A STUDY OF USED OIL MANAGEMENT: A CASE STUDY OF NAIROBI CITY - KENYA.

By:

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A project paper submitted in partial fulfillment for the Degree of Masters of Arts in Environmental Planning and Management in the Department of Geography University of Nairobi.

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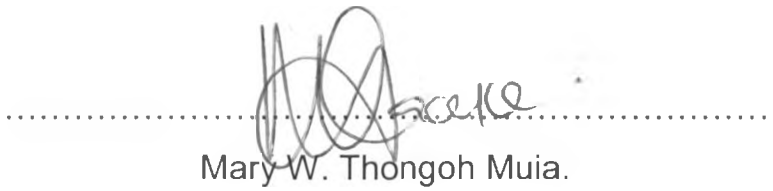
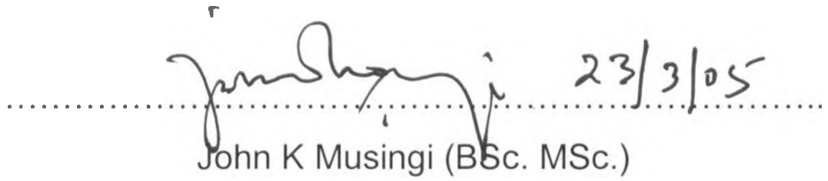
DECLARATION

This thesis is my original work and has not been presented for a Degree in any other University.



Mary W. Thongoh Muia.

This thesis has been submitted for examination with our approval as University Supervisors.



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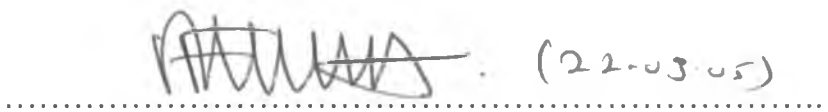


Dr. Francis Mwaura

DEDICATION

This work is dedicated to Margaret Njoki Njoroge and George Muia for their deep love for trees and Environment in general.

To the Total Eco Challenge for the great work they are doing throughout the country sensitizing all Kenyans to plant trees and for their ambitious target to plant a hundred (100) million trees per year. May this dream come to fruition.

ABSTRACT

For years, motor oil commonly has been used and reused or discarded in ways that neither protected the environment nor conserved its resource value. In Kenya alone, an estimated 200 million gallons of used motor oil are improperly disposed off by being dumped on the ground, tossed in the trash (ending up in landfills), and poured down storm sewers and drains. Just one gallon of used oil has the potential to contaminate up to one million gallons of drinking water.

Additionally, used oil that ends up in the country's rivers, lakes, and streams can threaten aquatic life. If all of the used oil that is improperly disposed off were properly managed, Kenya could save thousands of barrels of oil each day. Used oil that is properly handled can be re-refined into lubricants, processed into fuel oils, and used as raw materials for the refining and petrochemical industries.

The study aimed at identifying all uses and current disposal methods of used oils, and proposing environmentally friendly disposal methods.

The study chose Nairobi due to its high concentration of motor activity, garages and petrol stations and hence more used oil outlets. Nairobi alone has 452 petrol stations, comprising about 32% of all stations in the country. "Jua Kali" garages are also many and highly concentrated in Nairobi than in any other part of the country. Most of theses garages are makeshift structures erected on road reserves, river banks and in back streets. The highest concentration of the garages is along Nairobi River. Oil is directly disposed into the river, and hence accounts for the highest water pollution in the region.

The study found out that used oil has more than one uses ranging from dust suppression, lubrication of invalid carriages like wheelbarrows, used for marking fields in schools, mosquito control, termite control, wood preservative, to mention but a few.

Large proportions of used oil are taken away by motorists for undisclosed uses. Flower farms use it as dust suppressant and it is also claimed that it increases green house effect and thus leading to faster growth of the flowers. The largest proportion, over 55 percent, of used oil is given away to third parties freely, some is sold and the rest is poured away. In some few cases, it was reported that used oil is poured into the city council sewer system.

Though the greatest challenge faced by all oil marketers is that of disposal of used oil, a solution to the same must be put in place as a matter of urgency. All possible and current modes of disposal are known to contaminate the environment, very little if not nothing is being done to address the problem. The country lacks a legal framework that encompasses handling of harmful waste with the exception of toxic and radio active waste. It is commendable the efforts petroleum marketers are putting to collect used oil, but it will be seen that proper disposal is not yet in place. Disposal will include burning it in kilns, proper packaging and burying into the soil and treatment to remove toxins and resell for use in timber treatment.

ACKNOWLEDGEMENT

I am obliged to acknowledge the support and encouragement from my lecturers, friends and family alike, without whom I would not have realized this project.

First and foremost I would like to recognize the supervisors, Mr. Musingi and Dr. F. Mwaura of Nairobi University, Geography department, who tirelessly gave their guidance and input. Without their patience in reading this work and giving useful comments, this work would not have materialized.

I would also like to appreciate the various service station staff that assisted in administering my questionnaires. The number being so big I cannot name all of them.

The lubes Engineers and Territory managers Stella Kashenu, Fred Patta and Jackson Ongubo who gave support in technical know how and other useful insights.

The lab analysts who gave their technical input on used oil characteristics.

The Jua kali garage owners who allowed me to take photographs of their garage sites and freely contributed their ideas on used oil management, and whose names I cannot mention because they preferred to keep their names anonymous.

The chairman of the Department of Geography, Nairobi University, and all the staff in the department who were supportive and generous in their contributions of ideas and efforts.

Finally to friends and family (George Muia, Natasha and Shakinah) who gave me moral support to push on and complete this course work and project. To all I say thank you.

TABLE OF CONTENTS

CHAPTER FIVE

ABBREVIATIONS AND DEFINITION OF TERMS

EMCA-Environment Management and Coordination Act.

NEMA- National Environment Management Agency.

EPA- Environmental Protection Agency

P.I.E.A – Petroleum Institute of East Africa

Definition of terms

Primary users: those users who buy fresh oil i.e. lubrication oil for its intended use for their equipment. After the recommended life of the lubricant they replace the oil (have an oil change or service the equipment) with fresh oil for proper running of the equipment.

Secondary users: those users who buy waste oil/used oil generated from oil change for the sake of putting it to use as it is or recycling or reprocessing it for other uses.

CHAPTER ONE

1.1 INTRODUCTION

Used oil, according to United States Environmental Protection Agency, is defined as any oil that has been refined from crude oil or any synthetic oil and has been used and as a result of such use is contaminated by physical and/or chemical impurities. It includes motor oil, transmission fluids and hydraulic oils.

Lubrication oils manufactured from refineries and blending processes are normally meant for use largely in the automotive industry, industrial machinery operation or as process oils. This oil gradually deteriorates with use until a certain point when it must be replaced with fresh oil for proper functioning of the equipment. The oil removed in the process of replacement is then used oil that is sometimes inappropriately referred to as waste oil.

1.1.1 What is Used Oil?

Simply put, used oil is exactly what its name implies, any petroleum-based or synthetic oil that has been used. During normal use, impurities such as dirt, metal scrapings, water, or chemicals can get mixed up with the oil, so that in time the oil no longer performs optimally. Eventually, this used oil must be replaced with virgin or re-refined oil to do the job at hand.

EPA's used oil management standards include a three-pronged approach to determine if a substance meets the definition of used oil. These are;

1. Origin: the first criterion for identifying used oil is based on the origin of the oil. Used oil must have been refined from crude oil or made from synthetic materials. Animal and vegetable oils are excluded from EPA's definition of used oil.

2. Use: the second criterion is based on whether and how the oil is used. Oils used as lubricants, hydraulic fluids, heat transfer fluids, buoyant, and for other similar purposes are considered used oil. Unused oil such as bottom clean-out waste from virgin fuel oil storage tanks or virgin fuel oil recovered from a spill do not meet EPA's definition because these oils have never been "used." EPA's definition also excludes products used as cleaning agents or solely for their solvent properties, as well as certain petroleum-derived products like antifreeze and kerosene.

3. Contaminants; the third criterion is based on whether or not the oil is contaminated with either physical or chemical impurities. In other words, to meet EPA's definition, used oil must become contaminated as a result of being used. This aspect of EPA's definition includes residues and contaminants generated from handling, storing, and processing used oil. Physical contaminants could include metal shavings, sawdust, or dirt. Chemical contaminants could include solvents, halogens, or saltwater.

