycled antifreeze.
- Next, Water free oil is distilled under high vacuum in a thin film evaporator or vacuum distillation unit for separation of diesel fuel and materials such as residues, metals, additives, degradation products etc. are passed on to heavy asphalt flux system. Propane Deaspalting of total oil or heavy oil left after vacuum distillation may be employed for production of bright stocks leaving pitch for disposal.
- The lube cut next undergoes Filtering using earth treatment. In the modern processes, hydro treating, or catalytic hydrogenation is used to remove residual polymers and other chemical compounds, and saturate carbon chains with hydrogen for greater stability. The main target of virgin base oil hydro-treatment is controlling its color stability. Therefore, polar (oxygen-containing, unsaturated, etc.) compounds which produce the brown color in lube oil and also make this color unstable, are eliminated

by low temperature – low intensity hydrogenation. Under severe hydro-treating conditions, organic acids, chlorine, sulfur or nitrogen, metals (and metalloids) compounds are reduced/ removed. Also, a lot of the aromatics and other unsaturates, which were not eliminated by previous steps, are saturated to an acceptable low level. Hydrotreating enables production of Group-II plus oil.

- Finally, oil separation or fractionating, separates the oil into three different oil grades: Light viscosity lubricants suitable for general lubricant applications, low viscosity lubricants for automotive and industrial applications, and high viscosity lubricants for heavy-duty applications. The oil that is produced in this step is referred to as re-refined base oil (RRBL).

- The final step is blending additives into these three grades of oil products to produce final products with the right detergent and anti-friction qualities.

6.2 Hydrogenation based Technologies

The current advancement and quality requirement in automotive lubricants, in particular, requires final hydrotreating step, which is capital intensive requiring high pressure unit in hydrogen environment, similar to as practised by Petroleum refiners during production of virgin LOBS.

In this process, the pretreated feedstock as above is hydrotreated, in a similar process employed in a petroleum refinery. Under more severe conditions; nitrogen and sulfur are eliminated as NH3 and H2S and aromatics are saturated. This process has many advantages: Production of a high Viscosity Index lube oil with a good and stable color and well oxidation resistance; yet having low or no discards. At the same time, it consumes bad quality feed. Another important aspect of this method is that all of its hydrocarbon products have good applications. In other words, the product recovery is high with or very low disposals. Other hydrocarbon products are Light & Gas oil.

The operating conditions

Temperature: 250 – 370^{o} C
Pressure: 60-73 bar (gauge)
Liquid Hourly Space Velocity: 1 – 2.3
H_2 purity: 70 % mole (min.)

6.3 Membrane Ultra-Filtration Technology

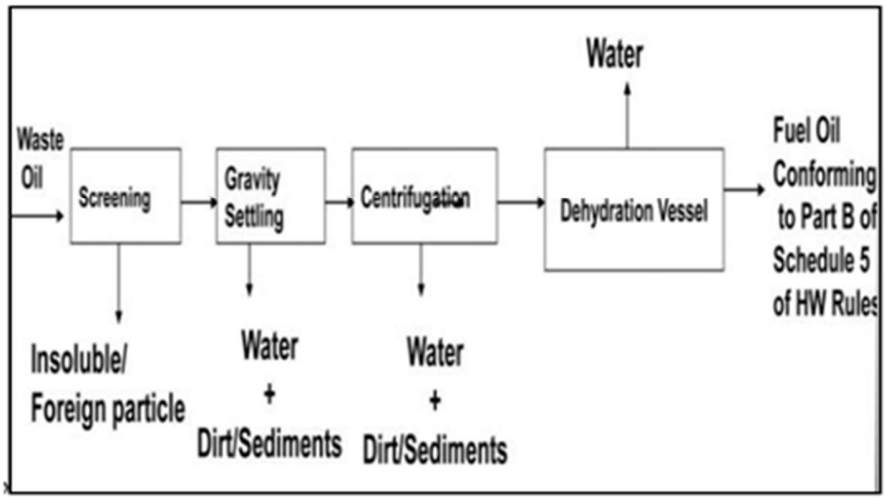
It is a much cleaner and energy efficient re-refining technology. The process is based on ultrafiltration of waste oils using efficient membrane. The technology includes centrifugation of waste oil at low temperatures to eliminate water and large size deposit and pre-distillation, for water and solvent removing. Pre-treated oil is treated by chemicals for quality improvement and transferred to a fractionating column where gas oil is separated.

