

GUIDELINES FOR ENVIRONMENTALLY SOUND MANAGEMENT OF USED OILS IN THE MEDITERRANEAN



UNEP



Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem

Together for the Mediterranean Sea

MedPartnership





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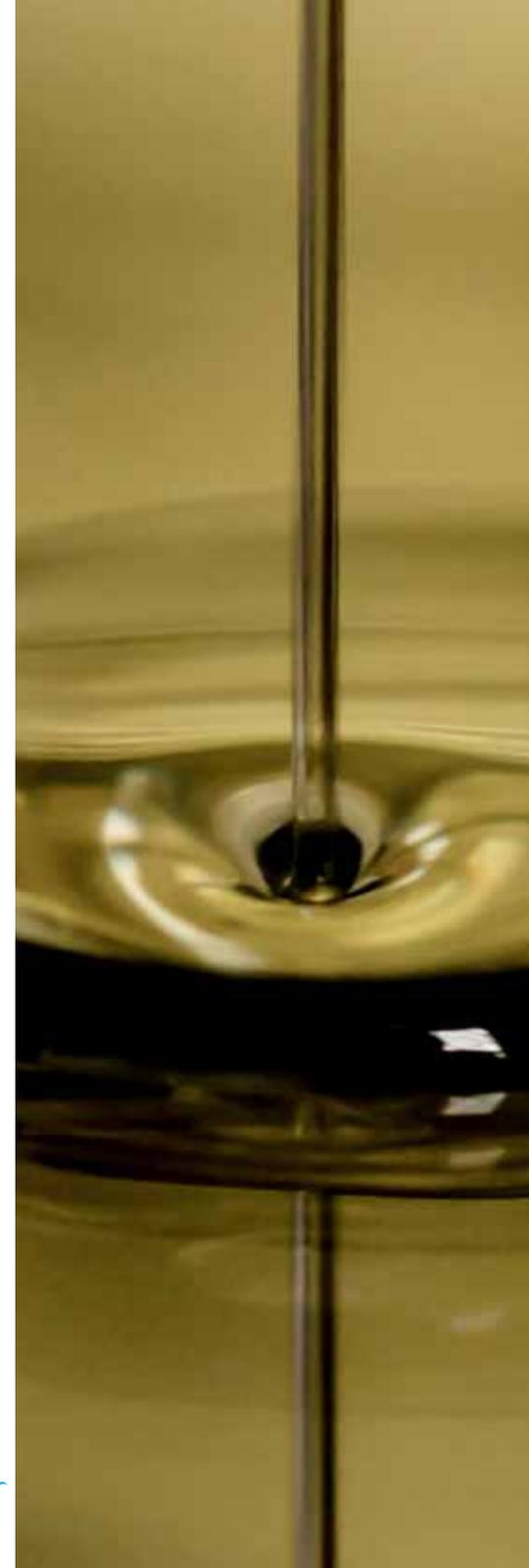
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PREFACE

This technical guide is focused on providing possible steps to the environmentally sound management (ESM) of used oils and to provide the Mediterranean countries with information in order to establish a 100% regeneration system to recycle used oils. Its ultimate objective is to support countries to design and set up an effective used lubricant oil management including prevention, as well as to promote its economic value and the circular economy.

It has been developed by the Regional Activity Centre for Sustainable Consumption and Production (SCP/ RAC) in collaboration with UNEP/ MAP MED POL Programme, under the MedPartnership project¹.

Used oils, or waste oils, are priority substances to be taken into account for the Contracting Parties to the Barcelona Convention when preparing programmes and measures against pollution, according to the Land Based Sources (LBS) Protocol. Used oil as a hazardous waste is also covered by the Basel Convention on control of transboundary movements of hazardous wastes and their disposal.

Used oil mainly contains three types of dangerous pollutants, polynuclear aromatic hydrocarbons (PAHs), heavy metals and lubrication additives. It is a dangerous polluting product, usually generated by its use as a lubricant in automotive vehicles and in industrial operations and classified as hazardous waste according to European environmental legislation. Pollution due to used oil has not received much attention compared to pollution from petroleum. Its inadequate management can have significant effects on wetlands, rivers, marine and fresh water organisms, air pollution and human health.

This technical guide provides background information and data on used oils, information on ecolabelling for lubricants and alternatives such as bio-lubricants, associated environmental problems caused by used oils as well as information on the main used oil treatment technologies.

It also describes in plain and simple language the possible steps towards the environmentally sound management of used oils that can generally be applied to any given country that goes from stakeholder engagement to final re-refining/ recycling and shows several case studies on used oil pollution prevention.

This guide aims at facilitating policy and legislation reforms for pollution prevention and control. It seeks to develop and improve the legislative and institutional framework in the Mediterranean region and to serve as a technical guidance for the Mediterranean countries in implementing the relevant priority actions of the National Action Plans adopted in the framework of Article 5 and 15 of the LBS Protocol of the Barcelona Convention and its Strategic Action Programme SAP-MED.

1. The Strategic Partnership for the Mediterranean Sea Large Marine Ecosystem (MedPartnership) is a collective effort of leading organizations (regional, international, nongovernmental, etc.) and countries sharing the Mediterranean Sea towards the protection of the marine and coastal environment of the Mediterranean. The MedPartnership is being led by United Nations Environment Programme (UNEP) Mediterranean Action Plan (MAP) and the World Bank and is financially supported by the Global Environment Facility (GEF), and other donors, including the European Union (EU) and all participating countries.

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POLLUTION PREVENTION

Pollution prevention is any action that reduces, eliminates, or prevents pollution at source. It is obvious that there are significant opportunities for industry to reduce or prevent pollution at source through cost-effective changes in production, operation, and raw material use.

In the case of used oils, our first priority should be to take prevention actions with the goal of generating zero used oil. In addition, biolubricants (plant-based lubricants) represent an opportunity to greatly reduce the environmental impact of lubricants and create green companies and jobs. Ecolabels are also a way to promote best environmental practices and reduce lubricants' environmental impact.

1.1 Alternatives to mineral oils:

Biolubricants

Biolubricants, also known as biolubes and bio-based lubricants, apply to all lubricants that biodegrade rapidly and which are non-toxic for human beings, fauna, flora and aquatic habitats.

Biolubricants are made of vegetable oils such as soybean, canola (rapeseed), sunflower, jojoba, jatropha, palm and coconut oils. Biolubricants can also be

made of synthetic esters manufactured from modified renewal oils.

The preferred application of biolubricants are those that might pose a risk for the environment, especially in aquatic, mountain, mining, pharmaceutical, agricultural and forest environments, although they can be used in all applications.

This is the case for:

- Machinery or applications that directly leak oil into the environment such as chainsaw bars and chain oils, 2 stroke-engines, railway flanges, cables, dust suppressants, marine equipment and release agents and greases.
- Machinery working on sensitive areas that may accidentally leak oil (in or near water bodies) such as hydraulic oils, oils for engines, gearboxes, axles, etc.

The key advantages of biolubricants are rapid biodegradability, low toxicity in the environment, environmental friendliness, good lubricating properties, high viscosity index, longer equipment life, contribution to improved water quality, reduction of greenhouse gases, increase in economic security and reduction of oil dependence.

Biolubricants management should

follow a separate recycling system from petroleum-based used lubricant oils. Used biolubricant oils containing heavy metals and other hazardous substances should be managed as hazardous waste, implementing environmentally sound management and complying with local environmental legislation.

The advantages of biolubricants compared to petroleum-based lubricants are as follows:

- Safer for staff working with lubricant oils since they are cleaner, non-toxic, and generates fewer skin problems;
- Better safety, since they have higher flashpoints, constant viscosity, and less oil mist and vapour emissions;
- Air emissions are lower due to higher boiling temperature ranges of esters.
- Rapid biodegradability;
- Costs are less over the product's life-cycle due to less maintenance, storage and disposal requirements. If spilled, environmental and safety penalties are less;
- Evaporate slower than petroleum lubricants; and
- Adhere better to metal surfaces.

The disadvantages of biolubricants during the use phase are:

- Bad odours may appear if contaminants are present;
- High viscosity at low temperatures; and

- Poor oxidative stability at extremely high and low temperatures, although specific additives (not biodegradable) solve this problem.

In spite of this, the price levels of plant-based oils and lubricants historically have been higher compared to petroleum-based oils and lubricants although, in recent years, this price difference has reduced considerably. Today, the cost of biolubricants is slightly higher than mineral oil lubricants, but equal to or less than synthetic lubricants. This global trend indicates a promising future for biolubricants. If the price of petroleum base oils increases, biolubricants will be even more competitive in the formulation of lubricants or as 100% bio-based lubricants.

Besides environmental benefits, biolubricants are a reliable alternative, providing improved performance over conventional lubricants. In particular, the lubricity of biobased lubricants is about 2 to 4 times greater than petroleum-based lubricants, reducing energy consumption and lengthening the equipment's service life. In addition, the viscosity of biolubricants does not vary with temperature as much as the petroleum-based lubricants. Finally, biolubricants have a very good safety

record in applications like grinding, where a fire hazard may be present.

Approximately 85% of all lubricants presently being used in the world are petroleum based oils. Nevertheless, the market for more biolubricants has been growing at a slow but steady pace. Europe has been leading the biobased lubricant market and it is expected to grow to 18% of the market in the coming years.

1.2 Ecolabels for lubricants

It is recommended to use ecolabels to promote best environmental practices. Among the most well-known ecolabels are those developed by the European Union, which have a specific ecolabel for lubricants.

The European Union Ecolabel covers a wide range of product groups, from major areas of manufacturing to tourist accommodation services. Key experts, in consultation with main stakeholders, develop the criteria for each product group in order to decrease the main environmental impacts over the entire life cycle of the product. Because the life cycle of every product and service is different, the criteria are tailored to address the unique characteristics of each product type.

The European Union Ecolabel helps

consumers to identify products and services that have a reduced environmental impact throughout their life cycle, from the extraction of raw material through to production, use and disposal. This ecolabel is a voluntary label promoting environmental excellence at European level.

With regard to the ecolabel on lubricants, the products that can apply for the ecolabel cover hydraulic fluids, tractor transmission oils, greases, stern tube greases, chainsaw oils, concrete release agents, wire rope lubricants, two-stroke oils, industrial and marine gear oils, stern tube oils and other total loss lubricants for use by private consumers and professional users.