1.1.2 Average composition of used oils

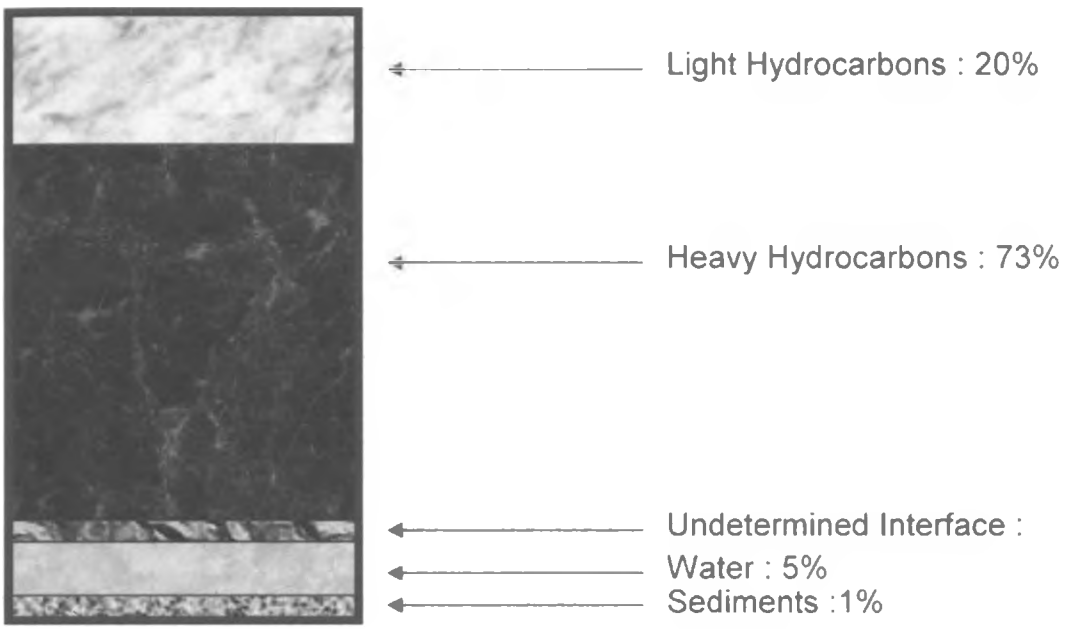


Fig 1.0: Average composition of used oil

1.1.3 Types of Used oil

Used engine oil: - typically includes gasoline and diesel engine crankcase oils and piston-engine oils for automobiles, trucks, boats, airplanes, locomotives, and heavy equipment. Transmission fluid, Refrigeration oil, Compressor oils, Metalworking fluids and oils, Laminating oils, Industrial hydraulic fluid, Copper and aluminum wire drawing solution, Electrical insulating oil, Industrial process oils, Oils used as buoyants among others.

The following are not regarded as used oil;

Waste oil that is bottom clean-out waste from virgin fuel storage tanks, virgin fuel oil spill cleanups, or other oil wastes that have not actually been used. Products such as

antifreeze and kerosene, Vegetable and animal oil, even when used as lubricants, Petroleum distillates used as solvents.

Oils that do not meet EPA's definition of used oil can still pose a threat to the environment when disposed off and could be subject to the Resource Conservation and Recovery Act (RCRA) regulations for hazardous waste management.

Oil Companies define used oil as follows;

Lubricants consumed or lost during use e.g. oil burnt in a 2 stroke engine and emitted in the exhaust. A greater percentage of lubricating oil and greases after it has come to the end of its useful life.

Sometimes used oil is polluted with heavy metals from tear and wear of the car engine system. When this oil is carelessly discarded, used to treat timber or upgrade dusty roads this does not only pose danger to the environment but also to human health.

1.2 Sources of used oil

Generators comprise the largest source segment of the used oil in the industry. Other sources are;

- Vehicle repair shops and service stations,
- Public and private motor pool fleets (taxis, buses and delivery vehicles),

- Commercial airlines and railroads,
- Military installations,
- Manufacturing enterprises, and
- Construction companies.

For years, motor oil commonly has been reused or discarded in ways that neither protected the environment nor conserved its resource value. In Kenya alone, an estimated 36.55 Million Litres of used motor oil were generated in the year 2003 (Source: Petroleum Institute of East Africa). Most of this volume is improperly disposed of by being dumped on the ground, tossed in the trash (ending up in landfills), and poured down storm sewers and drains. The rest is used for timber treatment, upgrading of dusty roads, and mosquito control in ponds, irrigation areas and swampy areas. Some insignificant amount is recycled for burning in cement kilns.

Applying the cradle-to-grave concept, manufacturers of products must follow them up from production, to their use, until their final disposal. Lubricant manufacturers should be the first ones to be concerned with measures to be taken in order to capture the cradle to grave concept in use of lubricants. Currently in Kenya we have three major oil blending plants all located in Mombassa where the major oil marketers, that is the big 5, namely Shell BP, Mobil, Caltex, Total, Kenol/Kobil, blend their lubricants. There are also small recycling plants that recycle used oil into lubricants and market them cheaply to jua kali

garages and hardware shops mainly at Kirinyaga road. A few exports are coming in from Dubai and the Middle East but they only account for less than 10% of lubricants market. 90% of lubricants are blended within the country (oil industry lubricant sales figures).

In Kenya most of the used oil generated is disposed off in ways that pose serious threats to the environment and this can partly be attributed to the slack legislation regarding its disposal and ignorance of persons about the health risks it poses during handling of used oil. This therefore poses major challenge to not only the government but also the oil manufacturers that supply other users, as well as on consumers who actually generate used oil from their equipment to come up with disposal methods that are environmentally suitable.

Now with the enactment of EMCA (Environment Management and Coordination Act, 1999) it has become more urgent to define the cradle to grave management process, in order to not only comply with legislation but also to ultimately protect our environment. Currently we have no defined system of used oil collection or disposal. It is clearly known that used oil, besides loosing it's physical properties, is normally contaminated with other chemical compounds having poisonous effects on both man and other living organisms and hence must be properly disposed off to minimize environmental pollution.

Environmental standards dealing specifically with used oil are yet to be put in place. Unfortunately, disposal of used oil through drainage system, storm water drains or simply

dumping on the ground is common all over the country especially at the so called Jua Kali garages yet this goes against EMCA legislation and municipal council legislation touching on effluent discharge from service stations. The major oil marketers who market their lubricants along side petrol fuel have a way of collecting used oil through used oil underground tanks in their service stations but still face difficulties on disposal. The tanks are connected to the pitstop bays where vehicles are serviced. The oil is then drained into used oil underground tanks or drums where underground tanks are not installed. The stations are designed with oil water interceptors/separators connected to the drainage system within the station that drains into storm water drains. The interceptor is a system of chambers that filter out the oil and allows only clear water to drain off into storm water drains. The oil left in the interceptor is schemed or scooped off into the used oil storage. However most independent garages especially the jua kali (down at Kirinyaga road, in estates and market centers) do not have this interceptor system and hence used oil is dumped on the ground and continues to flow and to be washed off by rain into storm water.

1.3 Background of the research problem

Oil in general poses serious environmental pollution risks if carelessly handled. Crude or refined oil slicks have been blamed for causing major pollution in natural water systems such as seas and underground water. Improper disposal of oil mainly affects the environment by interrupting oxygen circulation and consequently suffocating aquatic life forms. According to Environmental Protection Agency, one gallon of used oil (I gallon is

approximately equal to 20.6 litres) has the potential to contaminate up to one million gallons of drinking water.

Used oil contains contaminants that are poisonous to animals and microorganisms and could seriously affect them on mere exposure. Several million tons of used oil is generated worldwide every year and a substantial proportion of this is thought to be inappropriately disposed off - Environmental Protection Agency. Harmful impurities contained in used oil include Polycyclic Aromatic Hydrocarbons (PCA) and high levels of heavy metals such as lead and cadmium that have accumulated in the oil during its use. These impurities are generally harmful to living things as they are normally carcinogenic and mutagenic in nature.

The Kenya situation

Used oil is put to different uses in Kenya and as indicated earlier most of the oil is disposed off in environmentally unfriendly ways. Timber treatment for instance is relatively established in rural areas, this activity prevails because of lack of public awareness on the heath impacts of exposure to used oil. Environmentally harmful ways of used oil disposal are highlighted below;

(i.) Dust suppressant

The oil, mainly generated in the sugar belt region of Western Kenya, is normally poured onto roads to limit dust – NEAP (*National Environment Action Plan).* This method is

environmentally unacceptable as there are high risks of the oil being washed away to open natural water systems. It has also been established that, by NEAP (*National Environment Action Plan),* flower companies use the oil for suppression of dust; quantities used here are quite appreciable. The oil is mixed with water in a ratio of 3:1 water to oil and additives added to enhance emulsification and aid penetration on soil surface. The mixture is then agitated manually to produce a fine mixture before application to dusty surfaces. Some flower companies have gone to the extent of advertising for used oil to satisfy their demand.

(ii.) Timber treatment

The oil in other areas is used to coat timber to act as a preventative measure against termites. This could be risky to human health as volatile carcinogenic impurities may gradually accumulate in bodies of inhabitants and eventually cause irreparable health damage.

(iii.) Pests repellant in swampy farms

Used oil is smeared on to feet when working in swamps or rice fields. This could be harmful as poisonous components could be absorbed into the body and eventually could pose serious health risks. The oil also disperses into water causing contamination. The oil is also poured directly onto water surfaces to control mosquitoes and this is equally unacceptable.

(iv.) Dumping over land

In some workshops and stations where the oils are generated and collectors are not available, the oil is merely dumped over land or in landfills. This is environmentally harmful as the oil seeps down to the water table or gets washed away by surface water to open water bodies with consequent pollution risks.

In Kenya we have used oil that is directly dumped along with other solid waste generated during an oil change such as filters, oil rugs, air cleaners, and oil containers etc. then we have the used oil that is stored for the sake of selling it to secondary users.

The used oil that finds some practical use by secondary users is generally collected from the sources such as service stations and vehicle workshops by collectors that either get it for free or purchase it for small prices at the sources before supplying it to the final users. Some of the activities the oil finally is subjected to are allegedly environmentally friendly and acceptable whereas others are harmful.