MemPore has developed nano membrane technology to clean and repurpose used lubricating oil. MemPore's Patented Membrane Nano Filtration Technology does used oil refining and claims at the lowest overall production and investment cost. There are few units based on membrane technology is increasingly being adopted as it is not only environmental friendly but less energy intensive compared to the other technologies available. Membrane technology "VMAT " is now becoming the energy efficient standard among the oil recycling industry; installations have been setup in Indonesia, Mongolia, Beijing, Hong Kong and more will be setup in Southern China Europe and South Africa. Membrabe based technologies are also anvil, bur needs commercial experience.

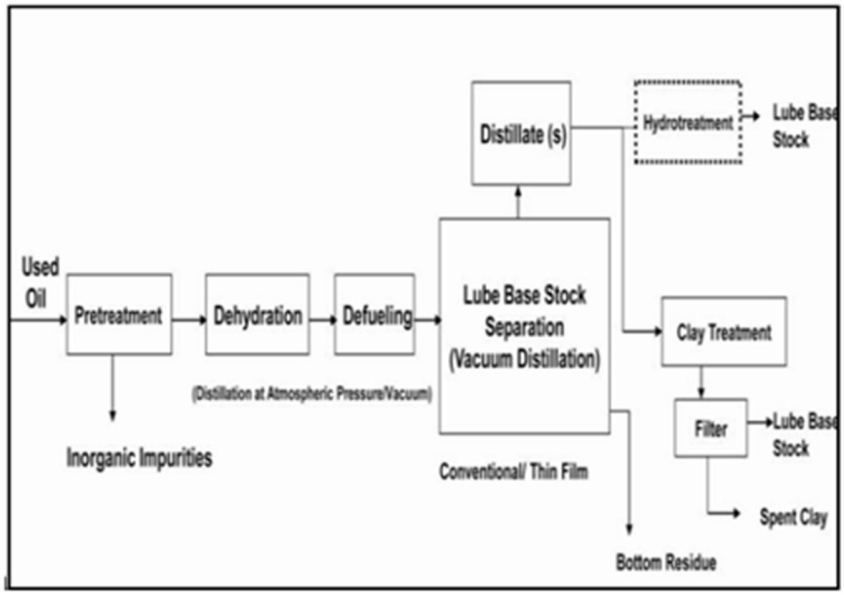
6.4 Following re-refining technologies are only approved by MoEF as being more environment friendly:

- Vacuum distillation followed by Clay treatment.
- Vacuum distillation followed by Hydrotreating.
- Thin film evaporation process
- Any other technology approved by MoEF.

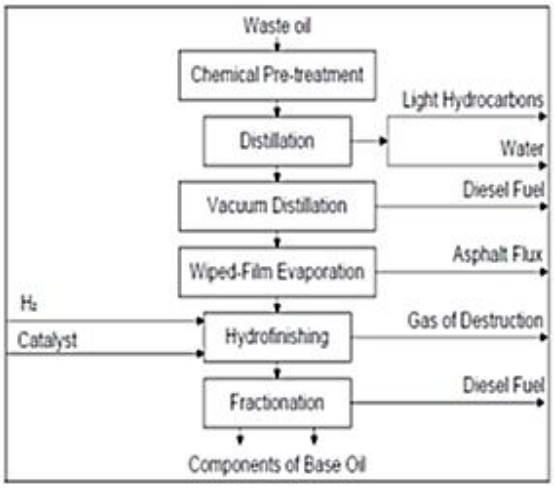
Generic Schemes for Used & Waste Oils Recycle