Manufacturers, importers, service providers, traders and retailers, may submit applications for the Ecolabel. Traders and retailers may submit applications in respect of products placed on the trade market under their own brand names.

On order to apply for the European Ecolabel, lubricants have to meet requirements for performance, show limited toxicity to aquatic organisms, have high biodegradability and low potential for bioaccumulation and contain a high proportion of renewable

(bio-based) raw materials.

For more information, please visit the EU Ecolabel website: www.ecolabel.eu

Other nationally and internationally recognized ecolabels for lubricants include the following:

- Blue Angel, Germany (www.blauer-engel.de);
- Swedish Standard, Sweden (www.sp.se/km/grease);
- Nordic Ecolabel, Norway, Sweden, Finland, Iceland, and Denmark (www.nordic-ecolabel.org); and
- OSPAR Commission (www.ospar.org)

USED OILS AND THE ENVIRONMENT

2.1 Used lube oil definition and composition

According to the Basel Convention's technical guidelines on used oil re-refining or other re-uses of previously used oil, used oil means any used semi-solid or liquid product consisting totally or partially of mineral oil or synthesised hydrocarbons (synthetic oils), oily residues from tanks, oil-water mixtures and emulsions.

According to EU legislation, "waste oils" are all mineral or synthetic industrial oils or lubrication, which have stopped being suitable for the original intended use, such as used combustion engine oils, gearbox oils, turbines, hydraulic oils and lubricants (Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain Directives Art. 3).

Waste oils, also known as used oils, are also priority substances to be taken into account for the contracting Parties to the Barcelona Convention when preparing programmes and measures against pollution, according to the Land Based Sources (LBS) Protocol. Used oil as a hazardous waste is also covered by the Basel Convention on

control of transboundary movements of hazardous wastes and their disposal.

Used oil is a dangerous polluting product, usually generated by its use as a lubricant in automotive vehicles and in industrial operations and classified as hazardous waste according to European environmental legislation.

Used oil mainly contains three types of dangerous pollutants:

- Polycyclic aromatic hydrocarbons (PAHs);
- Heavy metals; and
- Lubrication additives.

Used oil contains polycyclic aromatic hydrocarbons (PAHs), which result from fuel combustion during the running of engines or equipment and concentrated in lubricant oil. PAH concentration continually increases in crankcase oil with operating time. In addition, used oils contain important quantities of heavy metals, such as lead (Pb), zinc (Zn), nickel (Ni), cadmium (Cd), arsenic (As), copper (Cu) and chromium (Cr). Lubrication additives such as zinc dialkyl dithiophosphates, molybdenum disulphide, and other organo-metallic compounds are also present and are dangerous to the environment and human health.

These are the reasons why it is necessary to consider used oil as an

important pollutant, consider the effects on the environment and take action. Pollution due to used oil has not received much attention compared to pollution from petroleum.

2.2 Associated environmental problems

As stated, used oils are classified as hazardous waste. Inadequate used oil management can have significant effects both on human health and the environment. These effects might be as follows:

Effects on fresh water marine and terrestrial ecosystems

Chronic pollution due to used oil from automotive traffic and industrial activity reaches millions of tonnes a year. Lubricant oil pollution can damage the soil, aquatic environments and the water supply. When used oil is leaked, spilled or improperly managed or recycled, it may reach water bodies through storm water runoff or direct discharge on water or land, causing adverse effects on the environmental health of ecosystems.

When oil is poured into the water, it forms a layer on the surface, which prevents oxygenation and it can suffocate and kill organisms that live in the water. Four litres of used oil can generate a slick of 4000 m² on water. Also, petroleum hydrocarbons can be



found in aquatic sediments and are associated with used crankcase oil. Spilled used oil may also result in higher concentrations of PAHs in wetlands, rivers, bays, oceans, groundwater and sediments. Dumping used oil in water bodies can negatively affect fish and benthic macroinvertebrate communities even killing a large number of fish and other fauna. If used oil is spilled or discharged into the water, humans and animals may be exposed by direct contact, ingestion, inhalation and/or absorption. As used oil weathers, physical and chemical changes take place in the oil's composition, with the possibility of different processes occurring simultaneously.

Used oil may spread over the surface of water in an advection mode, meaning non-uniform spreading influenced by winds and currents, increasing the surface area affected and the probability of exposure of humans and ecosystems. In addition, some light and medium-weight oil components may evaporate into the air, altering the oil's composition. Dissolution may also occur, as certain lighter-weight oil components dissolve in the water column. Natural dispersion, emulsification, photo-oxidation, sedimentation and shoreline stranding

and biodegradation may also occur, further altering the oil's chemical and physical properties.

When used oil is poured on land, it will damage and contaminate the underlying soil, eventually reaching the groundwater and aquifers underneath. Discharging used oil on land may greatly disrupt any future use of the land such as for agriculture, recreation or urban development. Contaminated soil may be unsuitable for agricultural production, recreation purposes and urbanization unless expensive decontamination measures are undertaken. Used oil may slowly percolate until it reaches the groundwater and aquifers underneath, subsequently entering the pumping wells. This may cause a high risk for humans, ecosystems and agricultural systems if contaminated water is used for water supply and/or irrigation purposes, introducing pollutants into the food chain and water supply.

Effects on air pollution

Used oil pollution can also damage the atmosphere when used oil is burned without high-tech filtering measures. It has been calculated that 5 litres of burnt used oil pollute the air that a person breathes for three years. When used oil is burned without high-tech filtering

measures, toxic gases and harmful metallic dust particles are produced due to the presence of heavy metals and other organic compounds, sulphur, chlorine and aromatics.

The high concentration of metals (including heavy) that used oil contains, such as lead, arsenic, nickel, cadmium, zinc, chromium, copper and magnesium can be very toxic to ecosystems and to human health. They are emitted from the exhaust stack of uncontrolled burners, furnaces or boilers. In addition, if other pollutants such as PCBs are present in the used oil, the air pollution may be even more dangerous, generating dioxins and other carcinogenic by-products.

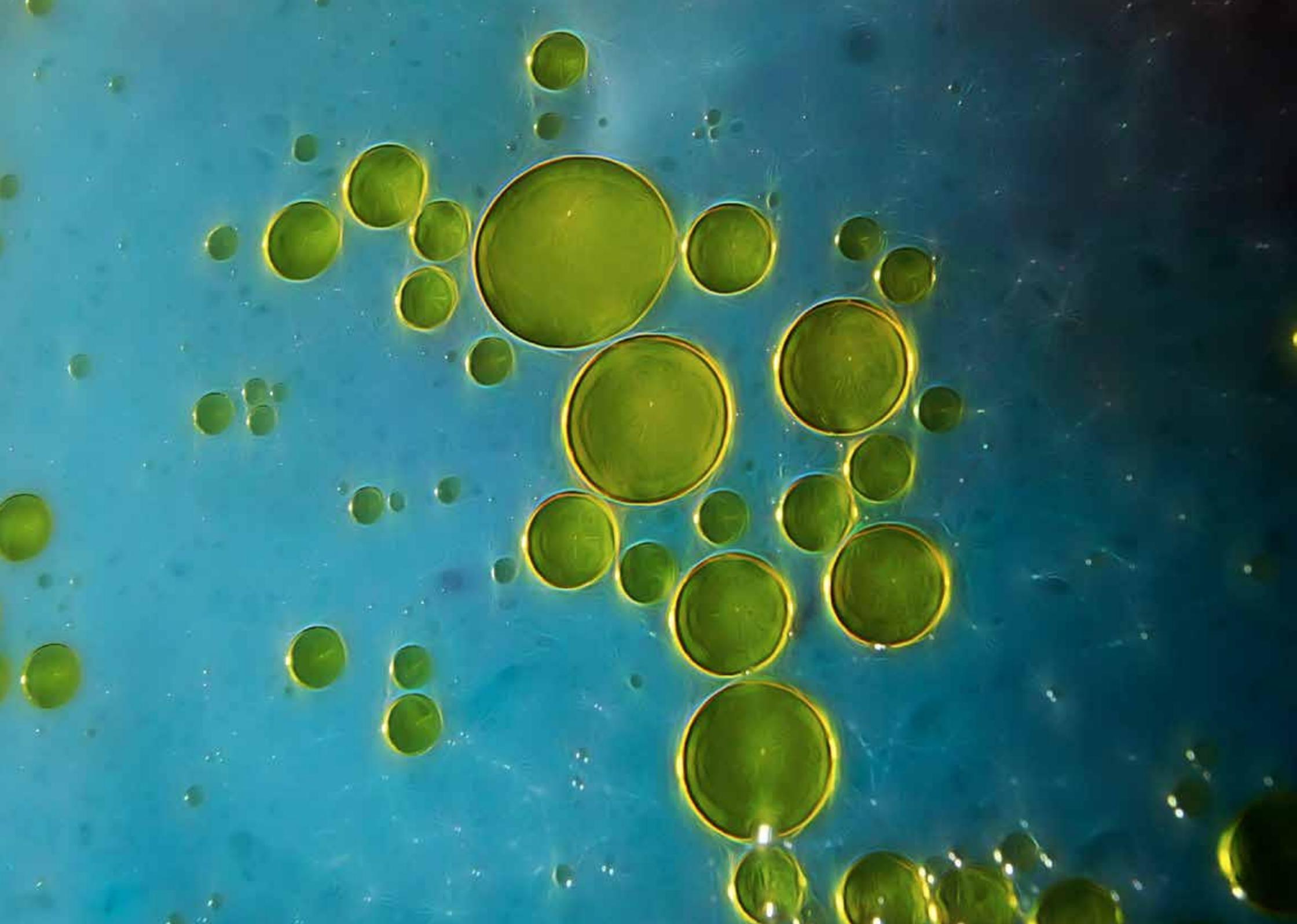
Human health effects

In addition to the content of hydrocarbons and additives (metals, detergents, etc.) in the lubricant oil, used crankcase oil contains contaminants that accumulate during the running of the engine. Sources of contamination include additive breakdown products such as barium and zinc and heavy metal particles from engine wear such as lead, arsenic, nickel and cadmium and other metals such as aluminium, copper, iron, magnesium, silicon and tin. Particular attention should be given to heavy

metals present in used oils due to their high concentrations and toxicities to humans, fauna and flora. If ingestion or dermal exposure is repeated or prolonged, the effects on human health will be very serious. All these compounds, especially heavy metals, are highly toxic to organisms.

