UNITED NATIONS

EP

UNEP(DEPI)/MED WG.419/3

UNITED NATIONS ENVIRONMENT PROGRAMME MEDITERRANEAN ACTION PLAN

3 July 2015
Original: English

Regional Meeting to review the used lube oil ESM guidelines
and best practices towards sustainable tannery sector in the Mediterranean

Barcelona, 22-24 July 2015

Agenda item 4: Review of ESM guide on used oil

These guidelines have been commissioned by the marine pollution assessment and control unit (MED POL) of the Mediterranean Action Plan (UNEP/MAP) from the Regional Activity Centre for Sustainable Consumption and Production (SCP/RAC) under the Medpartnership Project.

Supervision: SCP/RAC

Technical contents: PM&E sustainability consulting: www.pmecon.com and CATOR: www.cator-sa.com

April 2015

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Preface

This technical guide has been prepared under the Medpartnership project. 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 led by the 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.

This guide has been developed by UNEP MAP with the support of the Regional Activity Centre for Sustainable Consumption and Production (SCPRAC) on the framework of the project Sub-component 2.1 which aims at facilitating policy and legislation reforms for pollution prevention and control. This Sub-component seeks to develop and improve the legislative and institutional framework in the region and to implement National Action Plan (NAP) priority actions that will protect and reduce the inputs of contaminants to the Mediterranean marine environment from land-based activities.

The guide is focused on providing possible steps to the environmentally sound management (ESM) of used oils in Mediterranean countries. Due to the diversity of Mediterranean countries, this guide should be adapted to their individual conditions to be successful. The final objective of this guide is to provide information for Mediterranean countries to establish a 100% regeneration system to recycle used oils in their respective countries.

This technical guide has been structured as a step-by-step document to the environmentally sound management of used oils in any given country.

Chapter 1 provides background information, the scope of the document, information on ecolabelling for lubricants and alternatives to lubricants, in particular bio-lubricants.

Chapter 2 provides data and information on used oils, associated environmental problems caused by used oils as well as information on the main used oil treatment technologies.

Chapter 3 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.

Chapter 4 shows several case studies on used oil pollution prevention.

Chapter 1. Introduction

1.1 Pollution prevention. 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, 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 on aquatic, mountain, 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 should follow a different system of recycling from the one of used lubricant oils.

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.

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.

According to the study by Frost and Sullivan (2007) on the European Bio-lubricants Market, the estimated use of bio-lubricants in 2006 was 127,000 tonnes, with growth rates of 3.7%/y between 2000 and 2006. This volume of growth is still modest, although revenue growth is larger because of the higher price of the bio-lubes (Frost and Sullivan, 2007).

1.2 Ecolabels 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.

One of these ecolabels is designed for 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)

Chapter 2. Used oils and the environment

2.1 Introduction

'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:

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

Used oil contains polynuclear 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 wetlands, rivers, marine and fresh water organisms

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 stormwater runoff or direct discharge, 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 m^2 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 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.

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 7plants 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.