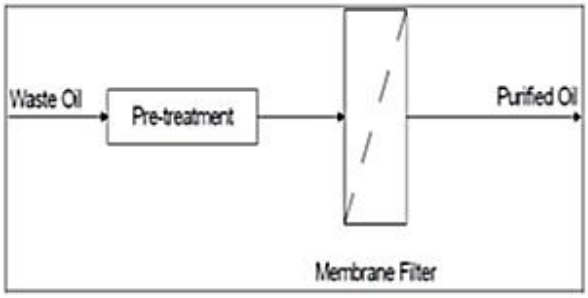
Generic Schemes for Used & Waste Oils Recycle



Technology adopted In USA
MOHAWK



Membrane Technology used by
Bengaluru Rerefiner



Used Oil Re-refining Technologies

Process	Pretreat	Refining	Finishing
Acid-clay (phased out	Settling, Decantation & Dehydration	Acid Treatment and Sludge Separation	Clay treatment and Fuel removal
IFP	Dehydration and Defueling	Propane extraction and Acid Treating	Clay contacting
IFP- SNAM PROGRETTI	Dehydration and Defueling	Propane extraction & Vacuum distillation	Hydrotreating
INTERLINE	Dehydration and defueling	Propane extraction & Vacuum distillation	Clay treating
KTI	Dehydration and Defueling	Vacuum distillation/ Thin Film Evaporation	Hydrofinishing
SAFETYKLEEN MOHWAK	Chemical treatment/ Distillation	Vacuum distillation/ Thin Film Evaporation	Hydrofinishing
VISCOLUBE IFP	Dehydration and Fuel removal	Deasphalting/ Vacuum Distillation	hydrotreating
CEP	Dehydration and Fuel removal	Thin Film Evaporation with internal condenser	Hydrofinishing

7 Joint Survey of Pre-processors: Summary Findings

The survey has been carried out for a sample of 25 recyclers, licensed by CPCB/ SPCB. The survey included 8 Nos of recyclers visited by the team comprising of OMCs and from the rest data was collected through questionnaire during consultative conference held on 25th November in New Delhi. The Questionnaire and the survey reports are attached.

The following the summary of 25 plants surveyed;

- **Capacity Utilisation**: Almost all plants are highly underutilised and running at 15 to 20% capacity. Capacity wise brake up of data.

Capacity Range, KLA	No of Plants
< 500	4
1000 to 1500	4
1500 to 3000	7
5000 to 10000	7
10000 to 20000	3

- Most of the plants also operate waste Oil Recycling plant simultaneously.
- **Manpower:** Most of the plant employ around 12 to 15 persons few plant have 40 to 60 people.
- **Investment on Plant and Machinery:** average Rs 2 -3 crore with investment of Rs 7- 8 crore in some cases (excluding land).
- **Annual turnover:** Rs 2 -12 crore
- **Type of Used Oil**:-Mostly from industrial and automotive sector and used oil segregation is very rare.
- **Collection Mechanism**: Collection of used oil from garages/ kabadi walas /service centres etc. are though bazar trade and from big corporates through tenders. Through tender it is sold to registered re-refiner only, in bazar trade part of it goes as burning depending on the demand.
- **Base Oil Average Yield:** ~ 70%
- **Cost of Reprocessing:** Rs 8 - 9 per litre (in some cases Rs 3 - 4 per litre, where simple filtration employed)
- **Taxation on Used Oil:** 5 to 5.5% in most of the cases. In some cases full VAT 14.5% is also charged especially in PSU tenders.

- **Tax on Re-Refined Base Oil:** VAT @ 14.5%. In case of blending of lubricant, ED 14% is also applicable.
- **Margin for re-refiner (Rs per litre)**: Used oil purchase rates tend to vary with base oil prices as well as with LDO price.

	Current (May'17)	GST Rates	With GST
Used oil	24		24
Scrap Tax @5.5% *	1.32	18% GST	4.32
Used oil procurement cost	25.32		28.32
Cost of reprocessing (including yield loss)	8		8
Excise duty	0	GST credit	(4.32)
Cost of re-refined oil Ex Re-refiner	33.32		32
Sales Tax on re-refined oil @ 14.5%	4.83	GST 18%	5.76
Re-refined oil selling price	38.15		37.76
Possible Margin for re-refiner	5		6.24
Virgin base oil price	44		44
LDO	45		45

* Scrap tax (waste oil tax) is applied @5.5%, however in some States, waste oil is charged @14.5% as applicable to lube oil