In addition, polycyclic aromatic hydrocarbons (PAHs) become highly concentrated due to the combustion of lubricant oil and fuel in the engine cylinders. PAH concentration increases in the crankcase oil with running time. If used oil is not handled properly people can be exposed via inhalation to high levels of PAHs. Also, during the treatment and recycling of used oil with higher PAH levels may similarly result in greater exposure of workers and handlers to PAHs. Additional exposure to PAHs in used engine oils may also occur from dermal contact while changing oil as well as from handling used oil for any use. PAHs, such as benzopyrene, are well known for their high carcinogenicity and mutagenicity.

Additionally, other contaminants might also accumulate in oil such as fuel, antifreeze, wear metals, metal oxides and combustion products that can affect human health.



Dangerous practices for human health and the environment

As a hazardous waste, used oils should only be managed by authorized waste managers. Enforcement control campaigns should be developed to detect non-authorized practices.

2.3 Main used oil treatment technologies

There are two main options for the treatment of used oil (see chart 1.)

One method is to reconvert used oil into a material that can be used as base oil to produce new lubricants. This process is referred to as regeneration (re-refining). According to the priority established by hierarchy of management of waste in the European Union (European Waste Directive 2008/98/EC art. 4.1.), regeneration

technology ensures the best environmental treatment for the management of used oils because it is environmentally friendly and more respectful of the environment, air emissions and human health. This treatment will be covered in more detail at a later stage.

Another method to treat used oil is as fuel (energy recovery). In order to comply with European legislation and international standards, strict treatment is needed to remove contaminants such as organic compounds, chlorides and heavy metals which are treated in authorized plants for energy recovery. Used oils can also be incinerated in large industrial plants or cement plants, where the combustion temperature is above 850°C and with a residence time of 2 seconds.

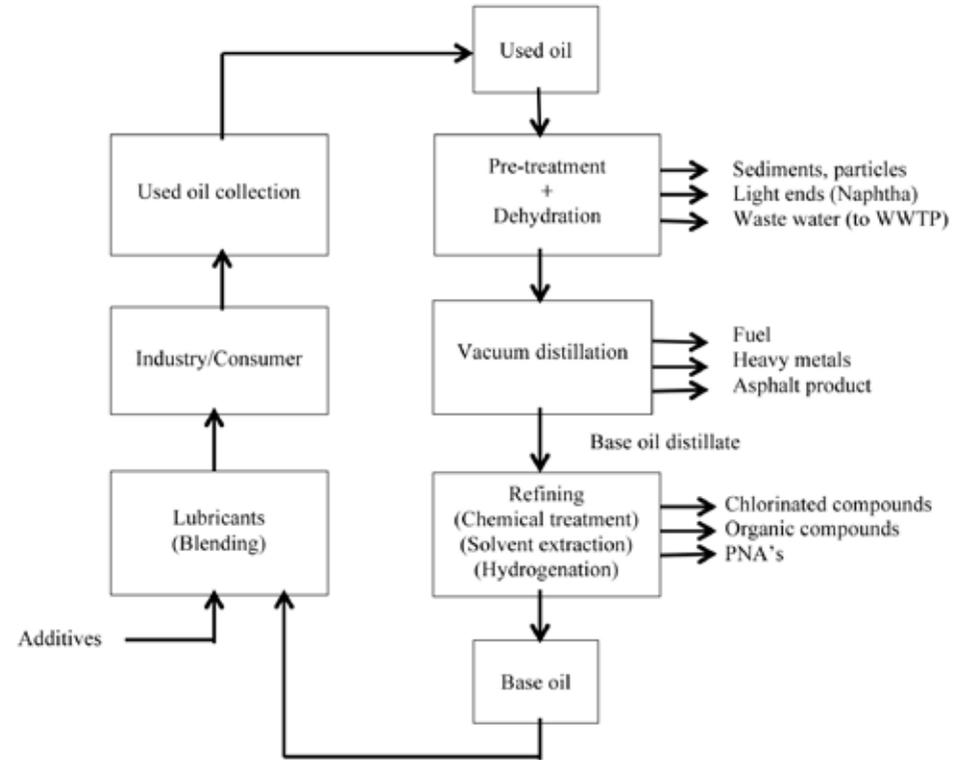


Chart 1. Regeneration (re-refining). Example of circular economy.

In the Basel Convention, Annex IV. Disposal operations, a reference is made to operations that may lead to resource recovery, recycling, reclamation, direct re-use or alternative uses stating R9 as “used oil re-refining or other reuses of previously used oil”.

Also, some reference on the main used oil treatment technologies is made in section II of the Basel Convention’s technical guidelines on used oil re-

refining or other re-uses of previously used oil.

A brief description of the different processes

Base oil qualities (API (American Petroleum Institute) Group I, Group II depending on technology) are similar or even better than primary products.

Modern technologies are differentiated by the type of final treatment

Group	Saturation	Sulphur	Viscosity index	Process
I	<90%	>0.03%	>80<120	Refined (classic)
II	<90%	<0.03%	>80<120	Hydrotreatment

implemented where most contaminants are eliminated or reduced, obtaining high quality base oils with high performance level and minimal waste generation.

Base oils are classified in different groups, according to American standard API, and must comply with the following requirements:

Group I

1. Technology of the enhanced selective-refining plant

The operating technology that meet and exceed parameters established for Group I is the technology of the enhanced selective-refining plant. The enhanced selective-refining process applies the liquid extraction principle. Through the solvent NMP (N-metil-2-pirrolidona), that it is recovered and reused, the following is obtained:

- High-quality base oil;
- Removal, polycyclic aromatic hydrocarbons (PAHs); and
- High average base oil process yield.

2. Sotolub process

This process consists of a combined

chemical treatment with an additive called Antipoll. The treatment with Antipoll is carried as pre-treatment in the dewatering unit and it is mixed with used oil. This process generates the following:

- Antipoll is dosed in different distillates, according to the needs;
- Quality base oil; and
- Good efficiency.

3. Technology TDA (thermal deasphalting)

It is based on the use of propane, distilling and treating soils. This process may give rise to the following:

- Problems with the treatment, specially with used oil with PCBs higher than 25 ppm and high in chlorinated compounds;
- Quality base oil; and
- Good efficiency.

4. Interline technology

The process is based on the use of propane and it is improved by the contribution of a strong base, according to process needs. This process generates:

- High quality base oil; and
- Good efficiency.

5. Vaxon technology with chemical treatment

Vaxon technology, also known as VCFE (Vacuum Cyclon Flash Evaporator), uses cyclon evaporators for distillation and a final treatment with a strong base.

This technology can treat used oil with high chlorine compounds. This process generates:

- High quality base oil; and
- High efficiency.

Group II

Technologies belonging to Group II have better efficiency than those of Group I. These technologies are based on a hydrogenation treatment requiring a large investment, a processing capacity of about 60,000 to 80,000 tonnes per year, and a soft treatment to avoid destruction of valuable synthetic base oil fractions.

1. Ecostream

This used lubricant oil process is re-refining which uses an advanced hydro-finishing technology. It generates:

- High quality Group II base oil;
- High efficiency; and
- Generate minimum waste.

2. The hylubetm process

This technology is based on the use of catalytic hydroprocessing operating continuously (no batch-wise production). It generates:

- High quality Group II base oil;
- High efficiency; and
- Minimum waste.

3. Revivoil process

This process is based on the catalytic hydrogenation treatment with high pressure and de-asphalted thermal generating:

- High quality base oil Group II;
- High efficiency; and
- Low waste.

PROPOSED STEPS FOR THE ENVIRONMENTALLY SOUND MANAGEMENT (ESM) OF USED OILS

This chapter describes proposed steps to the ESM of used oils that can be applied to those Mediterranean countries that need to start or improve the management, efficiency and finance of used oil recovery and recycling.

It is proposed that this step-by-step process should be based first on the establishment of a legal framework to improve the environmental management of used oils in order to reduce their impact on the environment and human health.

The used oil legal framework should guarantee the collection of 100% of generated used oil and contemplate all necessary measures to achieve that objective. We recommend the use of 100% of recovered used oil for regeneration purposes (use as raw material for new lubricant oil production) for economic, environmental and social reasons, as mandatorily stated in the European legislation. Despite this ecological objective, some of the recovered oil might not be used for regeneration due to its low quality and can be used for

thermal use (energy recovery) or other uses, if authorized facilities are in place.

In order to establish an effective step-by-step process, the strategy might be based on the following principles:

Legal framework

An existing legal framework is crucial in order to successfully implement ESM of used oils in any given country. This is necessary to establish clear 'rules of the game' for all stakeholders including their rights and obligations, mandatorily establishing that all logistical operations should be implemented through authorized hazardous waste management and transport companies while gathering official data, statistics and control documents.

Transparency

It is also important for the government to collect official data, statistics and documents and publicly inform on used oil quantities and efficiency and compliance ratios. The gathering of data should include information such as:

- Quantity of sold lubricant on the market (tonnes);
 - Potential quantity of used oil to recover (in tonnes and % of sold lubricants) (*)
- (*) It is estimated as 40% of total

lubricant sold;

- Recovered quantity of used oil (tonnes);
- Final destination of recovered used oil (final use); and
- List of used oil producers/generators.

Environmental objectives

Clear environmental objectives should be established by the government. It is recommended that these environmental objectives include the following:

- Valorization of recovered used oil: 100%;
- Recommended type of valorization of used oil: 100% regeneration-recycling (except for low-quality used oil, about 5%, which can be used for energy recovery or other uses).

Transitory period until proper infrastructure is available

In case there is no proper infrastructure to regenerate or recycle used oil in the country, recovered used oil could be sent abroad for proper management until necessary infrastructure is in place, taking into account Basel Convention procedures and recommendations.

Dialogue and partnership with stakeholders

Stakeholder opinion, collaboration and partnership are important during the

drawing up of a legal framework for used oil and its approval as well as in the implementation and attainment of project and environmental objectives.

Management

Used oil management should be based on the environmental responsibility of the pollution producer or the Pollution Pays Principle (PPP)..According to the Barcelona Convention, Article 4. General obligations, the Contracting Parties shall apply the polluter pays principle, by virtue of which the costs of pollution prevention, control and reduction measures are to be borne by the polluter, with due regard to the public interest.

