



NATIONAL ENVIRONMENT MANAGEMENT AUTHORITY

**TECHNICAL GUIDELINES ON THE MANAGEMENT
OF USED OIL AND OIL SLUDGE IN KENYA**



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FOREWORD

The Government of Kenya is committed to ensuring a clean and healthy environment for its citizenry. The Constitution of Kenya espouses the tenets, duties, and responsibilities of the state and its institutions to eradicate all forms of environmental degradation to promote sustainable development. As Kenya develops towards achieving vision 2030 it's imperative that all forms of development and waste associated with it are managed in a responsible manner.

According to the Environmental Management and Coordination Act, CAP 387 of the Laws of Kenya, the National Environment Management Authority (NEMA) coordinates and supervises environmental matters countrywide and is the principal instrument of government in the implementation of all environmental policies.

A key objective of NEMA is to classify hazardous wastes according to their characteristics such as corrosive waste, carcinogenic waste, flammable waste, persistent waste, toxic waste, explosive waste and radioactive waste and issue guidelines and regulations for the management of the various hazardous waste streams.

Used oil and sludge fall in the category of hazardous waste because of their characteristics and impacts to the environment. They contain heavy metals which when discharged to the environment pollute the air, soils and water bodies creating irreversible environmental problems.

In light of the above, NEMA has developed technical guidelines on the management of used oil and oil sludge in Kenya so as to assist all used oil and oil sludge handlers meet their requirements under the Environmental Management and Coordination (Water Quality) Regulations of 2006, Environmental Management and Coordination (Waste Management) regulations of 2006 and Occupational Safety and Health Requirements among others.

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PREFACE

The Constitution of Kenya, entrenches a number of environmental rights that are summed up under the over arching right to a clean and healthy environment which is provided for under Article 42. In addition, the fifth schedule specifies land, natural resources and the environment as some of the areas where a number of laws need to be enacted.

These guidelines are part of a series of environmental management tools for environmental management in Kenya under the Environmental Management and Coordination Act, CAP 387 of the Laws of Kenya and the Environmental Management and Coordination (Waste Management) Regulations, 2006.

These guidelines target government agencies (responsible for decision making, formulating policies and enforcing health and safety aspects of used oil and oil sludge management in the country), small generators, bulk generators of used oil and oil sludge, garages, used oil treatment plants, recycling and disposal facilities, and other interested stakeholders. It provides direction on safe management of used oil and oil sludge in Kenya and shall be the main regulatory reference material for management of used oil in Kenya.

The document has been designed to apply common approaches on safe handling, packaging, transportation, recycling and final disposal of used oil and oil sludge. These guidelines will be reviewed from time to time as deemed necessary.

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These guidelines are dedicated to the memory of the late Mr. Samuel Munene for his immense contributions towards the finalization of this publication.

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Table of Contents

List of Plates	vii
Acronyms	viii
Definition of Terms	ix
1.0 INTRODUCTION	1
1.1 Objectives	2
1.2 Scope	2
1.3 Types of Used Oil	2
1.4 Hazardous Characteristics of Used Oil	3
1.5 Effects of Used Oil	3
2.0 CURRENT STATUS OF USED OIL MANAGEMENT IN KENYA	4
2.1 Sources of Used Oil	4
2.2 Transportation of Used Oil	6
2.3 Recycling facilities	7
2.4 Uses of Used Oil	8
3.0 LEGAL AND INSTITUTIONAL FRAMEWORK	9
3.1 National Environment Management Authority	9
3.2 Ministry of Energy and Petroleum	10
3.3 The Kenya Bureau of Standards	11
3.4 Directorate of Occupational Safety and Health Services	12
3.5 Ministry of Health	13
3.6 Water Resources Management Authority (WRMA)	13
3.7 Compliance to the legislations	14
4.0 ROLES OF STAKEHOLDERS	15
4.1 Guidelines for Used Oil/Sludge Generators and Collectors	15
4.2 Guidelines for Used Oil from the Port	17
4.2 Guidelines for Used Oil/Sludge Collection Centers	18
4.3 Guidelines for Used Oil/Sludge Transporters	19
4.5 Guidelines for Used Oil Recycling Facilities	23
5.0 RECYCLING TECHNOLOGIES	25
5.1 Recycling Processes	25
5.2 Final Product	26
6.0 END PRODUCT USERS	27
6.1 Disposal of non-recyclable used oils	27
7.0 MANAGEMENT OF OIL SLUDGE	28
7.1 Sources of sludge	28
7.2 Characteristics of Sludge	28
7.3 Treatment methods	28
7.4 Disposal methods	29
REFERENCES	31

List of Plates

Plate 1: Sea Vessels..... 1
Plate 2: Construction and Farm Machinery 4
Plate 3: Vehicle repair in a garage 5
Plate 4: Industrial Machinery..... 6
**Plate 5: A poorly maintained yard with heavy contamination from
cumulative oil spills..... 7**
Plate 6: Drums of tar at facility yard 8
Plate 7: Bulk Generator 16
Plate 8: The Port of Mombasa 18
Plate 9: A non-compliant and a compliant used oil truck..... 19
Plate 10: View of an oil and water separator tank at a facility..... 20

Acronyms

NEMA	National Environment Management Authority
EMCA	Environmental Management and Coordination Act, CAP 387
EHS	Environmental Health and Safety
KPA	Kenya Ports Authority
KMA	Kenya Maritime Authority
PIEA	Petroleum Institute of East Africa
KRA	Kenya Revenue Authority
UoN	University of Nairobi
KEBS	Kenya Bureau of Standards
KPC	Kenya Pipeline Corporation
MoH	Ministry of Health
EPA	Environment Protection Agency
EIA	Environmental Impact Assessment
EA	Environmental Audit
LPG	Liquefied Petroleum Gas
WRMA	Water Resources Management Authority
GPS	Global Positioning Systems
PPEs	Personal Protective Equipments
PCBs	Polychlorinated Biphenyls
PAH	Poly Aromatic Hydrocarbons
SWOD	Safe Waste Oil Disposal
MSDS	Material Data Safety sheet

Definition of Terms

Act means Environmental Management and Co-ordination Act, CAP 387 of the Laws of Kenya.