- **Quality of Re-Refined Base Oil:** In most of the cases base oil produced is having viscosity in the range of 30 - 50 cst at 40 ^{o}C, GR-I, VI- 100 $\pm$ 10, yellowish colour, sulphur content not found in reports. In some cases cuts of 16/25/30/65 cst at 40^{o}C is taken.
- **End Use of Re-refined Base Oil**

  Metal Working fluids and Industrial Oil / Shuttering Oil, Local Lube Oil Manufacturers, small Industries /engine, hydraulic, gear oil/Small scale Lube producers / automotive & industrial lubricants and Greases, general purpose lubricants, light load greases. Sold in open trade etc., however, there is no monitoring mechanism for its end use

- **End use of By-products**
  - Light and heavy residues; Fuel Oils/Light end for fuel correction RFO / internally for burning fuel
  - Bottom (3%) for incineration, residue used world over as asphalt extender claimed in some reports.
- **Technology Used**: Out of 25 plants surveyed 10 nos had wide / thin film evaporation technology and 15 Vacuum distillation with clay treatment. The wiped film evaporation process comprises of used oils dehydration (heating 120^{0}C under vacuum)/ degassing/

passed through a wiped film evaporator, maintained at 305^0C and .01-.05 torr. The oil, falling by the sides, is wiped to form a thin film on internal condenser placed inside evaporator, unevaporated bottom residue, collected separately. Lube cut is bleached / polished for reclaimed oil.

- **Problems/ Expectations of Re-Refiners**
  - Availability of raw material at reasonable price
  - Higher tax rate: Lower VAT and ED exemption sought on recycled product
  - Technical competence of re-refiners to be checked
  - Alternative Utilization of bottom residue
  - Difficulty in selling Finished product : Marketing assistance for recycled base oils
  - Collection System: Suggested Channelization of Raw material through authorised Collection centres

8 Issues in re-refining of oil

8.1 Segregation of Used Oils

Used lube oil available from different industries like Automobile, Industrial oil etc. are quite different may be contaminated water, sludge, diluents, etc. Higher acidity (longer drain oil exposed to heat for more time); Higher contamination (on account of higher dosages of additives in latest generation oils) poses further challenge for recycling. The typical physicochemical properties of used and re-refined oils are given below;

Physicochemical Properties of Used Oils

Property or test	Motor oils	Industrial oils	Virgin motor oil (Average)
Viscosity, at 40°C, SUS	87 – 837 (15-180 cSt)	143 – 330	Up to 210 cSt
API gravity, at 15.6°C	19.1 – 31.3	25.7 – 26.2	25 on average
Specific gravity at 15.6°C	0.9396 – 0.8692	0.9002 to 0.8972	0.85 to 0.92 on average
Water, vol %	0.2 – 33.8	0.1–95	Traces
Bottom sediment and water, vol %	0.1 – 42	NA	Nil
Benzene insoluble, wt %	0.56 – 3.33	NA	Nil
Gasoline dilution, vol %	2.0 – 9.7	NA	Nil
Flash point, °C	79 – 220	157 – 179	>200
Heating value, kcals/kg	7,500 – 10,000	9580 – 9,500	NA
Ash, Sulfated, wt %	0.03 – 6.43	3.2 – 5.9	0.78 to 1.0 typical
Carbon soot, wt %	1.82 – 4.43	NA	Nil
Fatty oil, wt %	0 – 60	NA	Nil
Chlorine, wt %	0.17 – 0.47	<0.1 – 0.83	Nil
Sulfur, wt %	0.17 – 1.09	0.54 – 1.03	Group I oils >0.03
Zinc, ppm	260 – 1787	NA	Nil
Calcium, ppm	211 – 2291	NA	Nil
Barium, ppm	9 – 3906	NA	Nil
Phosphorus, ppm	319 – 1550	NA	Nil
Lead, ppm	85 – 21,676	NA	Nil
Aluminium, ppm	<0.5 – 758	NA	Nil
Iron, ppm	97 – 2401	NA	Nil

Wide variation in properties of used oil collected from different sources

Ref: "Compendium of Recycling and Destruction Technologies for Waste Oil" by UNEP

Presently, the base stocks are marketed broadly as per API specification. The lubricant blenders use combination of base oils to manufacturer desired grade of lubricants. Most commonly used viscosity classifications for various grades of automotive and industrial lubricants are governed by different standards.