Lubricant producers and importers should be responsible as individual companies or through industry associations with the strict attainment of used oil environmental objectives by using an Integrated Management System (IMS) as well as providing monthly and annual information and statistics to the national government and to the regional and local government (if applicable).

Lubricant producers and importers should finance all costs associated with the proper management of used oil by paying a specific quantity per new

lubricant sold on the domestic market.

The following proposed steps are suggested for the ESM of used oils in any given country:

Proposed Steps	
Step 1	Appointment of Ministry/Department responsible for used oil management and performance of a feasibility study addressing environmental, technical and economic aspects
Step 2	Initiate dialogue, awareness and training campaign and partnership with stakeholders
Step 3	Pass a law on used oil management and financial plan
Step 4	Create a database of consumption of new lubricant oils
Step 5	Create a database of recovered used oil, ratios and objectives
Step 6	Initiate used oil collection logistics
Step 7	Establish used oil transfer centres
Step 8	Establish used oil regeneration/re-refining plants

Table 1. Proposed steps for the ESM of used oils

3.1 Step 1: Appointment of Ministry/ Department responsible for used oil management and performance of a feasibility study addressing environmental, technical and economic aspects

The consumption of industrial oils and auto oils is directly linked to the production of used oils. Improper used oil management can generate relevant impacts on the environment and human health. It is therefore, necessary to take steps to minimize the production of waste oil and

ensure that all used oil generated is environmentally sound managed.

The first proposed step is to ensure proper management of used oils by appointing the Ministry or public administration and department responsible for the management of used oils in the country, which should ensure the following:

- Development of a feasibility study on used oil ESM in the country;
- Development, adoption and enforcement of laws and specific

environmental regulations for the management of used oils; and Generation of statistics on established objectives and degree of compliance with objectives. The proposed used oil ESM feasibility study for a country should include at least current status of used oil management, Ministry/ department responsible and legal framework, stakeholder engagement and partnership, statistics and database implementation, used oil collection logistics, capital and operational economic and financial analysis, management objectives, targets and timing of specific actions and targets, if possible.

3.2 Step 2: Initiate a dialogue, awareness and training campaign and partnership with stakeholders

Stakeholders can be defined as any individual, group of people, institution or firm who have a significant interest and/or role on the success or failure of a project. In general terms, these stakeholders might be:

- Implementers: those who implement the project;
- Facilitators: those who help or facilitate the implementation of the project;
- Beneficiaries: those who benefit in any way from the implementation of

the project; and

- Adversaries: those who might be against the implementation of the project.

It is crucial in order to be successful on the implementation of the environmentally sound management of used oils in any country that the government dialogues and partners with all key stakeholders. Key stakeholders might vary depending on local conditions. Generally, the main stakeholders to engage in the project might include:

- National Government
- Regional Government
- Local Government
- Lubricant Manufacturers Association
- Used Lubricant Producers
- Hazardous Waste Management Companies Association
- Hazardous Waste Transport Companies Association
- Consumers Association
- Workers Unions
- NGOs (Non-governmental Organizations)
- Academia
- Media

The economic, environmental and social benefits of establishing an environmentally sound management

of used oils in any country must be maximized while minimizing the potential negative effects such as stakeholder conflicts. Headed by the government, it is recommended first to initiate a dialogue, awareness and training campaign and eventually a partnership with all the different stakeholders that can contribute to the success of the project.

In order to attain this objective, implementing the following methodology is recommended:

First, identify all stakeholders that have

a significant interest and/or role in the project;

Second, identify for each stakeholder, their respective role, interest, power and capacity to participate in the project; and

Third, identify actions to address stakeholder interest and involvement in the project to ensure its success.

Before initiating the project, as a starting point, the following stakeholder analysis matrix could be developed, as shown in the table below.

Stakeholder and basic characteristics	Interests and role in the ESM of used oils	Capacity and power to participate on the ESM of used oils	Possible actions to involve stakeholder
National government...			
...			

Table 2. Stakeholder analysis matrix

After conducting the stakeholder analysis exercise, specific dialogue, awareness and training activities could be organized with key stakeholders for wise stakeholder engagement and partnership.

As an example, specific awareness and training activities for stakeholders might include the following:

- Development of an awareness campaign on management of used

oils (leaflets, brochures, workshops, TV and radio advertisements, website, social networking, etc.);

- Development of training courses for relevant stakeholders on:
 - o Legal framework of used oils (rights, obligations and penalties);
 - o Logistics and collection of used oils;
 - o Final treatment of used oils; and
 - o Other related courses.

Illegal dumping and illegal collection of used oil can be reduced or avoided if the local government takes action. First, it is important to have legislation in place and inform people, lubricant manufacturers and importers, uncontrolled collectors and used oil producers about obligations and penalties, and that non-compliance will be detected and violators will be caught and fined. And second, it is important to establish free collection/management of used oil for citizens in convenient public hazardous waste collection sites (this public collection site cannot be utilized by used oil producers or companies).

3.3 Step 3: Pass a law on used oil management and financial plan

Historically, improper used oil management has caused and continues to cause relevant

environmental pollution due to illegal discharges on land and in water bodies polluting soil, groundwater and surface water. In addition, improper use of used oil as an alternative fuel due to its high calorific value in unregulated facilities and industries has caused dangerous and carcinogenic air pollution emissions affecting the environment and human health.

Used oil management should be subject to the law of supply and demand if there is no clear rule. Defined responsibilities and a financing system should be established to ensure the full collection and improved environmental management of used oil.

In an unregulated used oil management market with a lack of regeneration plants and used oil treatment and decontamination infrastructure, the common use of used oil is as fuel, generally without any environmental or legal control. In this case, if the price of fuel is high compared to used oils that can eventually replace it, the used oil is usually collected from large producers and sold, for example, to consumers with large and small boilers, and to bakeries, brickworks and other

industries. If fuel prices are low, used oil is not usually collected and is mismanaged.

When used oil is collected in significant amounts by illegal or non-regulated collectors, used oil collection statistics will not be accurate, making it difficult to wisely manage used oils in the country.

Therefore, in order to properly manage used oils, the legal framework should be based on the following principles:

1. The principle of Extended Producer Responsibility (EPR), or the polluter-pays principle should be applied as regards responsibilities and funding;
2. Definition of ecological objectives to be achieved; and
3. Management should be based on the Basel Convention, taking into account other international laws such as the European Union's Waste Framework Directive 2008/98/EC, Article 4. Waste hierarchy as priority order and Article 21, Rules for Used Oil Management.

1. Extended Producer Responsibility (EPR)

Extended producer responsibility is an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. Makers and importers of lubricants placed on the market should have an EPR and an obligation to secure financing to assure the wise management of used oil in the country, individually as a company or through a National Integrated Management Systems (IMS), which combines all components of a business into one system for easier management and operation.

Lubricant manufacturers and importers are responsible for the production of used oils while producers and holders must ensure its delivery to an authorized waste manager for recycling. They are also responsible for compliance with ecological objectives.

It is recommended for example that, before April 1st of the year following used oil production in any country, lubricant manufacturers and importers, usually through the IMS, should provide the government with at least the following information:

- The total amount of lubricant that

has been placed on the market by Integrated Management Systems and final use of used oil; and

- A performance report on the environmental objectives attained. The economic agents involved on different operations should inform the appropriate authority or the IMS of the amount managed and the final use of used oil.

2. Ecological Objectives.

Ecological objectives should be established by law. If a 100% regeneration objective is established, it should comply with the following:

- Collecting 100% of used oil produced (corresponds to 40% of new lubricating oil consumed annually);
- Regeneration of at least 50% of collected oil, which is usually reviewed every five years; and
- Energy use. Use as fuel once used oil has been treated in plants and by authorized consumers such as cement plants and incinerators.

3. Management based on the Basel Convention and other International standards including the EU Waste Framework Directive 2008/98/EC.

In the Basel Convention, Annex I, it is stated that the waste stream Y8 "waste mineral oils unfit for their originally

intended use" should be controlled and managed.

The EU Waste Framework Directive 2008/98/EC lays out the principle of waste hierarchy as a priority order of Article 4 and the rules for used oil management in Article 21.

In European legislation, the used oil regeneration option has higher priority than other recovery options (including production of secondary fuels or direct incineration).

The priority used oil solution order from best to worst is the following:

- Prevention (no production of used oil);
- Preparing for re-use;
- Recycling meaning regeneration/re-refining;
- Other recovery such as energy recovery (burned after treatment as secondary fuel) and incineration (burning of used oil); and
- Disposal.

Also, in European legislation, in regards to disposal, Article 21 establishes the rules for used oil management stating that:

- Used oils have to be collected separately, where this is technically feasible;

- Used oil must be treated in accordance with the waste hierarchy;
- Prohibition of mixing used oils with other kinds of waste or substance if this impedes its right treatment; and
- Measures (technical, organizational, economic) should be applied to ensure separate collection and proper treatment.

Based on the above, the used oil regulation may contain the following provisions:

- Object and scope of application. This section should explain the law's objectives and the scope of application regarding used oil types, lubricant makers and importers and related issues.
- Definitions of terms. A list of definitions should be included for application of the law, including terms such as industrials oils, used oils, collection, collector, recovery, recycling, regeneration, energy valorization, previous treatment, secondary treatment, industrial lubricant makers, base oil coming from used oils, etc.
- Business plans for prevention and reuse. This section should show that lubricant makers and importers should prepare a business plan for the government which is aimed

- at preventing the environmental impacts of used oil and lengthening the lubricants' life cycle with the goal of reusing, recycling, regenerating or using other used oil valorization methods.
- Obligations regarding storage and treatment of used oils. This section explains the conditions that used oil producers must meet regarding storage and management of used oils.
 - Delivery system of used oils. This provision should explain how and by whom used oils should be handled, from used oil producers to authorized hazardous waste management companies or others. This provision should also include what kind of control documents should be registered in the process.
 - Management priority. This section should state the priorities for management and treatment of used oils, with regeneration normally as first priority;
 - Ecological objectives. This section should explain the specific ecological goals of used oil management by lubricant makers and importers, such as recovery, valorization, and regeneration by a specific date or deadline, usually at least 95% recovery, 100% valorization and at least 50% regeneration of used oils.
 - Material valuation. Regeneration.

This section should define the condition of the regenerated used oil or final base oil to be marketed.