Authority means the National Environment Management Authority (NEMA) established under Section 7 of the Act.

Disposal site means any area of land on which waste disposal facilities are physically located or final discharge point without the intention of retrieval but does not mean a re-use or re-cycling plant or site.

Environmentally Sound Management of used oil and oil sludge: means taking all practical steps in generation, collection, transportation, storage and disposal to ensure that used oil and oil sludge is managed in a manner which will protect human health and the environment against the adverse effects which may result from the waste.

Lubricating oil: An oily substance that is used to cover or treat machinery so as to lessen friction.

Reclamation: means treatment to separate solids and water from a variety of used oils by heating, filtering, dehydrating and centrifuging among others for purposes of obtaining fuel or fuel extender.

Recycling: means the reprocessing, reclaiming and regeneration (re-refining) of used oils by use of an appropriate selection of physical and chemical methods of treatment

Regeneration/Re-refining: means the production of base oils from used oils through processes such as pre-distillation, treatment with acids, solvent extraction, contact with activated clay and hydro-treating which remove contaminants, oxidation products and additives.

Reprocessing: means the treatment to remove insoluble contaminants and oxidation products from used oils by methods including but not limited to heating, settling, filtering, dehydrating and centrifuging to produce oil that can be used for its original purpose.

Re-use: means the reuse of used oil after reprocessing.

Oil Sludge: means a non-flowing mixture of solids and liquids.

Storage: means temporary placement of used oil/sludge in a suitable location or facility where isolation, environmental and health protection and human control are provided in order to ensure that it is subsequently retrieved for treatment and conditioning and/or disposal.

Treatment: means chemical or physical operations designed to produce from used oil, or to make used oil more suitable for production of fuel oils, lubricants, or other used oil-derived product and includes, but is not limited to blending used oil with virgin petroleum products, blending used oils to meet the fuel specification, filtration, simple distillation, chemical or physical separation and re-refining.

Used oil and/or sludge Generator: means any person whose activities or an activity under his or her direction produces used oil/ oil sludge or if that person is not known, the person who is in possession or control of that used oil/oil sludge.

Used oil: means any semi-solid or liquid product consisting totally or partially of mineral oil or synthesised hydrocarbons (synthetic oils) that has been used and as a result of such use is contaminated by impurities rendering it unsuitable for its original use and includes oily residues from tanks, oil-water mixtures, and emulsions.

1.0 INTRODUCTION

The world demand for lubricant oil is about 41.35 million metric tons. The regional distribution indicates that Africa consumes only 2.068 million metric tons of the global lubricant consumption. Within Africa, South Africa Consumes about 0.305 million metric tons of the Africa quota while Kenya consumes about 0.007 million metric tons of lubricating oils (PIEA, Kenya 2013). These lubricating oils become degraded after use due to presence of contaminants hence not fit for its intended use and require to be disposed. These contaminated oils become used oil. Improper storage, handling, transportation, treatment and disposal of the used oils results in negative environmental impacts and public health hazards.



Plate 1: Sea Vessels

Oil is insoluble, persistent and toxic due to additives and heavy metals hence can be a major source of contamination of the terrestrial and aquatic environment if indiscriminately disposed. Under the Environmental Management and Coordination (Water Quality) Regulations 2006, the effluent discharge standard for oil and grease is zero since impacts of oil on drinking water can be devastating. Generally, infrastructural facilities relating to collection, storage, transportation and recycling have also been inadequate in absence of clear guidelines.

These guidelines will contribute to reduction of pollution because they provide direction on safe management of waste oil & oil sludge. In particular they expound on the requirements stipulated in Part IV and specified in the fourth schedule of the Environmental Management and Coordination (Waste Management) Regulations of 2006 on management of hazardous waste. The guidelines may be complemented with the Energy Regulatory Commission, Environmental Health and Safety guidelines.

The U.S. EPA defines the term "used oil" as any petroleum or synthetic oil that has been used, and as a result of such use is contaminated by physical or chemical properties. "Used oil" is a precise regulatory term. "Waste oil" is a more generic term for oil that has been contaminated with substances that may or may not be hazardous. Any oil contaminated with hazardous waste may itself be a hazardous waste, and if so, must be managed subject to hazardous waste management standards. Both used oil and waste oil require proper recycling or disposal to avoid creating an environmental problem.

1.1 Objectives

Main objective

To promote safe management of used oil in Kenya.

Specific objectives:

- To ensure effective and efficient collection and transportation systems for used oil and oil sludge;
- To promote eco-friendly technologies for recycling of used oil;
- To create awareness on hazards associated with handling used oil;
- To provide guidance on infrastructure for management of used oil

1.2 Scope

These guidelines will apply to;

- a) Generation;
- b) Collection;
- c) Transportation;
- d) Storage;
- e) Recycling;
- f) Use;
- g) Disposal of used oil and oil sludge.

1.3 Types of Used Oil

There are two types of used oil, re-refinable and non-re-refinable. Re-refinable oils can be treated and reused for other purposes while the latter cannot.

1.3.1 Re-refinable used oils include:

- a) High viscosity index oils (all diesel and gasoline crankcase oils)
- b) Transmission oils
- c) Hydraulic oils (non-synthetic)
- d) Gear oils (non-fatty)
- e) Transformer oils
- f) Dryer bearing oils
- g) Compressor oils
- h) Turbine oils
- i) Machine oils (non-fatty)
- j) Grinding oils (non-fatty)
- k) Quenching oils (non-fatty)

1.3.2 Non re-refinable used oils include:

- a) Oils containing Polychlorinated Biphenyls (PCBs) and Poly-nuclear Aromatics (PNAs), Low viscosity index and Medium Viscosity Index oils
- b) Halides
- c) Synthetic oils
- d) Brake Fluids
- e) Cooking oils
- f) Asphaltic oils
- g) Black oils
- h) Bunker oils
- i) Metal working oils containing fatty acids
- j) Foam oils
- k) Rolling oils
- l) Solvents of any type

1.4 Hazardous Characteristics of Used Oil

The waste lubricant oils depict hazardous properties and impacts on various environmental media. This oil is non biodegradable hence its environmental impacts persist for a long time.