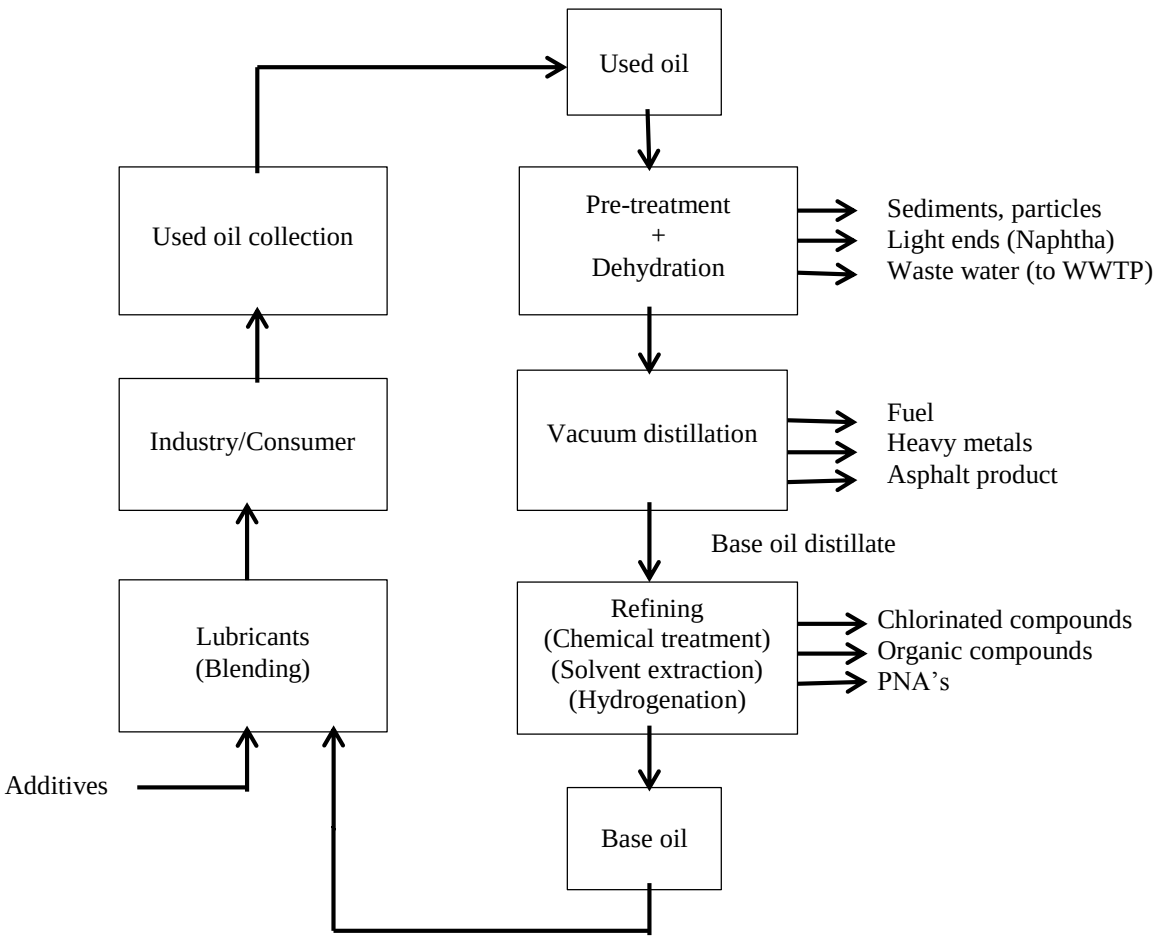


Chart 1. Regeneration (re-refining). Example of circular economy.

A brief description of the different processes that exist on the European market

Some of the various processes to treat used oils are quite similar, generally comprising a series of consecutive treatments such as pre-treatment, dewatering, vacuum distillation, deasphalting, demetallization and a final treatment where there are greater differences. This final treatment may include solvent extraction, chemical treatment and hydrofinishing and is where used oil contaminants (sulphur, chlorine, nitrogen, PNAs and oxygen) are reduced to desired levels.

This process produces base oils that are separated into different commercial fractions of varying viscosity in order to obtain marketable lubricants. These different fractions are often blended with additives. This process generates minimal waste.

The different base oil fractions obtained are the following:

- 80N-100N;
- 150N-200N; and
- 300N-350N.

The base oils obtained from different processes used in the European Union are of high quality.

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

According to the European re-refined base stocks supply, the production of re-refined base oils in Europe in 2011 was 74% for group I and 26% for Group II with the following quantities:

API Group I	385.000 t
API Group II	135.000 t
TOTAL	518.000 t

Source: Klime.

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 hylube^{tm} 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.

Chapter 3. 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), which implies as stated for example in EU Environmental legislation, the 'allocation of costs to polluters of pollution prevention and control measures to encourage the rational use of scarce environmental resources and to avoid distortions in international trade and investment'.

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). In the case of Spain (as shown in the case studies section), SIGAUS (integrated management system of used oils in Spain) is an IMS non-profit organization in charge of managing used oils in the country. In Italy, the COOU (Consortium for the mandatory management of used oil) is a similar organization.

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:

Table 1. Proposed steps for the ESM of used oils

Proposed Steps	
Step 1	Appointment of Ministry/Department responsible for used oil management
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

3.1 Step 1: Appointment of Ministry/ Department responsible for used oil management

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, 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.

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.

Table 2. Stakeholder analysis matrix

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…			
…			

Source: Adapted from Aid Delivery Methods: Project Cycle Management. European Commission, 2004.

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:
    - Legal framework of used oils (rights and obligations);
    - Logistics and collection of used oils;
    - Final treatment of used oils; and
    - Other related courses.

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;
3. Management could be based on 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)

Makers and importers of oils and lubricants placed on the market should have 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).

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 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 EU Waste Framework Directive 2008/98/EC.** Complying with the principle of waste hierarchy as a priority order of Article 4 and 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.

The used oil regulation should also include:

- Object and scope of application;
- Definitions;
- Business plans for prevention and reuse;
- Obligations regarding storage and treatment of used oils;
- Delivery system of used oils;
- Management priority;
- Ecological objectives;
- Material valuation. Regeneration;
- Energy use of used oils. Burning;
- Integrated Management Systems;
- Financing of Integrated Management Systems;
- Information to the public administration;
- Information campaigns and awareness;
- Penalties;
- Annexes;
- Documents which have to be delivered by economic agents to the public administration;
- Document for the control and monitoring of used oils; and
- Document controlling the transfer of used oil of small producers and workshops to authorized collectors (annual quantity collected less than 5000 litres) and document for large producers (annual quantity collected more than 5000 litres).