The practice employed in used oil management in many jua kali garages does not put environmental consideration into the use. Most garages operate under make shift shelters which have bare ground exposed to the effects of used oil. The handling process does not consider the control of spillages.

The used oil is collected into drums with plan of selling to interested vendors. If there are no vendors the oil is disposed off into dry areas or open sewer, drainages or the Nairobi

Rivers. The garage owner has descent offices for meeting customers. He mainly does oil change for heavy commercial vehicles. The oil change is done at his yard which is of bare ground no cement or Murram. The used oil is collected in drums by use of tins.

The rugs used during the oil change operation are simply dumped along the fence. Rain water also carries the contaminants into other water bodies and drainage system causing further pollution. Our discussion with the garage owner he seemed completely unaware that there are regulation & laws he was contravening by the method he was using to handle used oil. His workers also handle the oil change with bare hands oblivious of the health implications of such a practice.

1.4 Statement of the research problem

There are two major problems to address in this study.

1) Handling of used oil.
2) Used oil disposal.

The problem faced by the mainstream oil marketers is that of disposal of used oil after 'pollution free' collection at their station. Customers request to carry off their used oil. If used oil is not taken away, it is stored in used oil underground tanks, after which the challenge is the final disposal or utilization outlet. This project sought to offer recommendation and possible solutions to the two issues noted above.

1.5 The objective of the study.

This study seeks to establish how used oil is managed namely handling and uses and disposal of used oil in Kenya with particular focus on Nairobi where most of the users of oil are concentrated.

The objectives of this study are thus:-

1. To investigate how used motor oil is disposed.
2. Whether the used motor oil disposal is environmentally friendly.
3. To investigate the relationship between type of oil used and disposal method.
4. To investigate whether there exists a relationship between vehicle business type and used oil handling.
5. To investigate whether used oil is carried only by motorists or left at service points.

1.6 Hypotheses

1. Used motor oil is disposed in environmentally friendly ways.
2. There is a relationship between type of oil used and disposal method.
3. There is a relationship between vehicle business type and used oil handling/disposal.
4. All used motor oil is carried away by motorists.

CHAPTER TWO

2.0 Literature review

The Rose foundation is a brainchild of the private sector used oil management in South Africa and was started in 1994 by the major lubricant marketers. Its main objective was to manage environmentally acceptable collection, storage and recycling of used oil throughout SA. It does not accumulate profits but uses the funds at its disposal for the better management of the used oil system in SA. The Rose foundation found that used oil in huge demand both as a component of lube oil re-refining and for processing into low sculpture fuel as well s a lime kiln fuel substitute for coal and fuel oil. The Rose foundation has so far managed to collect up to 45,000,000L per year, this accounts for about 16% of all oil sold into the market (~320,000,000L) and their target is to achieve the high recovery percentage of 28% of all the new oil sold (so far only reported in Spain). The operations of the foundation are financed by donations from members pegged on quantity of oil sold. *The used oil collected is sold mainly to recyclers at a price considerably lower than collection costs and the shortfall is made up for by the member contributions.* The activities of the foundation can be outlined under the headings that follow.

2.1 Used oil depots:

Members of the Rose Foundation spent up to $2,000,000 on building specially designed depots located at Cape Town, Durban and Gauteng.

The depots are key to managing the used oil since they serve as points of storing used oil collected in either drums or bulk quantities and the water/solids are settled out of the used oil. The tanks used in the depots for settling out water have got fixed capacities whereas tanks for holding the various cargoes of used oils are sized as per the condition of the used oil.

The Rose Foundation depots are equipped with provisions for segregating the used oil and are securely equipped with necessary fire fighting apparatus and ablution facilities for staff. The depots have wash bays for vehicles with bunds that drain to proper oil/water separator traps.

The sites are well landscaped and are chosen for ease of access to maintain arterial highways and sources of used oil.

For its transport requirements Rose foundation has contracted the services of an independent **OILKOL** which organizes used oil collection and depots management on their behalf.

2.2 Bulk handling of used oil

The Rose Foundation seeks to eliminate use of 210L drums for used oil accumulation at generation points since they often get badly damaged and cause contamination of used oil with soil as well as spillage. The foundation has thus introduced their specially designed Rose Foundation mini tanks which come in different sizes from 1000L-5600L.

The tanks are designed with provisions for sampling and testing incoming oil since the contaminants in used oil need careful monitoring to determine pre-treatment needs. The tanks are located at workshops, factories and truck ports among others and generators of used empty their oil directly into these tanks. Among the special features of these tanks are the easy pour in opening, dry break couplings for sucking out the used oil, rings to lift the tanks, covers to keep out rain waters and footplates for easy access.

The used oil accumulated is then taken to depots by bulk tankers into which are pumped the used oil and the generator paid for it by OILKOL.

The operators of bulk used oil trucks are equipped with communication equipment so that in the event of an accident, leakage of used oil can be controlled. The trucks have on board spill absorbent pads to prevent used oil entrance into water systems.

2.3 Regulation of the final disposal of used oil

The Rose Foundation plays the final important role of ensuring that the used oil they collect is safely disposed off. Recycling used oil is an established activity in SA and they form the largest outlets for used oil. Other outlets include cement kilns which can use the oil with little pre-treatment.

The Rose Foundation has contracted two independent environmental consulting firms to asses and audit continuous improvement at all recycling/disposal points. The operations of the Rose Foundation, with a few modifications provide a good model for the entire oil industry in Kenya to emulate in their endeavor to ensure efficient management of used oil.

2.4 Oil industry (the majors) oil collection system.

Lubricants marketed by major oil marketers in Kenya require careful handling in order to ensure safe storage, distribution, handling, use and disposal. The marketers are committed to providing sufficient information to customers to ensure safety and facilitate safe disposal of used lubrication oil. Used oil and greases are a potential pollutant of the environment, depending upon the original formulation and the type of service. Each year the oil industry in Kenya sell over 30 million litres of lubricants. After these products have reached the end of their useful working life they become potential waste materials - Petroleum Institute of East Africa article.

Janis D. Bernstein in (1993) says, dumping used lubricating oils and greases onto the ground water and into land fills or using it as a preservative for wood causes damage to the environment. This is because the hydrocarbons degrade very slowly presenting long term negative effects on the environment. They reduce the oxygen supply to microorganism and plants which is vital for their existence. Used oils also contain low concentration of hazardous material such as heavy metal sand carcinogenic poly-aromatic hydrocarbons which if exposed to the skin for over a long period can cause cancer.

It in line with the product stewardship policy which means that the oil companies are responsible for their products from cradle to grave that oil companies should endeavor to run a used oil management system.

Challenges faced by the major oil marketers include,

Lack of involvement by al stakeholders.

Cost of collection and disposal.

Lack of government regulations – Although **E**nvironmental **M**anagement of **C**oordination **A**ct exists, there does not exist supporting standards to regulate used oil management.

Lack of infrastructural framework for disposal of used oil

Lack of environmental standards for used oil management.

Many African problems are imported from abroad, Lloyd Timberlake (1985). Most oils and lubricants are imported to African countries even though most of the raw materials

are available locally. This products don't come with proper disposal strategies and thus end up polluting the environment with water being the most affected by this liquid wastes.

Pollution can be viewed as any interface that prevents the beneficial use of air, water, land, plants or animals. J.E Otiende et al (1991); any direct or indirect alteration of the physical, thermal, biological or potential hazard to the health, safety or welfare of any living species. Pollution consists of inserting foreign matter in the wrong place and in quantities that are too large.

Used oil can be recycled in the following ways:

Reconditioned on site, which involves removing impurities from the used oil and using it again. While this form of recycling might not restore the oil to its original condition, it does prolong its life.

Inserted into a petroleum refinery, which involves introducing used oil as a feedstock into either the front end of the process or the coker to produce gasoline and coke. Re-refined, which involves treating used oil to remove impurities so that it can be used as a base stock for new lubricating oil. Re-refining prolongs the life of the oil resource indefinitely. This form of recycling is the preferred option because it closes the recycling loop by reusing the oil to make the same product that it was when it started out, and therefore uses less energy and less virgin oil.

Processed and burned for energy recovery, which involves removing water and particulates so that used oil can be burned as fuel to generate heat or to power industrial operations. This form of recycling is not as preferable as methods that reuse the material because it only enables the oil to be reused once. Nonetheless, valuable energy is provided (about the same as provided by normal heating oil).

It will be noted that used oil management is fairly a new topic and not a lot has been written on the same. This fact made it very difficult to find past work and material for this section.

CHAPTER THREE.

3.0 Research methodology

Visit were done to 70 multinational petrol stations and several independent petrol stations, jua kali garages at down town and to industries buying bulk lubricants, greases, hydraulic fluids from oil companies for use in their machinery to give a general idea of on extent of the problem. This was with an aim to observe use and disposal of used oil at various commercial sectors and the volumes generated from various uses.

3.1 Research Design

This study employed interview survey method of data collection, as it is the most suitable technique for gathering information for large samples bearing in mind the homogeneity of the sample.

3.2 The study area.

The increased levels of consumption characteristic of the population of urban areas lead to the generation of copious quantities of wastes. The impacts of this pollution are experienced both locally and at great distances from the sources. Domestic and industrial discharges contaminate air, land and water and harm flora and fauna. Much of this pollution stems from economic growth and industrialization rather than urbanization per se. Cities however concentrate this waste in one place straining the ability of local ecosystems to assimilate them. Wetlands can render small quantities of sewage harmless yet they are no match for the vast quantities of urban used oil that finds its way though

dumping and storm water wash off. Urbanization itself reduces the assimilative capacity of the environment by removing vegetation, slowing the flow of air and water, generating heat and reducing infiltration capacity of the land. This scenario is aggravated by generation of non-biodegradable wastes such as used oil.