1.5 Effects of Used Oil

A release of used oil to the environment, whether by accident or otherwise, threatens ground and surface waters with oil contamination thereby endangering drinking water supplies and aquatic organisms. Spilled oil tends to accumulate in the environment, causing soil and water pollution. Spilled oil gets into the soil, leading to contaminated crops which enter into the food chain causing diseases to human. Contaminated soils also produce low yields leading to food insecurity.

Oil decomposes very slowly; it reduces the oxygen supply to the micro-organisms that break the oil down into non-hazardous compounds. Toxic gases and harmful metallic dust particles are produced by the ordinary combustion of used oil. The high concentration of metal ions, lead, zinc, chromium and copper in used oil are toxic to ecological systems and to human health when they are emitted from the exhaust stack of uncontrolled burners and furnaces.

Some of the additives used in lubricants contaminate the environment. e.g. zinc dialkyl dithiophosphates, molybdenum disulphide, and other organo-metallic compounds. Certain compounds in used oil - e.g. poly-aromatic hydrocarbons (PAH) - are very dangerous to one's health. Some are carcinogenic and mutagenic. The PAH content of engine oil increases with operating time, because the PAH formed during combustion in petrol engines accumulates in the oil.

2.0 CURRENT STATUS OF USED OIL MANAGEMENT IN KENYA

2.1 Sources of Used Oil

Generators of used oil include;

- a) Small generators (do-it-yourself (DIY) for motor vehicle, farm machinery and other equipments);
- b) Vehicle repairs and servicing;
- c) Industrial activities;
- d) Ship operations;
- e) Electricity transformers.

The quantity of used oil generated from these sources is difficult to quantify.

2.1.1 Small generators

Oil change in machines is a regular activity which is carried out in facilities equipped for the job (formal garages), open air garages or on-site operations. Onsite oil changes are carried out by do-it-yourself (DIY) in service and repair of motor vehicles and farm machineries. These sources of used oil are regarded as small used oil generators and basically produce less than 10 litres of used oil at any one time. There is no proper used oil collection and disposal system.



Plate 2: Construction and Farm Machinery

2.1.2 Vehicle repairs and servicing

The amount of oil changed at petrol service stations is quite low compared with that changed in open air garages where multiple services are offered at the same time hence the preference by some motorists. The latter practice poses a great environmental risk since the grounds are pervious and there is no proper prevention of spillages. In open air garages, the used oil is collected in drums or other small containers and there is no clear Chain of Custody of the oil after collection. Hence the oil may be used in other applications rather than being re-refined as recommended.



Plate 3: Vehicle repair in a garage

In formal petrol service stations, there is a well established used oil collection system. The branded service stations have established a Safe Waste Oil Disposal (SWOD) initiative whereby a common truck collects the used oils and transports it to a treatment plant.

2.1.3 Industrial activities

Used oil is also generated from activities in petroleum refineries, other industrial sources such as metal working industries, industrial machines, transport industry (railway, ships and aviation), petroleum tank cleaning, bulk petroleum storage tanks and heat transfer e.g. electrical transformers and thermal generating plants.

A major source of oily wastes is the sludge recovered from tanks used for the storage of petrol. The sludge which is normally produced by high pressure water jet cleaning of storage tanks consist of iron-oxide, a corrosion product and sediments, containing organic and inorganic compounds mixed with fuel. The used oil from industrial sources is reprocessed at recycling facilities while that which is generated from petroleum tank cleaning operations is used for energy recovery or disposed off through weathering sites.



Plate 4: Industrial Machinery

2.1.4 Ship operations

A major source of used oil and/or sludge is from the servicing of ships which dock at the port of Mombasa. The used oil will come as bilge water, or sludge from ship engine and other auxiliary machinery.

Used oil from the ships is collected by either licensed storage or recycling facility operators while some directly gets into the environment due to improper handling. The oil collected by the recyclers is basically decanted and used as fuel for boilers and furnaces among other uses.

However, the quantity of used oil generated from these sources has been difficult to quantify.

2.2 Transportation of Used Oil

Used oil and/or sludge is currently transported from generators to licensed recycling and/or storage facilities or directly to energy recovery facilities and to informal collection centers. Currently only licensed transport vehicles operated by storage/recycling facilities are allowed to transport used oil country-wide.

Large volumes of used oil are transported using oil tankers or lorries while small quantities are carried in drums using pick-ups and vans. In some cases used oil is transported in small containers using bicycles, motorcycles and public means without proper guidance.

2.3 Recycling facilities

The following attributes describe the status of some of used oil and/or sludge recycling facilities within the country.

General description of a used oil and/or sludge facilities

Typical used oil/oil sludge recycling facilities are fenced with a loading/offloading area, oil storage tanks and processed oil storage tanks. The tanks are raised on concrete slabs above a paved ground with a drain for collecting the spills. The spills are then directed into an oil/water interceptor. The paved ground in the loading and offloading area is often insufficient thus leading to uncontained oil spills.

Most of the facilities have oil spills on the bare ground with no clear system of handling oil spillages. The tanks are predominantly ex-oil transportation tanks raised on concrete slabs which in some cases are worn out. The tanks in most cases do not have adequate bund walls around them.

Some facilities lack appropriate and functional oil water interceptors and site offices lack records of their day to day operations.

Used oil facility workers are provided with basic PPE's and emergency exits are not well labeled. However, most facilities still have inadequate fire fighting equipment which are also not regularly serviced; the sites lack adequate labeling and signage, the personnel training levels on EHS matters is generally low, there are no clear systems of managing solid waste and, record-keeping is generally poor.



Plate 5: A poorly maintained yard with heavy contamination from cumulative oil spills

The used oil/ oil sludge recycling is achieved by leaving the used oil in the tanks for some time to allow the separation of water and used oil. The oil floats above the water. After separation, the water is drained retaining used oil in the tank. The decanted used oil/sludge is then collected in trucks by users.