- Energy use of used oils. Burning. This section explains the conditions that used oils should meet in order to be incinerated, as well as the prevention of air pollution emissions in incineration facilities.
- Integrated Management Systems (IMS). This section should explain what IMS are and how they function legally and financially, including obligations and responsibilities.
- Financing of Integrated Management Systems. It should explain how the IMS will be financed.
- Information to the public administration. This section should list the information to be collected and sent to the authorities regarding lubricants sold on the market (including imports), used oils collected and treated, etc.
- Information campaigns and awareness. This section should explain the information campaigns and awareness activities to be implemented, particularly for collection, storage and ESM of used oils and marketable base oils. Penalties. Penalties for non-compliance should be explained in this section.

Annexes could include:

- Documents and information which

have to be delivered by economic agents to the public administration for proper management and supervision;

- Document for the control and monitoring of used oils. This section should explain all the documents that should be used between producers and hazardous waste management companies and between hazardous waste management companies. Document A could control the transfer of used oil of small producers and workshops to authorized collectors (annual quantity collected less than 5000 litres) and document B could be for large producers (annual quantity collected more than 5000 litres).

Financial plan

The purpose of the financial plan is to fund all costs associated with the IMS for the environmentally sound management of used oils, including a reasonable profit for all companies involved.

As stated before, lubricant makers and importers should be obliged to secure financing to assure the sound management of used oil in the country, individually as a company or through an Integrated Management System (IMS).

Integrated Management Systems are

usually financed by an amount per kg of oil or lubricant sold on the market. Integrated Management Systems will then finance all costs associated with the proper management of used oils including a reasonable profit for all companies involved in the process (usually 7-8%).

The IMS will usually finance the collection, transport, storage, analysis, previous or secondary treatment and regeneration of used oils. No funding should normally be allocated to used oil use for energy recovery, incineration, or any other option which involves its use as a fuel.

3.4 Step 4: Create a database of consumption of new lubricant oils

The next step is to create a national database of consumption of lubricant oil in order to have available (monthly and annual) information on the amount and types of lubricants which are consumed (sold) across the country by domestic producers and importers.

This information must be provided by lubricant manufacturers and importers, individually or through industry associations to the government. Used oil generated from lubricant consumption in any country is usually estimated to be the following:

(A) From all lubricants sold, it generates 40% of used oils; and
 (B) From all lubricants sold (excluding the types that do not generate used oil (types 3, 7 and 10 according to Europalub classification and coding, see annexes), it generates 44% of used oils.

A proposed control sheet is included below as an example of what this database should look like.

Developed databases should be in line with Basel Convention reporting requirements.

LUBRICANT CLASSIFICATION EUROPALUB AND CONSUMPTION (SALES) ANNUAL

		YEAR												Cumulative total
Ref	Product Group	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	
1	Engine oils													
10	Additives and brake fluids													
2	Gear oils and transmission													
3	Greases													
4	Metal working oils													
5	Highly refined oils													
6	Other oils													
7	Processing oils													
9	Marine and aeronautic oils													
Cumulative		0	0	0	0	0	0	0	0	0	0	0	0	0

Total oils which generate used oil 0 (l)

Ref	Product Group	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Cumulative total
A	Automotive (G1+2A+2A1+2B+2B1-1D)													0
G	Greases (G3)													0
I	Industrial (1D+2C+2D+2D1+G4+G5+G6+G10)													0
M	Marine and aeronautics (G9)													0
P	Process (G7)													0
Cumulative		0	0	0	0	0	0	0	0	0	0	0	0	0

Total oils which generate used oil 0 (l)

(A) From all new lubricants sold, it generates 40% of used oils
 (B) From all lubricants sold (excluding the types that do not generate used oil (types 3, 7 and 10, in blue); it generates 44% of used oils.

3.5 Step 5: Create a database of recovered used oil, ratios and objectives

The next step proposed is to create a national database of recovered used

oil and the final use of collected used oil. The following table is shown as an example of required information for proper management of used oils and wise decision making.

DATA BASE OF USED OIL COLLECTED

Used oil collected (tonnes)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Cumulative total
1 Total													0

RECOVERED USED OIL

YEAR

Recovered used oil (tonnes)	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Cumulative total
1 IN COUNTRY (1)													
1.1 Regeneration/ re-refining													0
1.2 Combustion (replacing heavy fuel oil)													0
1.3 Combustion (replacing coal)													0
1.4 Other recycled uses													0
TOTAL IN COUNTRY USED	0												
2 FOR EXPORT (2)													
2.1 Regeneration/ re-refining													0
2.2 Combustion (replacing heavy fuel oil)													0
2.3 Combustion (replacing coal)													0
2.4 Other recycled uses													0
TOTAL USES FOR EXPORT	0												
3 FROM IMPORT (3)													
3.1 Regeneration/ re-refining													0
3.2 Combustion (replacing heavy fuel oil)													0
3.3 Combustion (replacing coal)													0
3.4 Other recycled uses													0
TOTAL USES FROM IMPORT	0												
4 TOTAL (1) + (2) + (3)													
4.1 Regeneration/ re-refining													0
4.2 Combustion (replacing heavy fuel oil)													0
4.3 Combustion (replacing coal)													0
4.4 Other recycled uses													0
TOTAL RECOVERED IN COUNTRY + EXPORT + IMPORT	0												

3.5.1 Efficiency ratios and environmental compliance objectives

The result of the disposal of used oils on efficiency ratios and environmental objectives achieved once established is shown. Efficiency ratios and environmental compliance objectives

are key indicators needed to measure the Integrated Management System (IMS) performance. The following table is shown as an example of necessary information for wise management of used oils in any country.

RESULTS OF USED OIL MANAGEMENT		Quantity (tonnes)		
		2013	2014	2015
NEW LUBRICANT OIL AND USED OIL GENERATED				
1	Consumption of new oils (no types 3, 7, and 10)	0		
2	Products that are not collected as used oil (types 3, 7 and 10)	0	0	0
3	Total consumption of new oils	1+2	0	0
4	Used oil potentially generated (tonnes / %) (est. 44%)	3 of 1	0	0
USED OIL COLLECTED				
5	Used oil collected and sent to recovery	0	0	0
RECOVERED USED OIL FINAL DESTINATION				
6	Regeneration/ re-refining	0	0	0
7	Combustion (burning)	0	0	0
8	Other recycled uses	0	0	0
9	Total recovered	6+7+8	0	0

EFFICIENCY RATIOS AND COMPLIANCE OBJECTIVES	FORMULA	PROPOSED OBJECTIVES	CURRENT RATIOS			
			2013	2014	2015	
E1	Collection rate	E1=5/4	95%	0	0	0
E2	Regeneration/ re-refining	E2=6/5	100%	0	0	0
E3	Combustion rate	E3=7/5	0	0	0	0
E4	Other recycled uses rate	E4=8/5	0	0	0	0
E5	Total recovered rate	E5=9/5	100%	0	0	0
E6	Total used oil collected per capita (Kg/population)	E6=(5/population)x1000	-	0	0	0

3.6 Step 6: Initiate used oil collection logistics

In order to establish used oil collection logistics, several issues should be previously organized:

List of producers

A list of used oil producers should be identified, indicating the location of all workshops and industries, which acquire or consume lubricants and industrial oils. The government should provide an identifying code number for each producer.

Territorial organization

Establish whether the control of used oil management will be at national or regional level.

Producer

The used oil producer should have an individual code as well as drums to store used oil. These drums should be located in a covered place with easy access and secondary containment. Storage drums should be labelled with the product identification as toxic and hazardous materials according to local environmental legislation. Producers should be required to deliver used oil to an authorized hazardous waste management company.

Producers should also be sent to the

appropriate public administration, an annual statement on used oil generated and delivered to authorized hazardous waste management company and transporters, maintaining official registration documents.

Transport for oil collection

As a first step for used oil collection, the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) could be used as a reference. This Agreement was developed in Geneva in 1957 under the auspices of the United Nations Economic Commission for Europe, entering into force in 1968, amended in 1975 and entering into force again in 1985. The key article of this Agreement is the second, which states that apart from some excessively dangerous goods, other dangerous goods may be carried internationally in road vehicles subject to compliance with the conditions laid down in Annex A for the goods in question, as regards their packaging and labeling; and the conditions laid down in Annex B, as regards the construction, equipment and operation of the vehicle carrying the goods in question.

The collection of used oil is usually carried out using trucks with a useful load of 4 to 12 t. These trucks are

equipped with a pump allowing the draining of used oil from containers or drums located in workshops and industries.

The used oil truck driver will pick up used oils from producers and fill out the official collection form. This official document includes detailed information about the transporter, producer, date of collection, amount collected and the final destination or the transfer centre.

Transfer centres

A transfer centre is the facility for used oil reception, analysis, classification and temporary storage of collected used oil in a territorial work area.

Transfer centres receive the collected used oil usually within a radius of 150 km and once analysed and classified, it is sent to authorized end-use plants either in the country or abroad.

Collection business model

The collection business model can be public, private or a public-private partnership. The collection process could be organized and authorized to one or several collectors if the collection is regional.

If the collection of used oil is awarded

by public tender to a collector per region for a certain time (5 years for example), it will ensure greater control of producers and transporters as well as better compliance with environmental objectives. In this case, the collection contractor should have a transfer centre.

Existence of uncontrolled collectors

In this case, there are small collectors of used oil present who are not controlled; this is usually due to the existence of a network of potential consumers which replace fuel with used oil for economic reasons. This situation might have significant impact on the environment and human health due to air pollution.

Another problem in this circumstance is that the used oil collection service is not guaranteed to all producers, only to large producers. In addition, the fall in the price of fuel can prevent the collection of used oil as it becomes economically unprofitable.

The final destination of used oil should be controlled to prevent delivery by producers (workshops and industries) to unauthorized collectors.

The use of used oil as fuel should be avoided in any unauthorized facility which does not comply with minimum

pollution prevention requirements for used oil burning such as brickworks, ceramic factories, bakeries, workshops or other industries.

Also, the reception in transfer centres of used oil from small collectors should be promoted to ensure high collection rates and proper management.

In addition to used oil, used oil filters are also found in many workshops. Used oil filters, as a hazardous waste, should be managed in accordance with local environmental legislation on hazardous waste, following a different type of collection and treatment from used oils. Used oil filters are usually managed in authorized facilities by emptying them of used oil. Then, the metallic part is separated for recycling and the paper used oil part is sent for incineration in authorized facilities.