Nairobi has a high concentration of used oil users due to high number of vehicles and industries hence formed an ideal study area in terms of management and disposal of used oil. Nairobi also has a high concentration of service stations which are major outlets of selling of lubricants and where vehicles also come for oil change. There are approximately 1394 service stations countrywide out of which 452 are found in Nairobi i.e. 32% of the county's service stations are concentrated in one town!

Out of the 452 stations, 249 belong to the 5 major oil companies and 203 are the mushrooming independents services stations. All the major oil company stations market their respective lubricant brands along side petrol fuel. Of the 203 independent stations 90% do not market lubricants at the stations and have no service bays.

Informal sectors, jua kali garages, are also many in Nairobi they service a large number of Matatus and generate large volumes of used oil. A very big number of these garages border the Nairobi River where volumes of used oil find its way into the river. Kariokor market also has a high concentration of Jua kali garages. With these facts, Nairobi served as an ideal study area.

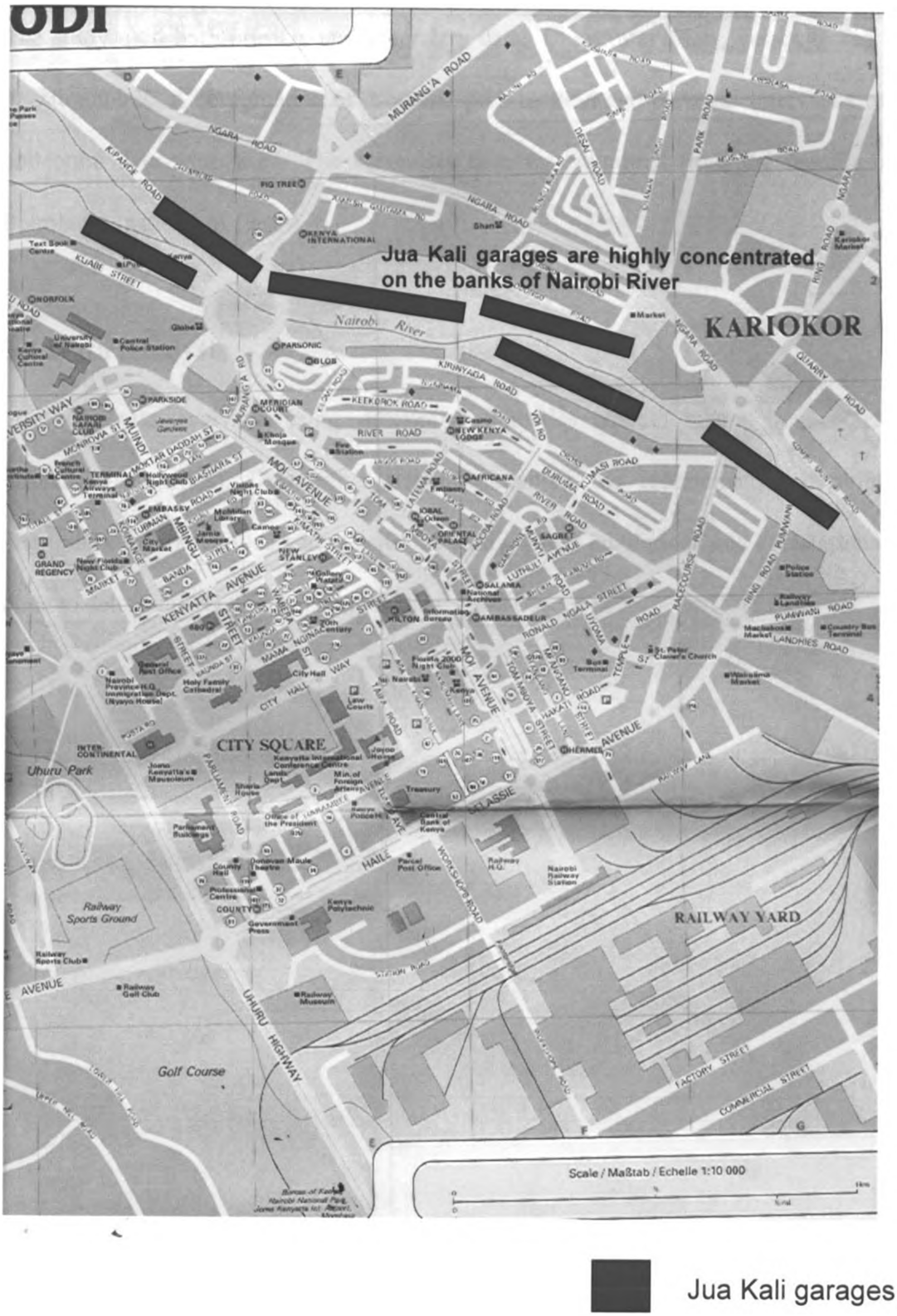
Table 1: Distribution of service station in Kenya

MARKETER	NAIROBI	MOMBASA	NAKURU	ELDORET	KISUMU	MT KENYA	Sum
Independents	203	121	73	152	178	49	**776**
SHELL/BP	88	33	21	19	25	20	**206**
Kenol/Kobil	60	19	11	13	15	16	**134**
Total (K)	37	17	12	11	12	12	**101**
Caltex	37	15	13	13	11	10	**99**
Mobil	27	12	7	11	12	8	**78**
Total (Sum)	452	217	137	219	254	115	**1394**

Source: Petroleum Institute of East Africa

The study focus is mainly Nairobi region where the total number of stations is 452. Out of this 452 the major oil marketers have 249 stations (55%) while the independents have 203 stations representing 45% of the market. The independents stations largely do not sell lubricants since they have no brands of their own.

Fig. 2: Distribution of Jua kali garages in Nairobi. There are over 200 garages here.



3.3 Data Collection

The study used both primary and secondary data. The primary data was collected using questionnaires. A combination of drop-and-pick method and personal interviews of data collection data were used. The secondary data was obtained from the records of the Petroleum Institute of East Africa.

3.4 Data Analysis

The data was analyzed using descriptive statistics (mode, mean, frequencies and inferential statistics). Descriptive statistics enabled the researcher to describe the distribution of the various variables in the study. Cross tabulations and correlations were done to determine relationships in the data.

CHAPTER FOUR

4.0 Data analysis

The data collected was analyzed using SPSS (Statistical Package for Social Scientists) to generate frequency tables, charts and descriptive statistics.

Research findings reveal that cumulatively, 76.4% of the oil is left behind by motorists after oil change service. Only 23.6% is taken away by the motorists. 6.9% is collected by construction firms; Mavoloni Ostrich Farm collects 8.3%, while various individuals collect 45.8%, as will be seen in table 2.

Table 2: Disposal of used oil at source.

	Frequency	Percent
Contractors - construction works companies	5	6.9
Motorists	17	23.6
Staff	1	1.4
Mavoloni Ostrich Farm	6	8.3
Schools	1	1.4
Various individuals	33	45.8
N/A	9	12.5
Total	72	100.0

The oil that is left behind by motorist was found to be disposed as follows. Table 3 show that a big proportion of used oil is given away freely to individuals, 55.6%. Some is sold to third parties at low prices, 31.9%. Other cases, 1.4%, were reported where used oil is disposed into the city council sewer system.

Table 3: Underground tanks Used oil disposal

	Frequency	Percent
Given away for free	40	55.6
Sold to third parties	23	31.9
Dispose in the council drainage system	1	1.4
N/A	8	11.1
Total	72	100.0

It was found that, majority of the motorists, 86.3%, did not take away their used oil. Table 4 show and figure 3 shows that 13.7% of the total used oil is taken away; majority of whom were the Canter motorists at 37.5%. Figure 2 shows that 13% of the Nissan Matatus took their oil, 87% did not. 12.5% of the Pick-up Vans took, 87.5% did not. 13.5% of Mini bus took, 86.5% did not. 22.2% of the Lorries took, 77.8% did not. Only 3.3% of the Saloon motorist took away used oil, while all 4x4 motorists did not take any.