2.4 Uses of Used Oil

The main uses of used oil/oil sludge include; fuel for industrial boilers, hotel boilers, furnaces in steel processing plants/smelters and re-use as lubricants after reprocessing and regeneration of base oil for manufacture of new lubricants. At the informal level used oil/ oil sludge has been used as lubricants on non-motorized transport (carts and wheelbarrows), for wood preservation, in asphalt coating plants as a primer, in stone quarries for stone drying purposes and for dust suppression on roads. In other parts of the world used oil is used for road oiling, weed killer and as a carrier for pesticides.



Plate 6: Drums of tar at facility yard

3.0 LEGAL AND INSTITUTIONAL FRAMEWORK

There are various institutions which have a role to play in management of used oils. The legislations below highlight the sectors relevant for the management of used oil and analyses the gaps.

3.1 National Environment Management Authority

The Authority is established to exercise general supervision and co-ordination over all matters relating to the environment and to be the principal instrument of Government in the implementation of all policies relating to the environment. Its mandate includes implementation of Legal Notice no. 121 on Environmental Management and Coordination (Waste Management) Regulations, 2006 which stipulates the disposal of Hazardous waste such as used oil/sludge. The Authority also administers Environmental Impact Assessments (EIA) under the provisions of Legal Notice 101 on Environmental (Impact Assessment and Audit) Regulations of 2003. According to regulations all waste recycling facilities should undertake EIAs failure to which enforcement action can be taken in accordance with the provisions stipulated in the Environmental Management and Coordination Act of 1999 and its subsidiary legislations.

3.1.1 Environmental Management and Co-ordination Act, CAP 387 of the Laws of Kenya

An Act of Parliament to provide for the establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental there to.

Section 93 of the Act prohibits discharge of hazardous substances, chemicals, oil or mixture containing oil into any waters or any other segment of the environment.

Section 58 and the second schedule of the Act require that operators of waste oil handling facilities should undertake an Environment Impact Assessment before commencing the project.

3.1.2 Environmental Management and Coordination (Waste Management) Regulations, 2006

Regulation 22, the fourth and the fifth schedule of the waste management regulations categorize used oil as hazardous waste and give specifications for handling hazardous waste.

3.1.3 Environmental (Impact Assessment and Audit) Regulations, 2003

Regulation 4 and 31 stipulate the requirements for Environmental Impact Assessment (EIA) and Environmental Audit (EA) for facilities that are likely to

have significant impact on the environment. Used oil and/or sludge facilities are required to undertake EIA as per the provisions of these regulations.

3.1.4 Environmental Management and Coordination (Water Quality) Regulations, 2006

The Third schedule of the regulation restricts effluent discharge from facilities listed under the Fourth Schedule (monitoring guide for discharge into the environment) or other point sources to the standards stipulated under the 3rd Schedule (standards for effluent discharge into the environment). They oblige operators of such facilities to install pollution prevention systems such as oil interceptor or oil-water separator where wastewater is contaminated with oil and grease. The oil and grease in the discharge should be nil. The standard for grease and water was set taking into account that a major portion of the Kenyan population drinks water directly from water sources and therefore the need to protect them. Water contaminated with oil is also very dangerous to aquatic life.

3.1.5 Environmental Management and Coordination (Air Quality) Regulations, 2014

Part II of the regulation prohibits any person through their activities to directly or indirectly cause immediate or subsequent air pollution by emitting any liquid, solid or gaseous substance in levels exceeding those set out in the First Schedule of the regulation.

3.2 Ministry of Energy and Petroleum

The Ministry of Energy and Petroleum is charged with Energy policy development, hydropower development, geothermal exploration and development, thermal power development, oil and gas exploration, oil/gas and minerals sector capacity development, rural electrification programme, petroleum products import/export/marketing policy management, renewable energy promotion and development, energy regulation, security and conservation, fossil fuels exploration and development.

3.2.1 Energy Act, 2006

The Energy Act, 2006 is presently the primary legislation in Kenya that contains provisions for the management of the petroleum sub-sector. Section 102 (h), (m) and (v) empower the Minister responsible for Energy to promulgate regulations for the environmentally sound management of petroleum related facilities and infrastructure. Waste-oil recycling plants by virtue of handling petroleum products automatically become petroleum facilities and therefore subject to this legislation.

3.3 The Kenya Bureau of Standards

The Kenya Bureau of Standards (KEBS) is a government agency established under the Standards Act, CAP 496 and is responsible for governing and maintaining the standards and practices of metrology in Kenya.

Standards, therefore, help to make sure that products and services are fit for the purpose and are comparable and compatible. KEBS formulates standards on lubricants and the products of used oil.

3.3.1 Standards Act, CAP 496

An Act of Parliament to promote the standardization of specifications of commodities and codes of practice.

3.3.1.1 KS 1967: 2006: The Petroleum Industry - Storage and Distribution of Petroleum Products in above ground Bulk Installations

This standard covers the layout and design plans of bulk petroleum depots and the installation of equipment of the types normally used for the handling, storage and distribution of petroleum products and their derivatives, other than equipment that are used for storage and dispensing on consumer premises (including service stations) and for which relevant standards exist.

3.3.1.2 KS 1968: 2006: The Petroleum Industry- Electrical installations in the distribution and marketing sector – Code of Practice

This standard covers the recommended safe practice in the design, construction, installation and maintenance of electrical and earthing and bonding systems intended to be used in flammable and combustible liquid storage, pumping, distribution and marketing facilities. The standard provides for classification of hazardous locations depending on the presence of flammable gases or liquids

3.3.1.3 KS 1969:2006: The Petroleum Industry- the Installation of underground storage tanks, pumps, dispensers and pipe work at service stations and consumer installations – Code of Practice

This standard covers provisions for the installation of underground storage tanks of individual capacity not exceeding 85,000L, pump dispensers and pipe work at service stations and consumer installations excluding LPG storage tanks. It provides that an Environmental Impact Assessment should be done before construction and installation of underground tanks for service and filling stations, commercial and consumer installations.

3.3.1.4 KS 2002: Part1:2002 Specification for Storage tanks for Petroleum industry: Part 1. Carbon Steel welded horizontal cylindrical storage tanks (First Revision, 2002): KS 2491; KS 1938.