It is proposed that the same specification should be kept for re-refined base oils also as dilution in the specification will have direct bearing on the quality of finished lubricants blended with re-refined base oils in comparison to similar grade of lubricant blended with virgin base oil.

The following specification has been finalized during the meeting of held at Mumbai on 1st June, 2017 (also attended by PRAI representatives) for recycled oils.

Specifications of Recycled base oils

S.No.	Tests	Methods	Solvent Refined API Group I RR-I/ II	API Group II 150N	API Group III 4 cSt
1	Appearance	Visual	Clear & Bright	Clear & Bright	Bright & clear
2	Colour, ASTM, max	D-1500	1.5	0.5	<0.5
3	Flash Point ^{0}C, min	D-92	210	200	200
4	Pour Point ^{0}C, max	D-97	-6	-15	-12
5	K Viscosity @100^{0}C	D-445	To Report	To Report	4.15 – 4.4
6	K Viscosity @40^{0}C	D-445	RR-I: 28 – 33 RR-II: 40-45	29 - 32	To Report
7	Viscosity Index, min	D-2270	95	105	121
8	TAN mg KOH/g, max	D-664/D-974	0.03	0.03	To Report
9	Sulphur % wt max	D-129/D-2622	To Report	0.03	To Report
10	CCR % wt max	D-189	0.03	0.03	-
11	Moisture1	Crackle	Negative	Negative	Negative
12	Copper strip corrosion @100^{0}C for 3 hrs.	D-130	1 max	1 max	-
13	Density @15^{0}C	D-1298/D-4052	To Report	To Report	To Report
14	Air release value, in minutes	IP 313	-	1 Max	-
15	NOACK Volatility @250°C,1 hr	D-5800	-	-	15.0 max
16	Saturates , % wt, min	HPLC/FTIR/D2007	90	-	95
17	Calcium, ppm	ICAP/ASTM/ D 5185	2		
18	Total Metals (other than Calcium), ppm		1		

Note 1: Crackle test - in case of positive crackle, water content by ASTM D-95 - 0.05 % wt max subject to clear and bright appearance at ambient temperature.

8.2 Collection System

Collection of used oil is the starting point for successful re-refining, which depends on collection effectiveness & used oil availability, availability, Quantity and Composition of used oil – Quality. Collection at present is just 20%, therefore attempts are required to collect at least 50% of the recyclable lube oils, out of the potential of 1.45 MMT based on 2015 consumption.

Advanced countries have been able to develop collection system and processing by way of subsiding through cess on sale of lube oil and very strict re-processing employing advanced technology.

Although, the collection system of used oil was established in Bengaluru almost 8 months back, the collection is only @ 500-600 barrels/year, which is 1% of the total estimated generated oils in the city. The audit by KSPCB officials, has found out that even some of the reputed OEM Service Centers are not fully disclosing the used oil generated and actually sells only a fraction to KarRecycle Centre.

8.3 Profitability

Re-refining processes may, in certain cases due to their high costs, not be viable on economic grounds. Regenerated products, such as lubricants, cannot usually command prices higher than premium quality new materials - in fact they would usually sell for somewhat less. Thus, regeneration processes are constrained both by feedstock and product prices which are dictated by oil product prices generally, and the margin between feedstock costs and product income must cover the total regeneration process costs if the activity is to be economically viable. This process will produce wastes that have to be disposed of and the disposal costs of the residues could represent a significant proportion of the total costs. However, regeneration reduces the amounts of waste going to final disposal, with significant indirect economic benefits. The main cause of lower amount for recycling is due to diversion of used oil for production of fuel oil for boilers/ furnaces by blending with SKO/HSD. This oil is sold at a premium to Furnace Oil.