VEHICLE	DISPOSAL	%
Van (Matatu)	Taken away	13
	Left behind	87
Van (Pick-up)	Taken away	12.5
	Left behind	87.5
Mini buses	Taken away	13.5
	Left behind	86.5
Saloon	Taken away	3.3
	Left behind	96.7
Lorry	Taken away	22.2
	Left behind	77.8
Canter	Taken away	37.5
	Left behind	62.5
4x4	Taken away	0
	Left behind	100

Table 4: Used oil handling, distribution by vehicle type

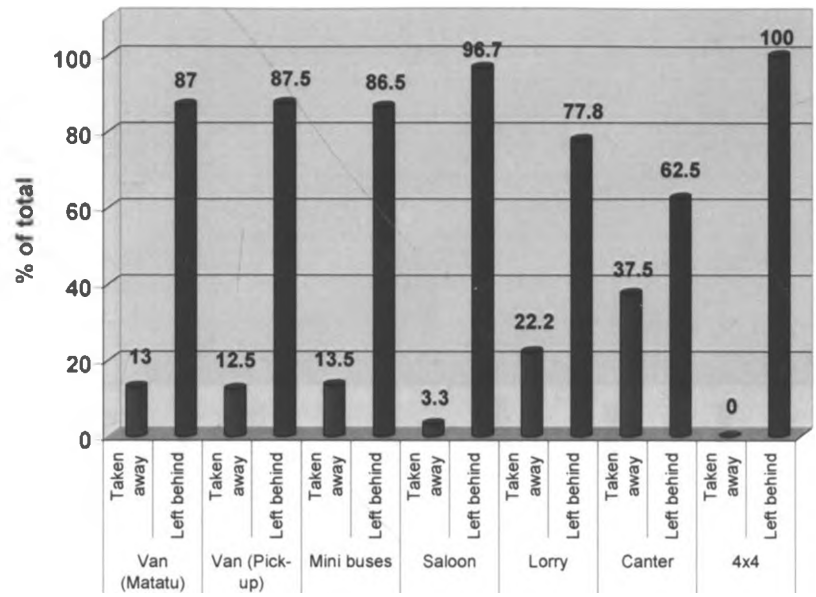


Fig. 3: Used oil handling, distribution by vehicle type

Matatus frequent Oil change bays more often than all other vehicles combined. As depicted by figure 3, 55.4% of the motor vehicles that were serviced were Matatus, mini-buses comprised of 17%, 11.8% were Lorries, 9.8% canters, 2.6% pick-ups and only 0.7% were luxury four wheel drives.

VEHICLE	%
Van (Matatus)	55.4
Van (Pick-ups)	2.6
Mini Buses	17.0
Saloons	9.8
Lorries	11.8
Canters	2.6
4x4	0.7

n=200

Table 5: Type of car serviced

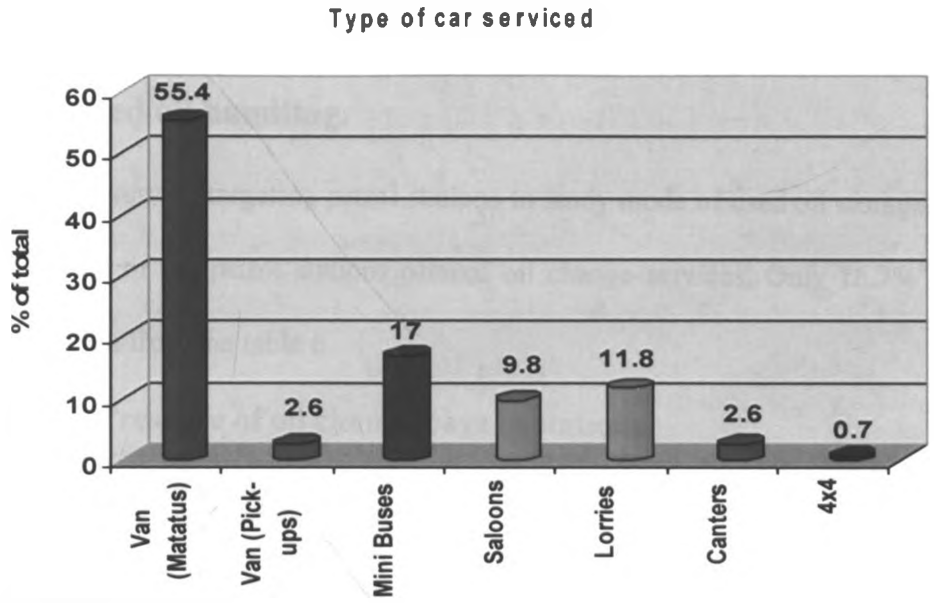


Figure 4.

In the bigger picture, 86.3% of the motorists did not take away their used oil, 13.7% did. See Figure 5.

Figure 5

4.1 Used oil handling.

In another survey, targeting petrol stations to study mode of used oil storage, it was found that 83.3% of the petrol stations offered oil change services. Only 16.7% did not. This will be seen from the table 6.

Table 6: Presence of oil change bays in stations

	Frequency	Percent
YES	60	83.3
NO	12	16.7
Total	72	100.0

Table 7 depicts that, 51.4% petrol stations had underground tanks for storing used oil. The rest, 48.6%, did not have.

Table 7: Presence of used oil storage tanks

	Frequency	Percent
YES	37	51.4
NO	35	48.6
Total	72	100.0

Mean monthly used oil, per station, stands at 653 litres. It was observed that the figures are slightly increasing month on month from 642.04 in May to 665.31 in July, as seen below.

Table 8: Cumulative Mean monthly used oil figures.

MONTH	MAY	JUNE	JULY	MEAN
MEAN (LITRES)	642.04	651.32	665.31	653

CHAPTER FIVE

5.0 Results and discussion

An interview with a Petroleum Institute of East Africa official revealed that petroleum marketers, who are the main outlet for oils have embarked on used oil collection at source. Most petrol stations that have oil change bays now have underground used oil storage tanks. The only nightmare is that there is still no laid down procedure of handling the oil once the tanks are full. This has lead the petrol stations disposing it through un environmentally friendly ways including selling to third parties who use it in various ways including dust suppression, swampy areas treatment, timber treatment, to mention but a few. All this methods of oil disposal pose serious threats to the environment, more adversely to water.

Site visits to Jua Kali garages revealed that, none have used oil tanks; the few who had something similar were those who had 210 litre drums. Collection of oil by this garages was purely intended for sale and when they could not find outlets, all the oil would be poured away to create room for fresh one. Jua Kali garages are most notorious for water pollution. As was depicted in chapter one, used oil dumping is profound at their sites. Asked if they new the dangers of handling used oil without protection, most mechanics had no idea that there were any. It is clear that public awareness of the dangers posed by used oil is need as a matter of urgency.

The extent of the problem is illustrate further in the photos below which were taken during site visits to the Jua Kali garages.

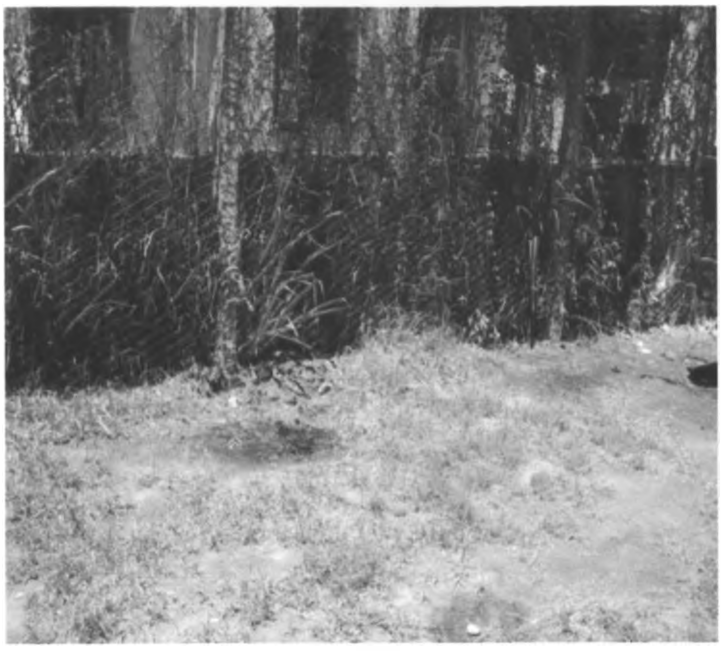


Fig. 6: Backside of a jua kali garage. Notice the environmental pollution on the ground

Fig. 7: A heavy commercial vehicle parking yard at Embakassi Nairobi area. This yard is used both as a parking and a garage.

Fig. 8: A parking yard in a Jua kali garage. Deep ground pollution is evident.

Fig. 9: A Jua kali garage at Kariokor area (notice poor handling of used oil and pollution it causes).

Fig. 10: A Jua kali garage along Nairobi River- back side of Kirinyaga road area. (The soil here is practically soaked with used oil).

In figure 10, notice that clean up and recovery of such grounds is almost impossible. Notice also the heavy spillage and the garbage lying all over. Here there are buses and Matatus that come for oil change and also body wash. The mixture of used oil, water, detergents, garbage and oil rugs all end up in the Nairobi River.

The recovery of used oils from direct consumers will involve majorly processing and manufacturing industries as well as garages and workshops. The current lack of definite disposal procedures from these sources is attributed to the irregular disposal methods by individuals who carry away the oil for use or to sell.

Garages, workshops and oil change bays however present a reliable source of recovering used oil should the accumulation procedures be streamlined.

Figure 11 and 12 shows good practice in major oil companies' service stations.

Fig. 11: This shows proper used oil handling.

This is a used oil interceptor in a major oil marketer service station. The surrounding areas are covered with cabro works (compare this to the open ground in Jua kali garages). This prevents seepage of any used oil into the soil or water. All the used oil and any water whether from station activities or storm water, are captured through the interceptor.

Fig. 12: Proper used oil handling system (spilled oil on the cabro works is simply washed off into the interceptor).

Environmentally friendly methods of oil disposal currently adopted, as revealed by PIEA, include;

(i.) Oil Recycling

Some of the used oil is recycled in a plant located near Kikuyu. The plant has a current capacity of 9000 ton per year and uses acid/cay process. This however produces highly toxic sludge that is buried at selected sites. A better method of treating the sludge is incineration in cement kilns and is currently under survey. The plant is also limited in capacity in for handling all collectable oil. Recently the plant has not been consistently operational.