It specifies the requirement for the design and construction of carbon steel fusion welded horizontal cylindrical storage tanks with dishes and flat flanged ends for the storage of liquids. The standard includes both above-ground tanks with saddle support and underground tanks. It gives the details of the range of dishes and flanged ends upon which the range of standard diameter tank size have been based. It also gives the overall lengths related to tanks with butt-welded circumferential seams and flat- flagged ends.

3.4 Directorate of Occupational Safety and Health Services

The department is mandated to implement all rules pertaining to the protection of workers from occupational hazards and ensure safe working environment. The Directorate implements the Occupational Safety and Health Act, 2007 and various rules made there under.

3.4.1 Occupational Safety and Health Act, 2007

This Act of Parliament was enacted to provide for the health, safety and welfare of persons employed in workplaces, and for matters incidental thereto and connected therewith.

At every workplace where chemicals or other toxic substances are manipulated, the employer shall develop a suitable system for the safe collection, recycling and disposal of chemical wastes, obsolete chemicals and empty containers of chemicals to avoid the risks to safety, health of employees and to the environment.

3.4.2 Medical Examination Rules 2005, (Legal Notice No. 24)

These rules provide for occupiers to mandatorily undertake pre-employment, periodic and termination medical evaluations of workers handling hazardous waste. The employees charged with handling of waste-oil may potentially be exposed to hazardous substances. This regulation requires that they undergo medical evaluations regularly.

3.4.3 Hazardous Substances Rules 2007, (Legal Notice No. 60)

Regulation 12 – 15 requires Proponents to have a Hazard Communication program implemented at their workplace. The Proponent is required to maintain an inventory of all Material Safety Data Sheets (MSDS) for the chemicals stored in their workplace. As a minimum the MSDS shall comply with the format indicated in the Third Schedule of the Regulations and will be disclosed fully to the employees handling the chemical by the Proponent. All unused, obsolete or expired chemicals must be disposed off in an environmentally sound manner. All containers containing chemicals must be labeled appropriately as per the

regulations. Training of employees on the hazards associated with handling chemicals safely in the workplace will be provided at the Proponent's cost.

3.5 Ministry of Health

The mandate of Ministry of Health is to support the attainment of the health goals of the people of Kenya by implementing priority interventions in public health, guided by the strategic framework provided from the medium-term Plan 2008-2012 and the wider health sector.

The Department of Environmental Health and Sanitation aims to reduce disease burden arising from environmental pollution from general environmental health pollutants.

3.5.1 Public Health Act- (Revised 1986)

The Act demands the adoption of practicable measures to prevent injurious and unhealthy conditions in the site. The Act requires the proponent to enhance effective management of Nuisances i.e. noxious matter or wastewater as will be discharged from the proposed project throughout the project cycle. To achieve this, systems on the management of both solid and liquid waste (effluent) will be adopted as proposed in the report. For instance, the effluent will be discharged into a septic tank. The solid waste shall be handled by a NEMA licensed garbage collector on regular basis and disposed accordingly.

Section 115 of the Act states "No person shall cause a nuisance or shall suffer to exist on any land or premises owned or occupied by him or of which he is in charge any nuisance or other condition liable to be injurious or dangerous to health."

Section 118 1(e) of the Act states "any noxious matter, or waste water, flowing or discharged from any premises, wherever situated, into any public street, or into the gutter or side channel of any street, or into any mullah or watercourse, irrigation channel or bed thereof not approved for the reception of such discharge."

3.6 Water Resources Management Authority (WRMA)

The Water Resource Management Authority (WRMA) is a state corporation under the Ministry of Environment, Water and Natural Resources established under the Water Act 2002 and charged with being the lead agency in water resources management.

3.6.1 The Water Act, 2002

Part II, section 18, of the Water Act, 2002 provides for national monitoring and information systems on water resources. Section 73 of the Act allows a person with a license (licensee) to supply water to make regulations for purposes of protecting against degradation of water sources. Section 75 and sub-section 1

allows the licensee to construct and maintain drains, sewers and other works for intercepting, treating or disposing of any foul water arising or flowing upon land for preventing pollution of water sources within his/her jurisdiction.

3.7 Compliance to the legislations

The above legislations and regulations highlight the requirements of the sectoral institutions in regard to management of used oil. The provisions under these legislations oblige oil users to manage used oil/sludge in an environmentally sound manner which is a challenge to most of the operators. In this regard the Authority has proposed these guidelines to enhance compliance to these legislations by the various stakeholders.

4.0 ROLES OF STAKEHOLDERS

This chapter identifies various stakeholders, their roles, obligations and provides guidance in regards to sustainable management of used oil. The stakeholders include small generators, bulk generators, collectors, transporters, transfer station operators and recyclers.

4.1 Guidelines for Used Oil/Sludge Generators and Collectors

4.1.1 Handling of Used Oil

It is advised that when in contact with used oil, ONLY use water and soap to wash off and not kerosene or petrol. This is because both kerosene and petrol exposes the skin to further toxic hydrocarbons which cause skin cancer, damage to organs and nervous system.

Workshops handling used oil should have a washing place with water and soap. Mechanics operating in Jua-kali garages should wash off their clothes immediately with soap and water and avoid putting on clothes soaked in used oil.

4.1.2 Small Volume Generators

Small volume generators are those oil users who occasionally produce used oil and have very little or no on-site used oil storage, and accumulate volumes of less than 20 litres of used oil at any one time. Those who maintain their own vehicle(s) and farm machineries should comply with the following procedures while changing their engine and/or other oil(s):

1. Place a drip pan directly under the vehicle's or other machinery engine oil drain cork to collect as much as possible of the used oil and to prevent spills, before draining oil from the sump.
2. When changing your oil filter, loosen the old filter (use a filter wrench if necessary), then spin it off and drain as much oil as possible into the drip pan.
3. Place the filter upside down in an empty container and drain for 24 hours.
4. Add the used oil to your collection container.
5. Take the old filter to your local scrap metal collection point.
6. In absence of oil filter recycler, wrap the filter in a newspaper and dispose it through your domestic waste collection.
7. Transfer the used oil using a funnel into a clean, empty container with a tight lid (e.g. the plastic container the clean oil was supplied in. Do not use a container that once contained food, or beverages).
8. Do not mix the oil with anything else, such as paint, gasoline, solvents, and cleaners.
9. Take used motor oil to a service station, lube center, or any other collection centre or auto-motive store that collects used motor oil for recycling.