8.4 Technology

Among the rerefining technologies, only environmental friendly technologies are licensed by MoEF. The environmental friendly technologies are either based on vacuum distillation or solvent extraction based with or without hydrotreatment. The older acid-clay based technologies are no longer in practice. Technology with distillation, solvent de-asphaltining and hydroprocessing is capital & technology intensive and therefore requires scale of economy and incentive to cover cost of re-processing.

Recyclers have primitive technology comprising of filtration & distillation and none have hydroprocessing, essential for base oil for engine oil application.

As Re-refining processes, particularly hydroprocessing, are economically viable only with larger capacities, Incentives required for Type-II processors, with hydroprocessing, for making re-refining industry a progressive one.

Quality of Re-Refined Base Oil: In most of the cases base oil produced is having viscosity in the range of 30 - 50 cst at 40 ^{o}C, GR-I, VI- 100 $\pm$ 10, yellowish colour, sulphur content not found in reports. In some cases cuts of 16/25/30/65 cst at 40^{o}C is taken.

End Use of Re-refined Base Oil

Metal Working fluids and Industrial Oil / Shuttering Oil, Local Lube Oil Manufacturers, small Industries /engine, hydraulic, gear oil/Small scale Lube producers / automotive & industrial lubricants and Greases, general purpose lubricants, light load greases. Sold in open trade etc., however, there is no monitoring mechanism for its end use

8.5 Taxation under GST regime

Used oils id getting diverted to burning as recycler cannot offer higher price due to cost of operation and taxes.

Cost of Reprocessing: Rs 8 - 9 per litre (in some cases Rs 3 - 4 per litre, where simple filtration employed)

Taxation on Used Oil: 5 to 5.5% in most of the cases. In some cases full VAT 14% is also charged especially in PSU tenders.

Tax on Re-Refined Base Oil: VAT @ 14.5%. In case of blending of lubricant, ED 14% is also applicable.

PRAI was requested to provide their views on preferable treatment in GST regime. PRAI had meeting of their managing Committee on 12th Jan, 2017 and has opined that since used oil would be raw material for recyclers, input credit would be available and hence any rate of GST would be inconsequential. In fact PRAI would prefer a higher rate of GST on used oil to discourage wrongdoing. Also for promotion of recycling, incentive should be extended to the final product containing at least “X %” of recycled oil.

9 Used Oil Management International Practice

Countries all over the world re-refine used oils into lubricating oil base stocks and Regulations/Rules to handle and process used oil(s) exist in each of these countries. In some countires, fee imposed on virgin oil producers to incentivise recyclers. This has also helped them in developing robust used oil collection system

Salient features of the practices being followed in some of the developed countries are as follows

Used Oil Management International Practice

Country	Features of Used Oil Management
France	• 78% collection of used oil • Government funded programs • Fees imposed on virgin lube producers • 42% of used oil is re-refined by Govt directed re-refining associations
Germany	• 48% of total lubes sold are recovered • Oil marketers provide lube oil collection facility near retail establishment • Retailers pay for used oil pick up • 41% of used oil re-refined • 35% burnt in cement kilns
Japan	• No national level program of recycling • High %age of used motor oil recovered, treated and burnt for heating value • Limited re-refining
Italy	• Mandated use of re-refined oils in motor oils • 6 operating re-refining plants • Collectors & Re-refiners both subsidized • Tax advantage granted only if used oil for re-refining collected from Italy
Australia	• High subsidies for re-refining • Low subsidies for low grade burning oil • None for reclaimed industrial oils • 38% of total lube sold collected • Organizations are there for collection from spots
Canada	• Focus on increasing collection • 51% of total lubes sold collected
USA	• Implemented broad range of recycling programs • Subsidised collections • Discourage illegal dumping of used oil • Disposition of used oil as a fuel encouraged

10 Proposed model for used oil collection

Collection of used oil is the starting point for successful re-refining, which depends on collection effectiveness & used oil availability, availability, Quantity and Composition of used oil – Quality.

OEM garages, which are generators of used oil, do not have defined policy for disposal. Used oil is collected by traders and agents who use the same for mixing with Fuels. Discrepancy between capacity on paper and actual capacity. Leading to traders getting benefitted.