3.7 Step 7: Establish used oil transfer centres

The objective should be to implement regional transfer centres to receive, analyse and store the oil collected from small collectors. In the case of large collectors, they should have their own transfer centres.

Transfer centres should cover used oil collection within a radius of 150 km. The stored used oil should be sent to the

authorized final-use facility.

In this case, ecological objectives are established, the final use of the used oil will be in accordance with the established percentage:

- % regeneration;
- % pre-treatment and used as fuel in authorized plants; and
- % burned in cement or similar facilities.

A transfer centre should have laboratory equipment to analyse received used oil and then send it to its final destination. This used oil analysis should include:

- Chlorine levels;
- PCBs;
- Water; and
- Sediments.

In addition, the transfer centre should have the following minimum equipment:

- Two circuit suction pumps, with reversible loading and unloading, with filters and sampling;
- A minimum of three 35 m³ storage tanks to store and one 8 m³ tank

A transfer centre, which satisfies the above criteria, can manage about 10,000 t of used oil per year.

All tanks should have secondary containment to avoid soil and groundwater contamination with a storage capacity of at least 110%. For used oil tank storage requirements, the European Standard CSN EN 12285-2.

Workshop fabricated steel tanks - Part 2: Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids, could be used as a reference (www.en-standard.eu).



Example of transfer centre with a storage capacity for used oil of 260 m³

3.8 Step 8: Establish used oil regeneration/re-refining plants

In order to establish re-refining/ regeneration of industrial used oil (mineral and synthetic) plant, a process is necessary which allows the elimination of contaminants (toxic and dangerous substances) so used oil regains the original characteristics of lubricant oil.

This process should be based on the Best Available Techniques (BAT) for the re-refining of used oil. In order to develop this process, it should comply with the definition what is meant by 'regeneration - re-refining'.

We can define 'regeneration-re-refining' of used oil as the process which generates industrial base oil, by refining and combining distillation with a physical-chemical process eliminating contaminants, oxidation products, spent additives and heavy metals. The objective is to make used oil suitable again for the same initial use, according to quality standards and technical specifications.

With the purpose to attain such objectives, regeneration plants should have the following units:

- Dewatering unit for water and sludge treatment.

- Distillation unit to treat different viscosities of oil bases.
- Elimination of asphalt and metals through the distillation unit or by treatment with propane.
- Final treatment unit for the removal of contaminants, through a chemical and hydrogenation process, removing any residual oxidation product such as chlorates and sulphates.

A specific treatment is also used to improve the colour and odour of bases. This physical treatment does not eliminate contaminants in the used oil.

It is considered as a regeneration process, when the yield of base obtained is superior to 60%, considering the yield on dry basis, by applying the best BAT.

In addition, the process must comply with environmental authorizations as well as local legislation on air emissions, wastewater discharges, spills, odours or other applicable environmental legislation.

In regards to establishing a regeneration plant to make it economically feasible, the government should guarantee an annual collection of 15,000 to 20,000 tonnes of used oils at a reasonable used oil price. Used oil may not be suitable

for regeneration if it is highly contaminated. In general terms, used oil should be accepted for regeneration if the following parameters are met:

- Water <8%;
- Chlorine < 2000 ppm;
- PCBs < 50 ppm; and
- Flashpoint >150°C.

If these parameters are not met, the contaminated used oil should be returned to the used oil producer for proper clean up treatment or be properly treated at the regeneration plant before regeneration use.

The energy valorization of used oils should only be implemented if used oils are previously analyzed and treated to assure compliance with the air emissions legislation applicable to the used oil incineration or energy valorization facility.

If there is no proper infrastructure in place and a country desires to export used oil, this process should comply with the conditions stated in Article 6. Transboundary movement between parties or Article 7. Transboundary movement from a party through states which are not parties and Article 8. Duty to re-import of the Basel Convention.

POLLUTION PREVENTION CASE STUDIES

4.1. Extended Producer Responsibility for used oils: SIGAUS (Integrated Management System of Used Oils), Spain

Introduction

In Spain, like in many other European countries, used oil management has been regulated by a producer extended responsibility system, requiring lubricant makers to guarantee and finance the sound management of used oils in the Spanish market. This system is in line with the different EU Directives demanding measures to ensure the collection and sound management of used oil including economic mechanisms such as incorporating in the lubricant price, the cost of its management at the end of its useful life.

SIGAUS is the Integrated Management System (IMS) organization in charge of collection and sound management of used oil. SIGAUS is a non-profit organization which started operation in 2007, when Spain applied Producer Extended Responsibility substituting a less efficient system of grants applied to finance used oil collection and treatment companies.

SIGAUS covers 90% of the lubricant

market representing almost 200 companies and operating in all economic sectors marketing lubricants. SIGAUS is authorized to operate in all Spanish regions having an effective management network by means of contracts with third-party companies and covering all phases of the used oil process, from collection to final treatment.

Economics

As a non-profit organization, SIGAUS uses 100% of its revenues for the recovery and recycling of used oil, financing all life-cycle used oil operations and implemented by contracted companies. As stated in the law, this financing comes from lubricant makers participating in SIGAUS (and materialized by a 0.06-euro-per-kilo tax on lubricants sold in the Spanish market). Through this system, lubricant makers and importers fulfil their obligations for the management of lubricants once they become used oil.

In addition, Spanish legislation has been more stringent than others in the EU, being one of the few European countries adopting specific environmental objectives in the recovery and regeneration of used oils. In the case of regeneration, the European legislation establishes that

regeneration is the most favourable treatment, and recommends that Member States take measures to prioritize regeneration as the final destination of used oil.

SIGAUS system has proven to be an effective mechanism to reach the environmental legal objectives which include recovering more than 95% of the used oils, valorising 100% of them and regenerating more than 65% of total used oil (not all used oils can be regenerated). Since SIGAUS began operation, these objectives have been attained without exception, producing high collection and regeneration rates for the first time in used oil management history in Spain, being one of the European leaders in this sense.

Based on these objectives, in 2014, SIGAUS recovered 126,089 tonnes of used oils in Spain, of which 85,438 tonnes went to regeneration. Regeneration yields a double benefit. One benefit is economic by saving scarce and expensive raw materials such as petroleum. The other benefit is environmental, preventing pollution impacts on the environment and CO2 emissions (related to lubricant production refined from petroleum and used oil utilization as fuel).

The attainment of these objectives has been possible thanks to a solid and extensive network of 130 contracted companies authorized in all Spanish regions and operating in all life-cycle phases of used oils such as collection, transport, storage, analysis, pre-treatment and final treatment. In regard to collection, SIGAUS has created more than 60,000 points all over Spain (including Balearic Islands, Canary Islands, Ceuta and Melilla) providing a collection service including rural areas, regardless of the volume to be collected and the distance to transfer or management centres. It is therefore ensured that used oil does not have a negative impact especially in protected natural areas.

Once used oil has been collected, two treatment processes are possible: regeneration and energy recovery. As mentioned, the regulatory scheme demands that at least 65% of used oil be used for regeneration. On the other hand, used oils that are not regenerated are subjected to physical-chemical treatment to obtain a fuel similar to fuel oil that can be used in power plants, cement plants, paper mills or other industrial facilities.

Related to the market, SIGAUS represents 90% of lubricants sold

and consumed in Spain, which is the proportion of SIGAUS members' sales in the Spanish market. This proportion is applied when financing used oil management operations by contracted companies, assuming its responsibility (on behalf of its member companies) on 90% of used oil generated in Spain. Of this quota, 2.89% of used oil is sold by unidentified companies that are not associated with any IMS and are in a fraud situation. SIGAUS assumes its management voluntarily, as the major IMS in the Spanish market.

In addition to collection and treatment operations, SIGAUS also works on prevention and mitigation of environmental impacts associated with the consumption of industrial oils. Since 2010, SIGAUS has encouraged lubricant makers to implement prevention measures related to the design process and application of lubricants and training on best practices. The idea is reduce the volume of used oil produced, thanks to wise product use, increase in the life cycle length, and improving performance characteristics while reducing their polluting potential and subsequent treatment. These actions are presented in the Prevention Business Plans developed by SIGAUS whose current version is valid from 2014 to 2017.

One of SIGAUS' commitments refers to guarantee the security and reliability of information coming from all used oil management operations. On that regard, SIGAUS develops periodically through an external and independent entity, the revision and verification of used oil declarations done by lubricant makers and companies, checking the accuracy of data. This revision guarantees the same conditions for companies participating in the system, which are competitors in the market, showing the objectivity and neutrality of SIGAUS as an IMS entity.

Another important issue for SIGAUS is communication. SIGAUS informs all stakeholders of its activity, as well as the environmental benefits derived from its mandate. In this sense, SIGAUS informs all stakeholders throughout the life cycle of used oil such as lubricant makers, used oil management companies, used oil producers and the public administration. In addition, SIGAUS carries out awareness campaigns for civil society about its work and environmental the benefits of used oil recovery, through different channels such as the website www.sigaus.es, social networks, publications and media campaigns.

Sources of information

For more information, please contact SIGAUS: Avda. Europa 34 - D, 3ºB. 28023 Madrid (Spain). Website: www.sigaus.es

4.2. 100% regeneration: the Catalan Used Oil Treatment Company (CATOR, S.A.)

Introduction

Catalonia is an autonomous region of Spain. It occupies an area of around 32,000 sq. km and has a population of almost 7 million. Catalonia consumes around 20% of lubricants of the Spanish market.

In 1992, before CATOR started operation, the situation of used oil management was as follows:

- Regulations were in place. Priority was given to regeneration rather than combustion. A subsidy was available for used oil pre-treatment and regeneration, and use of used oil as fuel;
- Low percentage of collection. Less than 15% of lubricants sold were collected;
- Regeneration of used oils was not working. Despite regulations, only 6,000 tonnes out of 480,000 tonnes of lubricants sold in Spain were regenerated;
- Use as fuel. used oil was used as fuel with little environmental control;

- Use and illegal dumping. Much of the used oil was not managed in a legal and controlled manner;
- Lack of producer census. There was not specific census of used oil producers (workshops and industries); and
- Lack of statistics. Statistics were incomplete and no institution was in charge of them.