4.1.3 Bulk Generators

Industrial and Commercial Used Oil/Sludge Generators



Plate 7: Bulk Generator

Industrial and commercial generators are defined as those entities that in the course of their commercial operations generate or accumulate used oil of more than 20 litres.

They collect maximum amount of used oil from their operations, storing it in an approved manner, and disposing of it in an appropriate way. Industrial and commercial generators have more complicated operations and need to take particular care to segregate used oils generated from different processes, and avoid contamination of oils on-site.

Bulk generators can be categorised into four main groups:

- Motor vehicle garages, repair yards, workshops and Petrol Service Stations, ship yards,
- Industrial manufacturing operations,
- Commercial operators and power generators and
- Collection centres.

Industrial operators, commercial operators and power generators should ensure that they contract licenced recycling facilities to collect used oil.

Requirements for Motor vehicle garages, repair yards, workshops and Petrol Service Stations, ship yards, Kenya Ferry Services, Boats

1. Drain used oil into the oil collection equipment,
2. Once the equipment is full, transfer into closed storage drums in a bunded area,
3. Place the filter upside down in an empty container and drain for 24 hours,
4. Provide a collection centre for used oil from small generators where applicable,
5. Take the used oil to licensed transfer stations or recycling facilities using a licenced transporter,
6. Dispose oil filters through licenced incinerators,
7. May offer incentives to encourage oil drain at the service station or **the lubricant marketers should establish take back schemes for their used oil brands** and
8. Dispose of solid waste through licenced incinerators, scrap metal dealers and licenced recyclers.

4.2 Guidelines for Used Oil from the Port

KPA has the key responsibility of ensuring that the huge volumes of used oil and sludge from the ships are managed in an Environmentally Sound Manner.

1. All the used oil and sludge generated at the Port is the responsibility of KPA as the manager,
2. KPA shall prequalify NEMA licenced used oil recyclers or transfer station operators for the management of sludge or used oil from the ships,
3. The prequalified NEMA licenced recyclers and transfer station operators shall engage the services of licenced transporters to collect sludge or used oil from the Port to their facilities,
4. The licenced transporter shall carry a tracking document signed by the prequalified NEMA licenced recycling facility or transfer station, at all times,
5. The tracking documents shall be duly filled, signed and stamped by KPA, the licenced transporter and the recycling facility or transfer station on receipt of the oil,
6. The recycler or transfer station operator shall keep copies of the duly filled tracking document and
7. For monitoring purposes, KPA will avail to NEMA periodic (quarterly) data of the used oil and sludge generated from the Port.



Plate 8: The Port of Mombasa

4.2 Guidelines for Used Oil/Sludge Collection Centers

4.2.1 Collection centers

Collection centers may include service stations (lube centers), garages that collect used motor oil for recycling, ship yards and Kenya Ferry Services.

These centers shall;

1. Undertake an Environmental Impact Assessment (EIA) and be duly licensed before commencement of operations,
2. Undertake an annual Environmental Audit (EA),
3. Have in its storage area paved surfaces, a canopy and bund walls,
4. Store a maximum of 5 drums (210 litres each) of used oil which should be tightly closed,
5. Transfer used oil received at a collection centre to a licensed transfer station or recycling facility,
6. Not process used oil in any way,
7. Not sell used oil to consumers,
8. Provide valid physical addresses, contact details, telephone numbers, email contacts and GPS coordinates of their locations,
9. Have an Emergency response plan which includes up-to-date procedures for notifying the relevant authorities and staff awareness,
10. Have a waste management plan,
11. Have a trained (Certificate level at minimum) operator in handling hazardous waste,
12. Maintain accurate records of oil received/generated and transferred,
13. Maintain tracking documents on site after collection by the approved transporters and
14. Establish a complaint management system (twenty-four (24) hour complaint contact telephone number) and ensure verbal response is provided to the complainant within two (2) hours.

4.3 Guidelines for Used Oil/Sludge Transporters

4.3.1 Transporters

All transporters shall;

1. Apply for a license to transport used oil from the Authority,
2. Operate appropriate type of vehicles for transportation of used oil e.g. tankers and covered trucks to protect the drums when being transported,
3. Ensure that all drums are metallic and securely closed,
4. Take used oil to a licensed transfer station and recycling facility,
5. Carry duly filled tracking documents which accounts for oil collected and transferred accordingly,
6. Have in place an Emergency Response Plan (spill contingency plan, spill control equipment, a fire control plan, an evacuation plan) in case of truck rollover incidents, spillages, fires, explosions etc,
7. Be responsible for any damages arising from spills or fires,
8. Have valid physical addresses, contact details (Postal addresses, phone number, email, face book and twitter handles),
9. Ensure all vehicles used in the transportation of used oil are appropriately labeled,
10. Ensure the drivers undergo appropriate training for tanker work, and this must be documented,
11. Collection vehicles should carry a Tanker Spill Kit for cleaning up any minor spillage,
12. All used oil transporters shall only be involved in the transportation of used oil from a generator to a licensed facility,
13. Ensure bulk transportation is guaranteed a flash point of 60.5 hence the load should undergo flash point testing before delivery and
14. Establish a complaint management system (twenty-four (24) hour complaint contact telephone number) and ensure verbal response is provided to the complainant within two (2) hours.



Plate 9: A non-compliant and a compliant used oil truck

4.4 Guidelines for Used Oil/Sludge Transfer Stations

4.4.1 Transfer stations Infrastructure

All storage/ transfer stations shall receive used oil/ oil sludge only for temporary storage before being taken to licensed recycling facilities.