10.1 Used Oil Collection in India: What is desired

For proper/ economic rerefining, following are desired;

- Collection and storage of different types of oils Separately
- No contamination with other wastes such as halogenated solvents etc.
- Labeling of containers and tanks as " Used Oil" & keep them in good condition.
- Avoiding Rusting of tanks, leakage deterioration
- Store used oil in areas with oil impervious flooring and secondary contaminant. Used oil is usually stored in above ground containers.
- Tanks and containers of used oil to be placed in weather proof area and kept away from incompatible materials

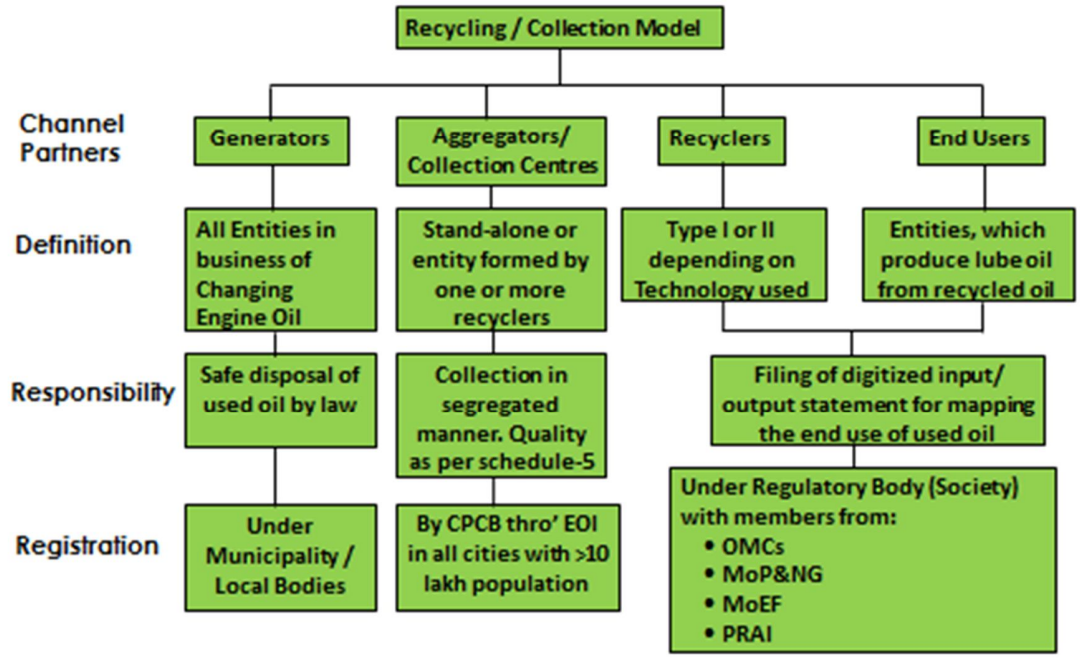
10.2 Used Oil Collection in India: Collection Strategy

- Identification of used oil providers e.g., Vehicle workshops, manufacturing plants, STUs, Railways, Defence, Aviation, Cement, other industries
- Multi-level collection strategies for identified providers
- Storage capacities at collection centre
- Transport network and skilled team for collection
- Pre-selection tests for value of used oil
- Segregation of used oil at all levels – providers, collectors and re-refining
- Complete mapping of used oil providers, collection agencies, processors, lubricant manufacturers for cost economic solution.

10.3 Recycling/Collection model comprising of the following channel partners:

1. Generator of Used Lube Oil
2. Aggregators/ collection Centres of used oils
3. Recyclers, Type-I/Type-II
4. End users of recycled used oil base stock.

Recycling / Collection Model



- All the entities engaged in business of providing services of changing engine oil are to be categorized as Generators. These entities will be responsible for disposal of used oil by Law and will be registered by Municipality/ Local bodies.
- Aggregators/ Collection Centres may be stand-alone entity or recycler, or entity formed by one or more recyclers and will be registered with CPCB/ SPCB, who will take initiative in appointing Collection Centres through EOI initially in all Cities with more than 10 Lakh population. Quality for Used oil will be governed as specified in Schedule-5 to encourage collection in segregated and professional manner. Collectors therefore, need to put up proper collection & storage facilities/system.
- Recycler will be categorized as Type-I or Type-II depending upon the technology used. The recyclers with simple thin film evaporator & clay treatment may be registered as Type-I and those with hydroprocessing technology as Type-II.
- End User is an entity, which finally purchases recycled oil, blends & fortifies it with additives to produce quality salable lube oil.
- It is suggested that all the Recyclers and End Users are registered under a regulatory body, comprising of members of OMCs, MoP&NG, MoEF, President/ Secretary of PRAI, etc. The regulatory body may be registered as Society.