In view of this situation, the Catalan Government declared the management of used oil a public service and established the obligation to collect and regenerate 100% of used oil generated in its territory. Through an open tender, the Ministry of the Environment awarded the private company CATOR, the management of used oils in Catalonia with the objective of achieving:

- Census of producers. Making a census and coding of all used oil producers (workshops and industries);
- Collecting 100% of the used oil produced. Having a collection strategy and a fleet of trucks to ensure its collection throughout the territory;
- Analysing and sampling. The objective is to ensure that collected waste oil is as clean as possible and there is no appearance of other pollutants such as solvents, PCBs, glycols, etc.; and
- 100% regeneration of oil collected. A

regeneration plant was designed and built with treatment capacity for all used oil generated, having a clean and efficient process with best available technologies, recovering products extracted from used oil and producing high-quality bases.

The public administration began to pay a subsidy per kilo of oil collected and per kilo of regenerated oil. From 2006 and through an IMS (Integrated Management System), these subsidies were paid by producers, based on the polluter pays principle (PPP) and the extended producer responsibility (EPR).

The success of this used oil regeneration model is primarily due to the political will of the Government and competent authorities to pass regulations and ensure their enforcement.

CATOR has collected almost 100% of used oil generated in Catalonia. It represents about 40% of the total annual consumption of lubricants, reaching a peak of up 30,000 t per year while regenerating 100% of collected oil.

CATOR also designed and implemented an awareness campaign on used oil management for public administrations, private sector associations, trade unions, environmental groups, schools

and the general public. This awareness campaign includes the explanation of the environmental hazard generated by the mismanagement of used oil and the risks to the environment and human health. In addition, the benefits and obligations of each party involved in the generation, collection and regeneration of used oil and the benefits for society and the environment were also presented. The benefits explained included optimizing resources such as petroleum, which is a limited and non-renewable resource, preserving the environment, preventing pollution of soil, groundwater and air and fighting against climate change.

Census of producers

As part of the used oil logistics system, a register of all producers and holders of used oil (workshops and industries) was developed including their locations. This census has reached about 16,000 used oil producers. The most relevant information included in the census is the following:

- Name and identification of producer;
- Allocation of the corresponding used oil producer codes;
- Address, coordinates, town, telephone, postcode and other related information;
- Annual estimate of used oil produced;

- Type of used oil produced (Higher consumption);
- Temporary storage;
- Capacity and type of drums for used oil storage;
- Type of access to facility (on-site and around site); and
- Type of truck needed for efficient collection.

Collection strategy

Much of the regeneration success is attributed to the collection process. Good design and implementation of logistics produces efficient collection in quantity and quality, preventing the mixing with other wastes such as glycols, solvents, PCBs, water, etc.

Another important aspect is to implement waste collection by pumping directly from producers drums eliminating the absorption of dirt and transport of contaminated containers. This system allows:

- Sector planning of territory, areas, provinces, towns, populations, etc.;
- Design and scaling up the fleet of collecting vehicles according to needs;
- Provide monthly and annual producers and management statistics;
- Plan for efficient routes for collection; and
- Prepare documents and labels in

advance for each used oil collection and sampling.

Transfer centres

Design and install transfer centres that can receive collected used oil and send it to the regeneration plant. The transfer centres provide service in areas within a radius of 300 km. These centres have a minimum storage capacity of 120 m³ along with the following:

- Loading and unloading lines with suction pumps and a sampling system, and
- One (1) 1-m³ container for water purge of tanks.

These installations have secondary containment for any leaks.

CATOR has storage capacity in the regeneration plant, besides two transfer centres with a capacity of 120 m³ each and an annual turnover of around 10,000 tonnes of used oil.

Transitional period

During the construction of the regeneration plant, used oil was sold and sent to other authorized regeneration plants. In cases where there are no regeneration plants in the country, the export of used oil to abroad regeneration plants allows to

get revenues based on the oil quality and expected performance in the regeneration process to compensate collection costs.

Analysis

CATOR has a laboratory for collected oil analysis and for quality control of the regeneration plant. All collected oil is analysed from a sample taken from each producer, with following acceptance limits:

- Water <8%;
- Chlorine < 2000 ppm;
- PCBs < 50 ppm; and
- Flashpoint > 150°C.

The plant can receive used oil with a higher content of water, chlorine and glycols but the producer must pay for pre-treatment.

Regeneration plant

The process at CATOR is based on an improved Vaxon technology. The plant has a treatment capacity of 42,000 tonnes of used oil per year. The most important treatment units are:

- Pre-Treatment;
- Distillation;
- Final treatment; and
- Water treatment plant.

As a result of treatment, three different base oils are obtained: 100N, 150N and 300N, which are sold to oil producers to manufacture new lubricants of the same quality as the first refining oils. In addition, Spindle oil and other end light oils are obtained and used in the treatment plant as fuel. Asphalt flux is also produced and used as asphalt product (waterproofing materials and asphalt for roads). The base oil obtained is marketed as REGENOIL and has obtained the approval certificates ACEAS_98, API SH/SJ and CF-4CG4

The plant is equipped with the following additional environmental measures:

- There is no discharge of industrial wastewater;
- The water generated is treated and reused in the refrigeration process; and
- Emissions comply with air pollution regulations.

The company is also certified with ISO 14001:08 and ISO 9001:04. The continuous improvement of processes allows all used oil from Catalonia, Spain and additional imported used oil to be treated. CATOR has accomplished a high efficiency, producing high-quality products while generating minimum waste.

Sources of information/related web links

For more information, please contact: CATOR. C/ Puig i Cadafalch, 17. Polígono Industrial Rubí-Sud. 08191 Rubí (Barcelona), Spain. Tel. +34 93 4882467. info@cator-sa.com. Website: www.cator-sa.com

4.3. Used lubricant oil management: Eco-Zit, Tunisia

I. Introduction

Over the years, industrial development around the world has generated a level of pollution that has reached critical thresholds for our planet. With increasing awareness of the danger, there is a growing concern at both national and international level to protect the environment and regulation in this sense is becoming increasingly strict.

Thus, in many countries and regions, environmental decontamination and protection policies advocate not only waste collection and storage but also waste recycling.

Within this international dynamic, Tunisia has been one of the first countries to have responded to this problem and has been collecting and refining used oils since 1979, having

created a state-owned company for this purpose – the Société Tunisienne de Lubrifiants (SOTULUB).

Within this context, a plant and collection centres were built and have been operating since 1984.

Subsequently, enactment in 1996 of the law regulating waste and waste management and disposal has required the implementation and organization of a system to guarantee collection, treatment and sale of refined used oils and the levying of an eco-tax.

The National Waste Management Agency (Agence Nationale de Gestion

des Déchets, ANGED), created in 2005, has been commissioned by the State to assure monitoring of the system and the creation of a network called 'Eco-Zit'.

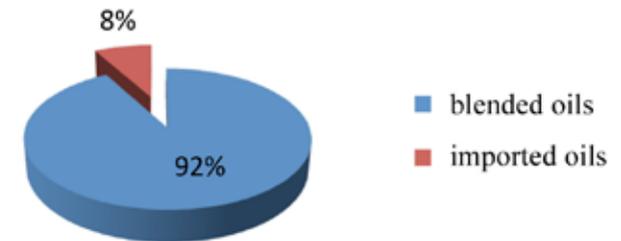
II. Quantities of lubricant oils

About 50,000 tonnes of lubricant oils are sold each year on the Tunisian market, as follows:

- 46,000 tonnes are blended locally, equivalent to 92% of the total placed on the market;
- About 4,000 tonnes are imported, equivalent to 8% of the total.

The quantity of collectable used

Quantities of lubricating oils



lubricant oils is estimated at 25,000 tonnes per year (about 50% of the total quantity sold on the local market, which is also the proportion used as an international benchmark).

The washing and emptying stations are the greatest holders of lubricant oils, with about 50%.

III. Regulatory framework

Decree no. 2002-693 of 1 April 2002 concerning the conditions and processes for returning used lubricant oils and used oil filters and their management, as amended and modified by Decree no. 2008-2565 of 7 July 2008, provides that:

1. Importers and distributors of new lubricant oils who import and place on the local market quantities of new lubricant oils not exceeding 500 tonnes must choose between one of the following options:
 - Pay the charges for the collection, transportation and storage of used lubricant oils in exchange for not taking back their share in regenerated base oils.
 - Or take back their share in regenerated oils and pay the cost of regeneration plus the cost of collection, transportation and storage.
2. The other new lubricant oil producers

and distributors must take back their share in regenerated oils, equivalent to the quantity of new oils placed on the market by each company.

IV. Current management of the system

1. ANGED is currently responsible for managing the public used lubricant oil return and regeneration system, called 'Eco-Zit', pursuant to Article 7 of Decree no. 2002-693 of 1 April 2002.
2. ANGED's functions are currently the following:
 - Develop the system by carrying out studies and implementing management programmes for these waste products;
 - Monitor and evaluate management of these waste products (collection, transportation, treatment and recovery);
 - Finance awareness-raising operations and pilot programmes in used lubricant oil management.
3. With the framework of a specific agreement, ANGED has commissioned the Société Tunisienne de Lubrifiants (SOTULUB) to carry out used lubricant oil collection, storage and regeneration operations. SOTULUB is currently the only authorised company in this field, with more than 30 years of experience;
4. The 'Eco-Zit' system is funded by the contributions made by its members (lubricant oil producers and importers).

These contributions are calculated on the basis of how each tonne of lubricant oils is managed.

Collection

1. Used lubricant oils are collected at about 10,000 collection points located in all parts of Tunisia;
2. SOTULUB has commissioned 11 subcontractors, located in different parts of Tunisia, to carry out used lubricant oil collection and transportation operations, under the terms of appropriate contracts;
3. It currently collects 15,000 tonnes of used lubricant oils (about 60% of the collectable quantities).

Recovery

1. SOTULUB performs the used lubricant oil regeneration operations at the plant located in the industrial area of Jarzouna, with a capacity of 16,000 tonnes of used lubricants each year (about 64% of the total of collectable lubricants);
2. Each year, SOTULUB regenerates about 10,000 tonnes.

Within the framework of monitoring compliance with the public used lubricant oil return and regeneration system, a joint order by the Ministry of Finance, Environment and Sustainable Development, the Ministry of Trade

and Craft and the Ministry of Industry and Technology was enacted on 4 June 2009, giving the list of imported lubricant oils and oil filters that are subject to the provisions of Decree no. 2002-693 of 1 April 2002, amended and supplemented by Decree no. 2008-2565 of 7 July 2008.