Transfer stations shall require standard infrastructure such as;

- Above ground or underground tanks (as per KS standards),
- Oil water interceptors,
- Bund walls,
- Paved surfaces with an impervious material especially at the offloading and loading bays,
- Proper drains,
- Pollution control equipments (spillage control kit),
- Firefighting equipment,
- Fenced facility with a single entrance and
- Signage.



Plate 10: View of an oil and water separator tank at a facility

4.4.2 Requirements for the site

1. Every person intending to establish a transfer station shall undertake an Environmental Impact Assessment (EIA) and obtain EIA licence before commencement of construction works,
2. The facilities shall undertake annual Environmental Audits,
3. All transfer stations must obtain an operational license issued under the Waste Management Regulation to own or operate a transfer station from the Authority,
4. All used oil from transfer stations shall be transferred to licensed recycling facilities,
5. A transfer station shall not process the used oil in any way except dewatering,
6. All transfer stations shall be provided with adequate and functional oil interceptors and other pollution control measures e.g. spillage control kit,
7. At each site the operator is to have a minimum amount of storage capacity of 90M³ on site to allow for discharge from the largest capacity of a vehicle that may be received, in the event of a contaminated load,
8. The loading and offloading area must have paved surfaces with an impervious material to prevent any spills from contaminating the soil,
9. The offloading and loading area should be bunded and must equal or exceed the volume of the largest compartment of any vehicle to be discharged,
10. All transfer stations shall provide valid physical addresses, contact details, telephone numbers, email contacts and GPS coordinates of their locations,
11. All transfer stations should have in place an Emergency Response Plan (spill control equipment, a fire control plan, an evacuation plan) in case of incidents, spillages, fires, explosions etc,
12. The transfer stations shall only sell used oil to licenced recycling facilities and energy recovery users,
13. All used oil to and from a transfer station shall be transported by licenced used oil transportation vehicles,
14. The transfer station shall have a waste management plan and
15. Establish a complaint management system (twenty-four (24) hour complaint contact telephone number) and ensure verbal response is provided to the complainant within two (2) hours.

4.4.2.1 Tank Farm

1. All oil tanks shall meet the KS 200: Part 1: 2002 on specifications for storage tanks for petroleum industry,
2. All oil tanks shall be bunded appropriately with a bund wall of size stipulated under the KS 1967:2006,
3. All tanks are to be made from steel,
4. All tanks compartments should be padlocked when not in use,
5. All tanks are to be bunded. The bund must equal or exceed the volume of the largest tank in that bunded area,
6. The bunded area must be paved with concrete or asphalt, not soil, clay or gravel,

7. All tanks are to be inspected on a regular basis for worthiness in accordance with KS 1938,
8. All tanks are to have some method to determine the volume in each tank,
9. All tank maintenance is to be recorded and kept for five years and
10. Haulage of 5 percent must be left when the tank is full.

4.4.2.2 Tracking

All transfer stations shall keep records of incoming oil by date, volume and source. Records of Used oil/Oil sludge going off site should indicate date, volume, and destination.

4.4.4.3 Record retention

Records of volumes in and out of each tank must be kept for a period of three years.

4.5 Guidelines for Used Oil Recycling Facilities

4.5.1 Recycling Facilities

A recycling facility shall undertake reprocessing, reclaiming and regeneration (re-refining) of used oils by use of an appropriate selection of physical and chemical methods of treatment

All the recycling facilities shall specify the nature of recycling activity to be undertaken e.g. Reprocessing, Reclamation, Regeneration (Re-refining) and the final products to be produced.

4.5.1.1 Standard Infrastructure

Recycling facilities shall require standard infrastructure such as;

- Tanks (as per KS standards);
- Oil water interceptors;
- Bund walls;
- Paved surfaces with an impervious material especially at the offloading and loading bays;
- Proper drains etc;
- Pollution control equipments;
- Signages;
- Fire assembly and exit points;
- Minimum required area for each facility;
- Perimeter walls;
- Refractionating column and
- Site office.

4.5.1.2 Requirements of the site

1. Every person intending to establish a recycling facility shall obtain an Environmental Impact Assessment (EIA) license before commencement;
2. All recycling facilities shall obtain a waste recycling license on commencement of operations and adhere to the license conditions;
3. The operator shall undertake annual Environmental Audits and submit the report to the Authority;
4. All oil tanks shall meet the standards set out under KS 1967:2006 for storage and distribution of petroleum products in above ground bulk installations;
5. All oil tanks shall be bunded appropriately with bund wall of a size stipulated under the KS 1967:2006;
6. All recycled oil emanating from the processes shall be handled and stored in accordance with the requirements set out in KS 1967:2006;
7. All recycling facilities shall be provided with adequate and functional oil interceptors and other pollution control measures;

8. All recycling facilities shall receive used oil from licensed transporters only;
9. All recycling facilities shall maintain a record of dully filled tracking documents;
10. All recycling facilities shall ensure any waste arising from their recycling operations is disposed as per Environmental Management and Coordination (Waste Management) Regulations of 2006;
11. All recycling facilities shall control emissions and ensure the levels meet the required set standards under the Environmental Management and Coordination (Air Quality) Regulations of 2014;
12. All recycling facilities shall provide valid physical addresses, contact details, telephone numbers, email contacts and GPS coordinates of their locations;
13. All recycling facilities should have in place an Emergency Response Plan (spill control equipment, a fire control plan, an evacuation plan) in case of incidents, spillages, fires, explosions etc;
14. The loading and offloading area is to be bunded. The bund area must equal or exceed the volume of the largest compartment of any vehicle to be discharged,
15. The owner or operator of a recycling facility shall ensure that the recycling area is fenced off and no other activity should take place within the fenced area other than recycling of used oil and
16. Establish a complaint management system (twenty-four (24) hour complaint contact telephone number) and ensure verbal response is provided to the complainant within two (2) hours.

5.0 RECYCLING TECHNOLOGIES

5.1 Recycling Processes

The choice of technology will depend on the desired product. The table below summarizes some of the recycling processes, final products and their recommended uses.