- For mapping the end use of the used oil, The Recyclers and End Users will have to regularly file digitized input/ output statement with the regulatory body for reconciliation & data generation.

10.4 Separate sub-rules may be made for used oils under Hazardous Waste Rules. Re-refining of used oils may be made mandatory.

10.5 Norms to be developed for Collection Centres including conduct of business, facility design and area jurisdiction.

11. New Developments

11.1 Initiative of PRAI to develop, maintain and opearate Collection system

In order to ensure that all used oil goes only for actual recycling, PRAI in a meeting of their Managing Committee held on 12th Jan, 2017 has decided to develop, maintain and operate a network of collection centres all over India through a Non For Profit Company under section 25, with an authorised capital of Rs 1.0 crore. Oil companies would also be invited to be part of this venture. This company will be the holding company of State chapters (LLP's) through which actual collection would be done.

11.2 First re-refined engine oil launched by Castrol

Re-refined oil: the future of the lubricant market

Castrol launches first re-refined 'Eco' engine oil in India

- **Castrol has launched the first 'Eco' product – Castrol GTX Eco – for diesel cars. India is the first market to get the eco engine oil**
- **Launched in** Mumbai in the initial phase with other cities to follow soon
- **Petrol variant also planned in the coming months.**
- Uses a base oil blend of **50% virgin oil and 50% re-refined oil**.
- ***Same price as the standard product – Rs 1,600 for a five-litre pack***.
- Re-refining process includes dewatering, defueling, demineralization, vacuum distillation and distillate treatment. GTX additive technology is then used to fortify the oil
- The Company says that the "GTX Eco delivers 10% less CO_2 when compared to standard products without compromising on engine performance or protection."
- Company's technical team in the UK said, "The ultimate objective is to develop 100% re-refined oil. ***We believe re-refined oil is the future of the lubricant market."***

12. Recommendations

12.1 Recycling/Collection model comprising of the following channel partners be developed over a period of time:

1. Generator of Used Lube Oil
2. Aggregators/ collection Centres of used oils
3. Recyclers, Type-I/Type-II
4. End users of recycled used oil base stock.

12.2 Separate sub-rules may be made for used oils under Hazardous Waste Rules. Re-refining of used oils may be made mandatory.

12.3 Norms to be developed for Collection Centres including conduct of business, facility design and area jurisdiction.

12.4 One Collection Centre by each IOC, HPC and BPC to be started at separate locations. The Private entities, including PRAI/ Automobile OEM, may be encouraged to participate in these Centres.

12.5 About 5-10% of bottom residue is generated during treatment of used oil. According to the current rules, these have to be incinerated or can be put to cement kilns. In order to derive value from bottoms, a study may be taken up for use in specialty bitumen like crumb rubber/ bitumen emulsion, which are certified by producers of these bitumen. Use in hot applied bitumen, which are produced in refineries, is not advisable due to high PNA, which are considered carcinogenic.

12.6 Awareness campaign may be conducted by PCRA to educate user regarding adverse impact due to use of spurious / substandard oils.

12.7 For promotion of recycling, incentive in the form of tax exemption by creating a separate group under GST may be extended for the quantity of the re-refined oil blended in the final product. However, re-refined oil of only Indian origin meeting quality requirement will be allowed for blending.

12.8 All OMCs to develop at least one product in 2017-18 with blending of min 25% re-refined oil. All OMCs were also advised to put up action plan to progressively enhance blending of re-refined oil of Group II/III quality so as to reach 25% blending on overall basis by 2023.

12.9 Blending of re-refined oil on overall basis may be made mandatory by Govt. from time to time for all formulators of lubricants in the country.