(ii.) Oil Laundering

This involves processing the oil by methods such as filtration, dewatering and addition of additives before returning it to its initial use. It results into very little waste oil and is practiced by some electricity companies. Certain power generating companies have advertised tenders for used oil reclamation.

(iii.) Use as fuel

Some of the used oil is blended into fuel and burnt to recover energy. This is normally done in furnaces and smelters. The furnace conditions however do not guarantee complete destruction of harmful impurities. Burning of used oil in Kenya is however not very well established and the practice is largely restricted to road construction and few metal working workshops. This kind of disposal does not however guarantee complete destruction of harmful components in used oil.

(iv.) Use as a timber preservative

This includes use on electricity and fencing posts as a termite retardant and is considered acceptable because the oil generally immobilized in exposed conditions and cumulative exposure health effects are eligible. However there is still danger of over use where excess oil can be washed off onto the ground leading to pollution. Handling procedures are not well defined.

(v.) Other uses

Some of the used oil especially that generated by building and construction firms is normally incorporated into bitumen for road construction. This method immobilizes the dangerous components in the tarmac bust. Leaking from road surfaces has been reported in places where the practice is common (like German) and the possibility of careless handling during these kinds of applications does not make it a preferred disposal option. The used oil is also used for demarcating sports fields by marking out lines and this is common in learning institutions and sports clubs. The environmental effects of this practice are not considered harmful due to the small quantities used and the fact that the oil used outdoors over open fields. There is still the danger of over use and spillage during such operations leading to pollution. With enactment of proper standards such practices should cease.

From the study, there was found to be no significant relationship between the type of oil used and the disposal method, it will be noted that, all 4x4 motorists did not take away their used oil. It was however noted that diesel vehicles' used oil had higher demand than petrol engine oil.

Most the used oil is left behind after oil change as was observed in chapter four. We therefore do not reject hypothesis and thus conclude that, not all used oil is taken way by motorists, most of it is left behind after service.

5.1 RECOMMENDATIONS

From the study, it was found that an initiative for the collection and disposal of used lubricating oil can be undertaken sustainably to ensure safe disposal of the used oil generated from various sources. As evident from the research, 84% of the respondents did not take away their used oil. Most of the oil left behind is however disposed off in activities that are not entirely recommended, either posing hazards to human beings (e.g. house timber treatment) or the natural ecosystem (by dumping overland or in drainage systems). Underground collection tanks should therefore be constructed to store the used oil in all oil change bays and garages.

Most of the oil is removed from points of generation by selling to collectors at varying prices. It is evident that collected used oil is either given away for free or sold to third parties at different prices. With proper disposal methods, this oil will not end up in unsafe hands. Again, if there were strict policies on the handling of the oil, it would be easier to tame this menace thus policies should be formulated and documented as a matter of urgency.

The final disposal method is an issue that will require further ground work. PIEA is working on used oil policies and thus documentation of the same. However the following are recommended ways as we await government intervention and PIEA's documentation. This secondary information is the result of tireless research in the PIEA library. It has been consolidated for public knowledge

(i). Cement Kiln Option

Currently the use of used oil as cement kiln fuel can be considered as be the most effective way of disposing it. Cement kilns have traditionally been used to incinerate a wide range of waste materials ranging from highly toxic chemical industry waste and municipal sludge discarded tyres. The kiln operating parameters such as temperatures in excess of 1200^{0}C, clinker residence times of over two hours and exhaust gas residence of over two minutes ensures complete destruction of all harmful components of used oil and the alkaline nature of the clinker ensures acidic gas is not exhausted to the environment. Combustion ashes from incombustible materials in used oil such as heavy metals are integrated into the clinker and safely immobilized.

Specification for used oil fuel and limits placed on individual contaminants will accord to individual kiln and regulatory requirement and it is therefore important to discuss these with specific cement manufacturers. Most specification on limits is currently well below process functionality limits and this is done merely to ensure operation on the safe side.

One of the major difficulties encountered in using used oil as fuel is the water content which will normally require pre-treatment of the used oil before use in ordinary boilers. This limitation is however greatly eliminate in cement kilns where it has been established that the kilns can handle up to 15%-20% volume of water. Cement manufacturers may however impose conservative limits and a typical one is 5% water in used oil.

Simple pre-treatment of the used oil may thus have to be undertaken and this will include filtration and settling to remove solid particles. This operation could be carried at the plant or at used oil central collection points.

Modification of the kiln burners involve investment on the part of the cement plants before the change to work on whole or blend used oil as fuel. The capital investment for modification varies with the difference in properties between the substitute fuel and fuel used initially, and has been reported to fall in the range of 1 to 2 million USD (1993 estimates), mainly used on additional storage tanks, fuel injection system, laboratory facilities and monitoring systems. The monitoring system accounts for the largest proportion of the costs. Used oil however comes very close in terms of thermodynamic properties of fuel oils and well pre-treated used oil can be used with lesser system modification.

(ii). Use as supplementary boiler fuel

World-wide, this is one of the major disposal options currently being employed. The oil blended in proportions of up to 2% with fuel oil. The option is therefore both cost effective and energy efficient. When carefully adopted, it produces an exhaust that is environmentally acceptable with only moderate amounts of dioxins.

The complete breakdown of poly-aromatic hydrocarbons and volatile heavy metals is however not guaranteed since temperature conditions in most boilers is only 500^{0}C and complete destruction of these substances require temperatures of about 1200^{0}C onwards.

Combustion in these boilers may also produce ash that could be deposited on boiler hardware and interfere with boiler operation. The solid contaminants could also affect nozzle functioning while the amount of water in used oil could interfere with the thermodynamic efficiency of the boiler. It is therefore essential to subject used oil to some form of pre-treatment to minimize unwanted components like water, diluents and particulate matter. The pre-treatment method analyzed below could be applied to produce fuel that can be burned in a variety of boilers, including the LOBP in Mombassa for which this application is being considered.

Pre-treatment of used oil before use in boilers

The used oil from automobiles has been reported to contain up to 8% water and 10% particulate matter. Other chemical contaminants are heavy metals and poly-aromatic hydrocarbons which are normally associated with generation of combustion ash.

The acidity/Alkalinity of used oil depends on factors such as engine conditions and storage vigilance. Combustion in engines normally produces acids that are usually by additives in the oil to enhance Total Base Number (TBN). The total acid number of used

oil will thus also depend on the particular oil being used in terms of its ability to neutralize acids generated during operation. Acidity of used oils have been however reported to fall within the range of pH=5.5 to 6.5. Used oil contaminated by acid water externally may however have lower values of pH going down to 4.5.

This acidity could cause concern in given applications due to corrosion enhancement but considering that for boiler fuel the used oil is blended in a proportion of only 2%, maximum, the risks of acidity are greatly reduced by the diluting effect of new fuel oil.

Should the end users pose specifications on acidity of used oil acceptable by them, the severe pre-treatment option could be modified to include a water "washing" stage that dissolves away most of the acids before taking it for flashing to remove water. This activity can however not be done for only light pre-treatment explained later as the water content cannot be entirely reduced to very low levels.

The assumption in however pre-treatment and equipment specification is that the used oil is treated to desired condition and then blended with the new fuel oil. The resulting fuel should not pose any risks to the physical functioning of the boiler, considering that the used oil is only 2% of the blend. The more capital intensive investment of changing the boiler configuration is only justified in applications where the used oil is fired wholly or in proportions of over 10% in the fuel blend e.g. in cement kiln usage.

Schemes of pre-treatment of used oil will depend on the actual condition of the oil and this could be made easier when the process of collecting and storing of this oil is monitored to ensure no additional contaminants are introduced during handling. The monitoring should also be extended to the plant where the used oil should be tested for a few requirements before use (e.g., solids and water content).

The pre-treatment process for used oil prior to use in boilers will center on minimizing particulate matter, removal of water and normalization of acidity. Each of these is examined below.

(A). Water and particulates removal

(a.) Light pre-treatment

Particulate removal can take place simultaneously with water removal since the physical operations involved are similar. Degree of treatment will depend on extent of contamination of given used oil. Relatively well tended used oil can be lightly pre-treated by a combination of settling and filtration. This method is however limited by the fact that most oils have detergency properties and the water is integrated in the oil and phase separation is difficult by this method.

This method works as a batch treatment process done offline before blending with fuel. The process of settling is very slow and for any meaningful separation, the residence time before sludge is drained off from material in the settling tank should be about 2-3 weeks!

This limitation in the process can be contained by performing this process at collection and storage points before delivering the oil to the plant.

The settling tank is drained from the bottom to remove the sludge as well as the water rich phase that tends to settle at the bottom. The degree of water removal is however strongly dependant on the nature of the oil and since most oils has detergency characteristics, this operation cannot remove over 20% of the integrated water.

The settler used shall have to be a simple tank with provision for bottom drainage. It should be of little depth and have slight glasses and test cocks for checking the level of water and sludge. A heating coil should be provided in the settler for heating the oil to about 70C to regulate the viscosity to values that allow fast settling. Heating should however not be done continuously as convection currents will hamper settling of finely dispersed particles.