Financial plan

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% for Spain).

In the case of Spain, the profitability of the waste management system including used oil regeneration is guaranteed by the IMS as established in Royal Decree 679/2006 on used industrial oils .

In regard to a regeneration plant in Spain, the plant is profitable at an oil base price of about 750 €/t according to index ICI (Independent Chemical Information), the maximum price of used oils at 250 €/t and with a government subsidy for regeneration of 125 €/t.

The IMS will usually finance the collection, transport, storage, analysis 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.

LUBRICANT CLASSIFICATION EUROPALUB AND CONSUMPTION (SALES) ANNUAL

YEAR

Types of product not collected as used oils

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

Total oils which generate used oil **0** (B)

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** (A)

Total oils which generate used oil **0** (B)

(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 DE 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**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**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**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3	**TOTAL (1) + (2)**													
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 RECOVERED IN COUNTRY + EXPORT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**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 and10)		0	0	0
3	Total consumption of new oils	1+2	0	0	0
4	Used oil potentially generated (tonnes / %) (est. 44%)	3 of 1	0	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	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**

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

The collection of used oil is usually in trucks of 4 to 12 t. useful load. 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 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.

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 waste 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:

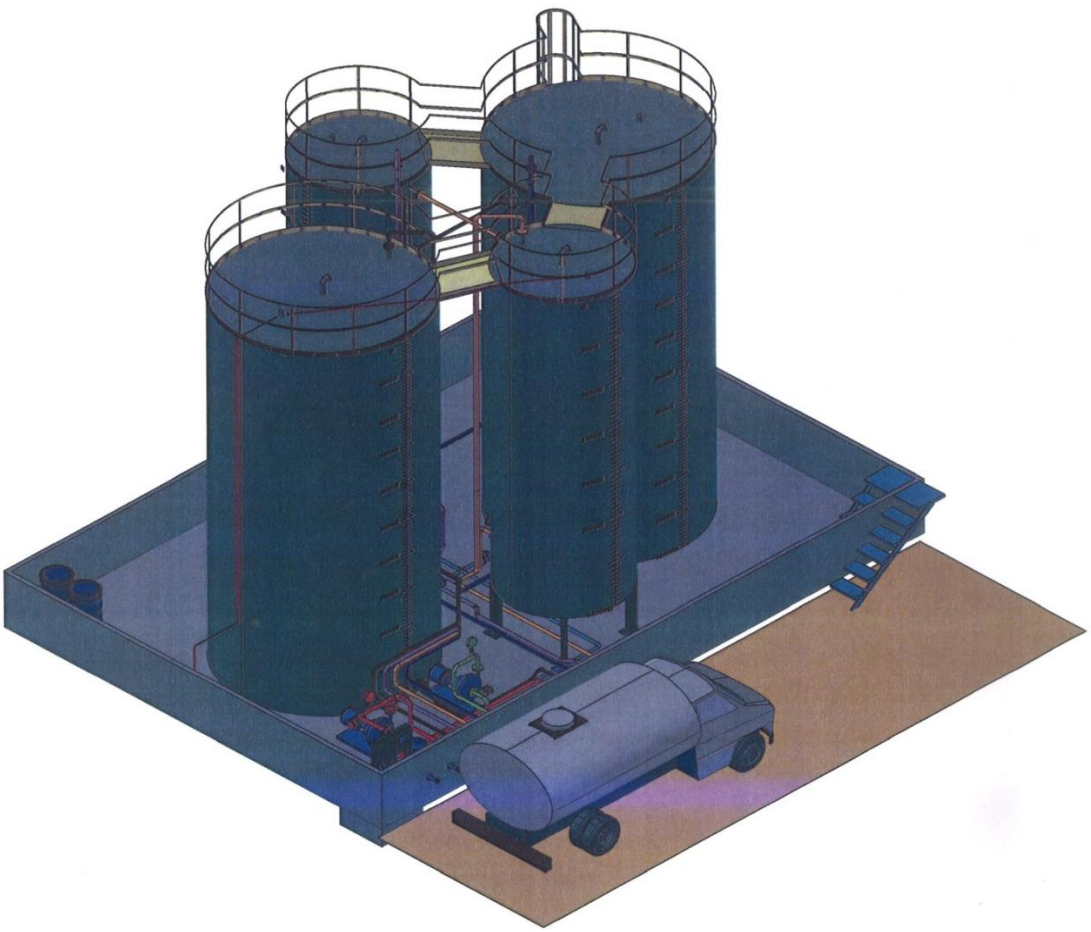
- Chlorine levels;
- PCBs;
- Water; and
- Sediments.