Table 1

Process	Products	Recommended Use
Reclamation	clean fuel	Fuel or fuel extender
Reprocessing	Base oil	Fit for original use or its equivalent
Regeneration	Base oil	Manufacture of lubricants

When the above listed products (clean fuel and base oil) are below standard then it can be used in industrial furnaces, boilers, kilns and hazardous waste incinerators.

The following guidelines will apply to the different methods of recycling namely, reclamation, reprocessing and regeneration (re-refining).

5.1.1 Reclamation

A facility reclaiming used oil should separate solids and water from the oil by heating, filtering, dehydrating and centrifuging.

A recycling facility producing fuel or fuel extender must process the used oil through reclamation.

5.1.2 Reprocessing

A facility reprocessing used oil should remove insoluble contaminants and oxidation products from used oils by heating, settling, filtering, dehydrating and centrifuging.

A facility reprocessing shall ensure that the product is suitable for reuse as per FDKS 2491:2013 or the quality of the resultant material can be blended with base oils and additives to bring the oil back to its original or an equivalent specification.

5.1.3 Regeneration/Re-refining

A facility regenerating used oil should remove contaminants, oxidation products and additives by pre-distillation, treatment with acids, solvent extraction, contact with activated clay and hydro-treating.

A facility regenerating used oil will ensure the produced base oil is suitable for manufacture of lubricating products.

5.2 Final Product

The final product produced as a result of regeneration, reclamation, re-refining and reprocessing shall meet the relevant Base oil standard FD KS 2491:2013.

6.0 END PRODUCT USERS

All end users shall only procure recycled used oil from licensed recycling facilities.

Notwithstanding the above, all cement kilns and furnaces and large boilers operating a minimum combustion temperature of 1100 Degree Celsius, may obtain used oil from the transfer stations and recycling facilities.

All end users must handle the recycled used oil in an Environmental Sound Manner as follows:

- Use in boilers- blending into residual fuel oil
- Use as a substitute for coal or residual fuel in the cement industry
- Use in high temperature incinerator

6.1 Disposal of non-recyclable used oils

Used oils that cannot be recycled must be managed in accordance with the provisions of the Environmental Management and Coordination (Waste Management) Regulations of 2006 through incineration.

7.0 MANAGEMENT OF OIL SLUDGE

Oil sludge is that viscous, non-flowing, semi-solid material which is generated as a result of long storage of oils.

While the useful products from the used oil are managed, it is the hazardous residues, this being the sludge that calls for very special attention and utmost care in handling and disposal. As this is the end of the line output, there is very little or no value attached to it and hence it needs to be safely disposed off.

7.1 Sources of sludge

Sludge can be generated from the following sources;

- Oil storage tanks cleaning
- Petroleum refinery plants
- Motor engines
- Oil water interceptors
- Ship operations

7.2 Characteristics of Sludge

Sludge is characterized as;

- Toxic
- Viscous

7.3 Treatment methods

Sludge must undergo various types of processing for economic and hygienic reasons. The purpose of all types of sludge processing is to reduce the volume, stabilize the sludge, remove water and kill pathogenic organisms. It is processed in stages that comprise a sequence of treatments such as conditioning, thickening, dewatering, weathering, solvent extraction and sludge pyrolysis.

7.3.1 Sludge Conditioning

Conditioning involves modification of the sludge structure so that more water can be separated. This treatment improves further treatments such as thickening or dewatering.

7.3.2 Sludge Thickening

Sludge is thickened so as to reduce the volume and cost of treatment by removing the free water through either floatation or sedimentation.

7.3.3 Dewatering

This practice reduces the volume of water by using the drying beds, centrifuging filter belt and filter press. This requires chemical conditioning agents.

7.3.4 Weathering

Oil weathering involves the application of several natural processes together to degrade the oil slicks (a layer of oil floating on the surface of water) that are spread on the ocean waters. Oil weathering processes (OWP) act naturally on oil slicks conceived after oil spills, on the sea surface.

It includes spreading, evaporation and dissolution.

7.3.5 Solvent Extraction

It involves mixing of oily waste with solvents at desired proportions to ensure complete miscibility while water and any other solid particles are rejected by the solvent. Some of the widely used solvents for oil extraction are; used turpentine, methyl ethyl ketone or liquefied petroleum gas condensate.

7.3.6 Sludge Pyrolysis

Pyrolysis is the thermal decomposition of organic materials at elevated temperatures (500–1000°C) in an inert environment. The main product of pyrolysis can either be char, liquid (i.e. pyrolysis oil), or gas, and they may have a more elevated heating value than the raw oily sludge. Pyrolysis oil produced can be used as a fuel or a source of other valuable chemical products.

7.4 Disposal methods

The well accepted ways of sludge disposal is through incineration and disposal in secured landfills.

7.4.1 Incineration

Sludge must be treated and dewatered before incineration. The following incinerators are recommended for disposal of sludge;

- The multi chamber incinerator - A multi-chamber excess air incinerator has two or more combustion chambers and may be of the retort type.
- The Rotary Kiln incinerators - similar to the rotary kilns used in the cement industries.

7.4.2 Deposition to a secured landfill

Deposition of sludge should be done in a secured landfill which should be properly engineered.

Composition of the landfill

There are four critical elements in a secured landfill used for disposal of sludge. These elements are as below;

- a bottom liner,
- a leachate collection system,
- a cover and
- the natural hydro-geologic setting.

REFERENCES

1. All the quoted Acts.
2. Government of Kenya, (1999), Environmental Management and Coordination Act.
3. Government of Kenya, (2006), Environmental Management and Coordination Act (Waste Management) Regulations 2006. Government Press.
4. Guangji Hua, Jianbing Lia,, Guangming Zeng, Recent development in the treatment of oily sludge from petroleum industry: A review, Journal of Hazardous Materials 261 (2013) 470–490
5. Guidelines for Management and Handling of Used oil – New Zealand
6. Multilateral Environmental Agreements (MEAs), (1989) Basel Convention – Technical Guidelines on Used Oil.
7. Petroleum Institute of East Africa (PIEA), Kenya (2013).
8. United States Government, (1970), United States Environmental Protection Agency, (EPA Used oil guidelines).
9. United States Government, (1970), United States Environmental Protection Agency, (Recycle your used motor oil).