The process of filtration can be combined with settling to speed up the clarification of used oil prior to use in boilers. A simple three tier mesh filter working by gravity flow and having a maximum of 50 mesh net would not hamper flow and having a large portion of the suspended solids. A probable design for this kind of filter is attached. Other filters with particulate filter mediums like sand were considered and dropped on account of filter medium disposal problems and general ease of handling. The mesh was adopted

due to the fact that it is cleanable by naphtha/petrol and can be used for a longer period. The mesh sizes specified will allow easy flow by gravity and can remove much of the suspended solids.

The total capital investment for this kind of pre-treatment is low. This can be explored in future.

(b.) Severe pre-treatment

For used oil that has been extremely contaminated by solid particles, water and acids, the method of separation normally employed if centrifugation in a tubular bowl centrifuge. This is the standard method for solids removal in used oil reclamation operations. The high throughputs characteristic of centrifuges keep product residence times down to seconds.

(B). Simple treatment filter design (Used with settling operation).

A simple three tier filter used to aid the process of sedimentation in the settling tank would be made from mild steel meshes arranged one on top of the other with the one having smaller mesh (largest opening) at the top. A 30-mesh gauze followed by a 40-mesh and 50-mesh nets respectively could be used. Discussions with a filter specialist

showed that these meshes would not offer appreciable resistance to flow of used oil at the right viscosity under the action of gravity alone.

The use of a packed bed filter media using materials such as sands of different fineness or diatomaceous earth was considered but it was felt that handling costs and disposal ways for the spent media would be both high and environmentally risky since the filter mediums have the ability to absorb some of the harmful components in used oil. The use of cartridge filters of the kind used in motor vehicles was also considered but the additional pumping costs necessary to achieve flow through these filters makes capital investments on them higher than simple gravity filters. Cleanable cartridge filters which are renewable could be considered but similar filtration actions are easily obtainable by simple gravity filters as designed here. Any impediment to flow through the meshes should be overcome by merely increasing the pressure head (height of liquid on feed hold).

The supporting frame of the filter is constructed from mild steel plates and the filter meshes are welded on to the cylindrical holds constructed so that they fit one on top of the other in order of increasing mesh (decreasing filter opening). The entire assembly is held inside an outer cylinder to prevent leakage. The different filter holdings are removable to necessitate cleaning by petrol.

Provision for mild suction at the last segment should be made to ensure sustainable flow in case flow by gravity is not adequate. This would be especially necessary when cleaning is not done frequently enough but the capital investment would have to increase.

The assembly can alternatively be made air tight so that the feed pump is also employed in aiding flow of the oil through the meshes. These are however details that shall only be established after pilot studies in case functionality is found wanting. This process is meant to aid and hasten simple pre-treatment in conjunction with sedimentation and will enable removal of the lowest density solids that normally require long times for settling.

Other types of filters were based mainly on maintenance and operational convenience: Filters require regular downtime for filter media changes and cleaning of build up. The viscous nature of oil which is handled in this process also makes pumping costs through filters prohibitive.

Centrifuges on the other hand will have no media to change, are self cleaning, provide consistent output, offer automatic operation, require less frequent maintenance and provide lower operating costs. The use of the centrifuge is therefore the best method of removing most of the suspended solids in the used oil and to a considerable extent will also remove part of the water. The removal of residual water will normally follow centrifugation and this is done by passing the oil through a heat exchanger where it is

heated to flashing temperatures of about 150C before being fed to the flashing chamber. The flashing operation will remove most of the water and volatile fuel that leak into oil during usage and could consequently reduce the flash point of used oil to unacceptable limits for use as fuel (below 40C). This operation should however be performed only for oil that has been established to contain unacceptable levels of water that cannot be removed by moderate physical methods considered above or centrifugation alone.

The resulting oil from the flash chamber can be comfortably used as fuel in a wide variety of boilers without posing any risks to physical operation.

The capital investment for standard severe treatment is high but resulting oil has a higher economical value and can actually be marked as fuel oil, even though it cannot be reused without additional treatment as a lubricant.

The above process will remove the water and solids that pose the greatest risks to boiler functioning and efficiency. For very acidic used oil which may pose corrosion risks to the boiler and containing very finely dispersed solids that produce large quantities of ash after burning, flocculating agents like tri-sodium phosphate or calcium carbonate which also has basic properties can be added in the settling/hold-up tank with agitation to ensure elimination of these risks.The centrifuge and flashing operations are energy intensive and the capital investment will be higher but it also offers better pre-treatment action which

adds greater value to the used oil and increases the range of boilers in which it can be used. The high throughputs associated with the process means it only needs to be used when a given accumulated amounts of oil has been collected and not continuously.

The oil severely treated by centrifugation and dehydration (flashing) can be used in cement burners with minimum changes to burner configurations as it is much more similar to fuel oils popularly used. Even severe treatment without additional further operations beyond those given does not remove heavy metals and PCA's from used oil and for it to be used in other boilers; it must be blended in proportions of less than 2% of the fuel mixture. This is a treatment unit for treating used oil in order to remove pollutants. The treated used oil can then be used as a boiler fuel or recycled and by adding some additives which enhance the oil the product can be used once more as a lubricant.

The following material is not my original work, while undertaking the study I came across it and I believe it will be of use to the reader as general public awareness material. It has been consolidated from various journals, magazines, Audio & Tele media and the Internet.

5.2 Public awareness and Education (Simple educational materials for used oil generators and the general public).

Generators are businesses such as service stations, fleet maintenance facilities, and "quick lube" shops that generate and handle used oil. They should be encouraged to have used oil management standards--a set of "good housekeeping" requirements for used oil handlers. A generator or the common Mwananchi should know the following simple facts for best practice in used oil management.

5.2.1 Answers to most common Questions on used oil management.

(a). How is Used Oil Recycled?

Once oil has been used, it can be collected, recycled, and used over and over again. Audit and Reduction Manual for Industrial Emissions and Wastes (UNEP technical report series 1991) reveals that an estimated 380 million gallons of used oil are recycled each year in USA. Recycled used oil can sometimes be used again for the same job or can take on a completely different task. For example, used motor oil can be re-refined and sold at the store as motor oil or processed for furnace fuel oil. Aluminum rolling oils also can be filtered on site and used over again.

(b). Recycling Used Oil Is Good for the Environment and the Economy;-

- Re-refining used oil takes only about one-third the energy of refining crude oil to lubricant quality.
- It takes 42 gallons of crude oil, but only one gallon of used oil, to produce 2 « quarts of new, high-quality lubricating oil.

- One gallon of used oil processed for fuel contains about 140,000 British Thermal Units (BTUs) of energy.

(c). Does My Business Handle Used Oil?

Generators are businesses that handle used oil through commercial or industrial operations or from the maintenance of vehicles and equipment. Generators are the largest segment of the used oil industry. Examples of common generators are car repair shops, service stations, quick lube shops, government motor pools, grocery stores, metal working industries, and boat marinas. Farmers who produce less than an average of 25 gallons of used oil per month are also generator. Individuals who generate used oil through the maintenance of their personal vehicles and equipment are also generators.

(d). What Standards Should My Business Follow?

If your business generates or handles used oil, there are certain good housekeeping practices that you must follow.

Unfortunately currently Kenya does not have used oil standards but we can borrow from the US environmental protection agency. Such as: These required practices, called "management standards," were developed by EPA for businesses that handle used oil. The management standards are common sense, good business practices designed to ensure the safe handling of used oil, to maximize recycling, and to minimize disposal. The standards apply to all used oil handlers, regardless of the amount of the oil they

handle. Although different used oil handlers may have specific requirements, the following requirements are common to all types of handlers. These requirements relate to storage and to cleaning up leaks and spills, as follows.

(e). Storage

- Label all containers and tanks as Used Oil.
- Keep containers and tanks in good condition. Don't allow tanks to rust, leak, or deteriorate. Fix structural defects immediately.
- Never store used oil in anything other than tanks and storage containers. Used oil may also be stored in units that are permitted to store regulated hazardous waste. Tanks and containers storing used oil should be labeled and in good condition. Storage of used oil in lagoons, pits, garbage dumps or surface impoundments is prohibited.

(f). Oil Leaks and Spills

- Take steps to prevent leaks and spills. Keep machinery, equipment containers, and tanks in good working condition and be careful when transferring used oil. Have sorbent materials available on site.
- If a spill or leak occurs, stop the oil from flowing at the source. If a leak from a container or tank can't be stopped, put the oil in another holding container or tank.
- Contain spilled oil. For example, containment can be accomplished by erecting sorbent beams or by spreading a sorbent over the oil and surrounding area.

- Clean up the oil and recycle the used oil as you would have before it was spilled. If recycling is not possible, you first must make sure the used oil is not a hazardous waste and dispose of it appropriately. All used cleanup materials, from rags to sorbent booms, that contain free-flowing used oil also must be handled according to the used oil management standards. Remember, all leaked and spilled oil collected during cleanup must be handled as used oil. If you are a used oil handler, you should become familiar with these cleanup methods. They may also be part of a spill response action plan. *(Currently multination oil industry in Kenya has personnel trained in oil spill clean up. The government can approach them for knowledge transfer. Hopefully they can do it for free as a part of social responsibility.)*
- Remove, repair, or replace the defective tank or container immediately.

(g). Record Keeping.

NB: The Kenyan government should develop such a system to ensure audit of used oil management in all sites. The identification numbers establish an audit trail easy to follow to ensure all used oil is disposed off according to sound practices.