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 m^3 storage tanks to store and one 8 m^3 tank

All tanks should have secondary containment to avoid soil and groundwater contamination.

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



Example of transfer centre with a storage capacity for used oil of 260 m^3

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 waste 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 waste 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, doors 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.

Chapter 4. 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 CO_2 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, SIGAIS 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 m^3 along with the following:

- Loading and unloading lines with suction pumps and a sampling system, and

- One (1) 1-m^3 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

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.

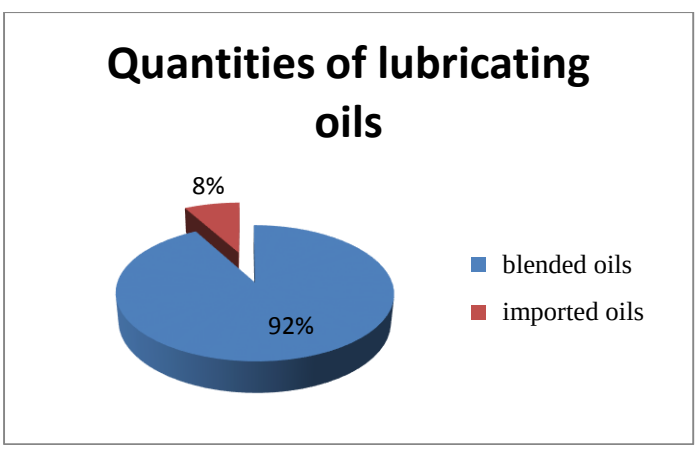
Subsequently, enactment in 1996 of the law regulating waste and waste management and disposal has required the implementation and organization of a system to guarantee collection, treatment and sale of refined used oils and the levying of an eco-tax.

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 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.

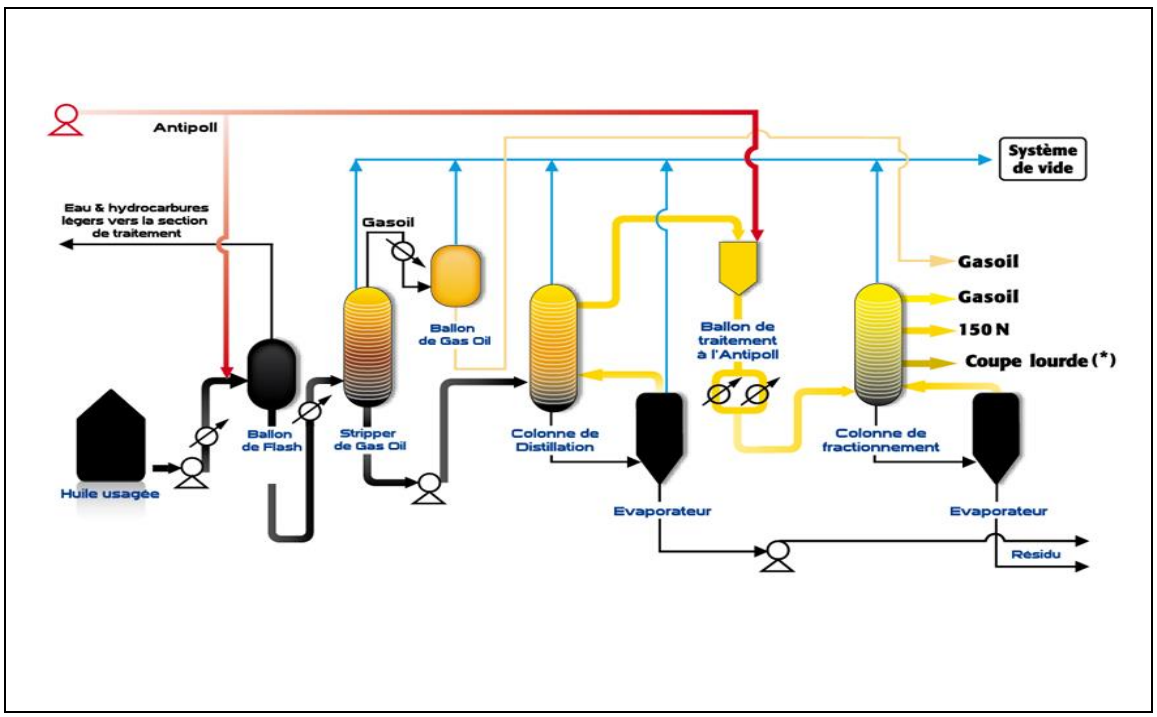
The SOTULUB process

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

A1. Bibliography and sources of information

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- 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
- Europalub: www.europalub.org
- 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

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,
ISO international standards 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 pollution 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