In compliance with this order, on 19 June 2009, the ANGED started to monitor lubricant oil and oil filter import operations through the authorisations of import invoices, in cooperation with the Tunisian customs authorities. A database was developed and implemented to make it easier to organize monitoring of these processes.

V. The Société Tunisienne de Lubrifiants

The Société Tunisienne de Lubrifiants (SOTULUB) is a public limited company created in July 1979 with the following corporate purpose:

1. Collection and regeneration of used lubricant oils
2. Manufacture and marketing of lubricant greases
3. Physico-chemical analyses

Until the end of the '80s, SOTULUB used an acid-earth process for used

oil regeneration which had to be discontinued for economic and above all environmental reasons. Faced with this dual requirement to combat pollution and adjust quality and cost to market conditions, SOTULUB developed a new, proprietary process which it has been using since the early '90s and has patented worldwide. It has become a key asset in partnership and cooperation policies within Tunisia and abroad.

SOTULUB's industrial plant has been modified in order to meet the requirements of the new process, adding new hi-tech equipment.

The SOTULUB process

Used oil regeneration according to the SOTULUB process consists of the following stages:

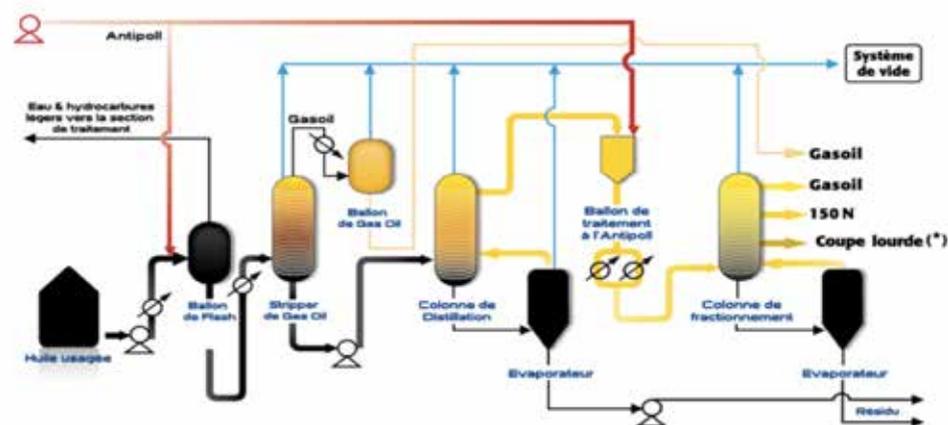
- **Dehydration and quintessence removal:** The used oil taken from storage is pumped through a filter, preheated in heat exchangers, recovering energy from the hot end products, and then treated with an additive called Antipoll.

- **Diesel stripping:** The dehydrated oil is sent to the diesel stripping column. After condensation and separation, the diesel is pumped to the storage tank and the gases are burnt in the heating oil oven.

- **Vacuum distillation:** The oil from the diesel stripping column enters a vacuum distillation column connected to a thin-layer evaporator where separation of the lubricant fraction and the residue takes place. There follows a second treatment with Antipoll.

- **Fractionation:** The lubricant cut is then sent to the fractionating column. The lubricant is separated into two cuts of regenerated base oils (150 NR and 350 NR), which have the same specifications as those of the corresponding new oils.

Installation diagram



Industrial products Oils

Two cuts of regenerated base oils are produced, a light cut 150 NR and a heavy cut 350 NR. Base oil consumption in Tunisia has undergone a very significant qualitative evolution towards light cuts and away from heavy cuts. This has meant that the oil used is increasingly lighter and has reversed the distribution of regenerated oils towards the light cut. Furthermore, the heavy cut produced, which was initially 600 NR, is now 350 NR. These two cuts comply with **international specifications** for the corresponding new base oils and the increasingly demanding requirements of SOTULUB's

customers, consisting of multinational customers operating in the oil industry.

Greases

SOTULUB has a grease production plant with a rated capacity of 2400 tonnes/year. It is becoming increasingly consolidated as a leader of the Tunisian market, especially after the installation of homogenizers which enables improved finishing of the greases produced. SOTULUB produces four grease qualities with different NLGI grades, in line with the requirements of its customers, consisting mostly of multinational companies operating in the oil industry. These four grease qualities are the following:

- A **calcium** grease based on calcium soap which is for lubrication in mild conditions.
- A **multi-service** grease based on mixed lithium/calcium or pure lithium soap which can be used for lubricating all machine parts operating in normal load and speed conditions.
- A **Superstabil EP** grease based on a complex lithium soap which uses the latest lubricant grease technology. This can be used for lubricating virtually all machine parts within a temperature range between -20°C and +130°C.
- An **Akron EP** grease based on a complex lithium soap. It is exceptionally stable, with very high corrosion resistance properties, thanks to its high doping level. It is basically formulated for greasing materials used in demanding conditions, such as impacts, vibration, corrosive atmosphere and heavy loads.

By-products

Used oil regeneration gives two by-products: the first is used as an adjuvant for bitumen without any harmful effects for the environment and the second is added to commercial diesel. To comply with the line of conduct that it has set for itself, i.e. environmental protection, SOTULUB has undertaken a local complementary study to confirm the conclusions that have already been

reached regarding the lack of harmful effects on the environment caused by using the distillation column bottom as a bitumen adjuvant and to determine a means by which this product can be made available to all businesses for use. The new regeneration process does not produce any effluent that is harmful to the environment.

Investment cost

The investment cost (engineering and supervision costs, equipment costs, construction – metal structure work, equipment assembly, piping, etc.) and utilities equipment (1 air compressor, 2 steam boilers, 1 demineralisation circuit, 1 transformer station, 1 cooling tower) is approximately USD 5,800,000.

Partnership

Completion of the revamping of the used oil regeneration plant built in Kuwait within the framework of the SOTULUB/STP/KLOC tripartite agreement signed in August 1998 and successful partial adaptation in 1999 of SOTULUB's technology at the regeneration plant operated by the French company Éco-Huile (Lillebonne - France) are two examples of the success achieved by SOTULUB in its quest to broaden partnership horizons and internationalize its know-how.

Related information sources / Internet sites

To find out more, contact:

Agence Nationale de Gestion des Déchets (ANGed); 6, rue Al Amine Al Abbas – 1002 Tunis – B.P 162 – Le belvédère – Tunisia – Tel: (216-71) 791595 – E-mail: contact@anged.nat.tn
Société Tunisienne de Lubrifiants (SOTULUB); rue Lac Mälaren, Les Berges du Lac – 1053 Tunis; Tel: +216 71 86 12 34 – Fax: +216 71 86 02 38 – 71 86 11 98 – E-mail: sotulub.siege@planet.tn – website: www.sotulub.com.tn

ANNEXES

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- Afilub: www.afilub.com
- Europalub: www.europalub.org
- European Ecolabel application pack for lubricants. EU Ecolabel. www.ecolabel.eu
- European Re-refining Industry section of UEIL (Independent Union of the European Lubricants industry): <http://www.ueil.org/en/>
- European Renewable Resources and Materials Association: www.errma.com
- European Standards: www.en-standard.eu
- GEIR (Groupement européen de l'industrie de la régénération): <http://www.geir-rerefining.org/>
- Lube Media: www.lube-media.com
- Lubes'n'Greases Magazine: www.lubesngreases.com/magazine/
- Lubes'n'Greases Magazine – Europe Middle East Africa: www.lubesngreases.com/magazine-emea/
- Lubrication Management and Technology Conference: www.lubmat.org

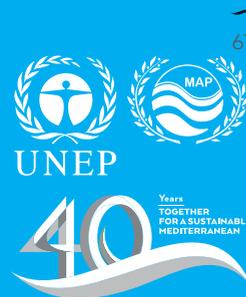
A2. List of acronyms

ADR	European agreement concerning the international carriage of dangerous goods by road
As	arsenic
API	American Petroleum Institute
CATOR	Catalan used oil treatment company
Cd	cadmium
COOU	consortium for the mandatory management of used oil (Italy)
Cr	chromium
Cu	copper
ESM	environmentally sound management
EU	European Union
EPA	Environmental Protection Agency (United States of America)
EPR	extended producer responsibility
IMS	integrated management system
ICI	independent chemical information, International Standards Organization
ISO	Organization
LBS	land based sources
MAP	mediterranean action plan
NAP	national action plan
NGO	non-governmental organization
Ni	nickel
NMP	n-metil-2-pirrolidona
PAHs	polynuclear aromatic hydrocarbons
Pb	lead
PCBs	polychlorinated biphenyls
PNAs	polynuclear aromatics
PPM	parts per million
PPP	polluter pays principle
SCPRAC	regional activity centre for sustainable consumption and production
SIGAUS	integrated management system of used oils in Spain
UNEP	United Nations Environment Programme
VCFE	vacuum cyclon flash evaporator
WWTP	waste water treatment plant
Zn	zinc

A3. EuropaLub lubricant classification

The following table shows the EuropaLub (www.europalub.org) lubricant classification and coding.

1) Engine oils	Europalub
Gasoline or diesel engine oils for passenger cars	1 A
First-fill gasoline or diesel engine oils for passenger cars	1 A1
Diesel engine oils for commercial & industrial vehicles (excluding marine and aviation)	1 B
First-fill diesel engine oils for commercial & industrial vehicles	1 B1
Universal diesel engine oils for tractors (agricultural, road construction,...)	1 B2
Two-stroke engine oils	1 C
Other engine oils	1 D
Marine engine oils (national) *	1 E
Aviation engine oils and turbine oils	1 F
2) Gear oils and transmission	
Automatic transmission fluids	2 A
Automotive gear oils	2 B
Industrial gear oils	2 C
All hydraulic transmission oils, incl. fire-resistant fluids	2 D
Shock absorber oils	2 E
4) Metalworking oils	
Quenching oils	4 A
Neat oil for metalworking	4 B
Soluble oils for metalworking	4 C
Rust prevention products	4 D
Rolling mill oils	4 E
5) Highly refined oils	
Turbine oils, excluding aviation applications	5 A
Electrical oils	5 B
6) Other oils	
Compressor oils	6 A1
Compressor oils	6 A2
General machine lubricants (incl. slide-wav, pneumatic tool...)	6 B
Other industrial oils for non-lubricating purposes	6 C
7) Processing oils	
Process oils, technical white oils, medicinal white oils, aromatic oils, waxes and paraffins	7 A, 7 A1, 7 A2, 7 B, 7C
8) Basic Oils	8 A



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