EPA uses 12-digit identification (ID) numbers to track used oil. Transporters hauling used oil must have a valid EPA ID number, and generators, collection centers, and aggregation points must use transporters with EPA ID numbers for shipping used oil off site. If one needs an ID number, they only require to contact the EPA regional office or local

municipal council. Generators, collection centers, aggregation points, and any handler that transports used oil in shipments of less than 55 gallons do not need an ID number, but may need a state or local permit. Used oil transporters, processors, burners, and marketers also must record each acceptance and delivery of used oil shipments. Records can take the form of a log, invoice, or other shipping document and must be maintained for three years. Re-refiners, processors, transfer facilities, and burners must have secondary containment systems (e.g., oil-impervious dike, beam, or retaining wall and a floor) so that oil cannot reach the environment in the event of a leak or spill. EPA also encourages generators to use a secondary containment system to prevent used oil from contaminating the environment.

Burners of used oil that meets a certain set of quality standards called the used oil specifications are not regulated under the used oil management standards, as long as the used oil is burned in appropriate boilers, furnaces, or incinerators. Know and understand your state regulations governing the management of used oil.

(h). Mixing Used Oil and Hazardous Waste

In addition to EPA's used oil management standards, the business may be required to comply with state hazardous waste regulations if your used oil becomes contaminated from mixing it with hazardous waste. If used oil is mixed with hazardous waste, it probably will have to be managed as a hazardous waste. Hazardous waste disposal is a lengthy, costly, and strict regulatory process. The only way to be sure your used oil does

not become contaminated with hazardous waste is to store it separately from all solvents and chemicals and not to mix it with anything.

(i). How Can My Business Avoid Costly Cleanups?

Meeting the following conditions relieves service station dealers from responsibility for costly cleanups and liabilities associated with off-site handling of used oil. To meet these conditions, service stations must: (1) comply with the management standards described above and not mix used oil with any hazardous substance, and accept used oil from Do-it-yourselfers (DIYs) and send it for recycling i.e. act as collection centres for the public.

The following are recommended cleanup programs.

1. Maximize the recovery of used oil;
2. Minimize the generation of used oil sorbent waste by choosing reusable sorbent materials;
3. Use the spent sorbent materials to produce recycled Sorbent materials;
4. Buy sorbent materials with recycled content.

Extraction devices (e.g., centrifuges, wringers, and Compactors) can be used to recover used oil from reusable sorbent materials. Sorbent pads can be reused between two and eight times depending on the viscosity of the used oil. These technologies, while not required, can be used to reduce the number of sorbent pads ultimately sent for remanufacture, energy recovery, or disposal. The potential to reduce waste and save

money (i.e., lower disposal costs for spent pads and lower per use cost of sorbent pads) by reusing and recycling sorbent pads can be substantial.

(j) How can my business manage cleanup Materials?

If you have used oil on rags or other sorbent materials from cleaning up a leak or spill, you should remove as much of the free-flowing oil as possible and manage the oil as you would have before it spilled. Once the free-flowing used oil has been removed from these materials, they are not considered used oil and may be managed as solid waste as long as they do not exhibit a hazardous waste characteristic. Note, however, that material from which used oil has been removed continue to be regulated as used oil if they are to be burned for energy recovery (regardless of the degree of removal).

(k). Other than the above, what else can my business do to conserve oil?

- Minimize the amount of used oil you produce. The less used oil that is produced in the first place, the less that ultimately has to be handled. Businesses can filter, separate, and recondition used oil to prolong its usable life.
- Purchase re-refined used oil products instead of virgin oil products. Re-refined oil works just as well as virgin oil.
- Practice safe management of used oil. Don't mix used oil with anything. Always store used oil in leak-proof containers that are in secure areas safely away from workers and the environment. Send used oil to a re-refiner whenever possible.

For the general public a lot of awareness campaigns are necessary to educate them on the issue outlined above and also on dangers of used oil usage on their health. The public should be encouraged to service their cars in the major oil companies services stations and leave the used oil in the station for safe disposal.

Garage owners can also be educated on safe handling and disposal of used oil. The major oil companies should share the knowledge.

The government should enforce guidelines and legislation for used oil disposal they can borrow from already working guidelines such as those of EPA . It should also support garages that are willing to enforce these guidelines and on the other hand enforce strict inspections and penalties on all garages not observing environmental sound ways in used oil disposal.

PIEA- petroleum institute of East Africa together with the oil industry and NEMA should run an awareness campaign jointly to educate all oil generators and the general public on:-

- The dangers of mishandling used oil both to the individual health and environment. .
- Best practice in used oil handling.
- Common questions on used oil handling
- Easy recycling steps and means.

- Advantages of recycling.

PIEA and NEMA should act as information centers for used oil management. Simple brochures should be given to the public. The media should be used aggressively to promote this awareness.

Garages and service stations should be points of distribution for this information. Workshops to disseminate information and give solutions should be organized for all generators by PIEA and NEMA jointly with government and oil marketers.

Best practice AWARDS in used oil management should be given in the similar way now PIEA has began **the energy awards** for those who are conserving energy and promoting environmental good.

If possible, incentives should be offered to motorist to leave the used oil in the station or vetted garages. Used oil audits should be done to ensure all left used oil is being disposed off in sound methods. This will require the necessary infrastructure and facilities, sound technology like that of lube packager should be developed and shared with all. Simple infrastructure logistics will include and address;

Setting up of collection centers and aggregation points:-

Facilities that accept small amounts of used oil and store it until enough is collected to ship it elsewhere for recycling. Collection centers typically accept used oil from multiple sources that include both businesses and individuals. Aggregation points collect oil only from places run by the same owner or operator and from individuals.

Transporters:- companies that pick up used oil from all sources and deliver it to re-refiners, processors, or burners. Transfer facilities include any structure or area where used oil is held for longer than 24 hours, but not longer than 35 days. Examples of transfer facilities are loading docks and parking areas.

Re-refiners and processors:- facilities that blend or remove impurities from used oil so that it can be burned for energy recovery or reused. Included in this category are re-refiners who process used oil so that it can be reused in a new product such as a lubricant and recycled again and again. EPA's management standards primarily focus on this group of used oil handlers.

Burners:- to burn used oil for energy recovery in boilers, industrial furnaces, or in hazardous waste incinerators.

Marketers:- handlers who either a) direct shipments of used oil to be burned as fuel in regulated devices or, b) claim that certain EPA specifications are met for used oil to be burned for energy recovery in devices that are not regulated. They also sometimes

help move shipments of used oil to burners. By definition, marketers must also fall into at least one of the above categories.

In conclusion, Kenya needs to establish a strong recycling industry and a culture of environmental responsibility in every citizen. To ensure sustainability of such programs the government may perhaps put a levy on every litre of oil sold as is the practice currently in developed countries. These fees would facilitate the running of the used oil management program countrywide.

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Appendix I. Questionnaires

Used oil questionnaire:

Date: .....

	Car type – Nissan matatu, saloon, 4x4, truck , lorry etc	Volume of oil change	Did customer request for his used oil –Y/N
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			

This questionnaire was used for data collection in stations to assess the behaviour of various motorists as regarding used oil management.

Appendix II. Raw data.

	Date	Vehicle	Litres drained	Oil taken away
1	28.06.04	Van (Matatu)	6	NO
2	28.06.04	Van (Matatu)	6	NO
3	29.06.04	Van (Matatu)	6	YES
4	29.06.04	Van (Matatu)	6	YES
5	29.06.04	Van (Matatu)	6	YES
6	29.06.04	Van (Matatu)	6	YES
7	30.06.04	Lorry	15	YES
8	30.06.04	Van (Matatu)	6	NO
9	30.06.04	Van (Matatu)	6	NO
10	30.06.04	Van (Matatu)	6	NO
11	30.06.04	Van (Matatu)	6	NO
12	21.06.04	Saloon	5	NO
13	21.06.04	Van (Matatu)	6	NO
14	21.06.04	Van (Matatu)	6	NO
15	21.06.04	Van (Matatu)	6	NO
16	21.06.04	Van (Matatu)	6	NO
17	21.06.04	Van (Matatu)	6	YES
18	21.06.04	Van (Matatu)	6	YES
19	21.06.04	Van (Matatu)	6	YES
20	22.06.04	Van (Pick-up)	6	NO
21	22.06.04	Van (Matatu)	6	NO
22	22.06.04	Van (Matatu)	6	NO
23	22.06.04	Van (Matatu)	6	NO
24	22.06.04	Van (Matatu)	6	NO
25	22.06.04	Van (Matatu)	6	NO
26	22.06.04	Van (Matatu)	6	NO
27	22.06.04	Van (Matatu)	6	NO
28	23.06.04	Van (Matatu)	6	NO
29	23.06.04	Van (Matatu)	6	NO
30	23.06.04	Van (Matatu)	6	NO
31	23.06.04	Van (Matatu)	6	YES
32	23.06.04	Van (Matatu)	6	YES
33	24.06.04	Van (Matatu)	6	YES
34	24.06.04	Van (Matatu)	6	YES
35	24.06.04	Van (Matatu)	6	NO
36	25.06.04	Van (Matatu)	6	NO
37	25.06.04	Van (Matatu)	6	NO
38	25.06.04	Van (Matatu)	6	NO
39	25.06.04	Van (Matatu)	6	NO
40	25.06.04	Van (Matatu)	6	NO
41	25.06.04	Van (Matatu)	5.5	NO
42	26.06.04	Saloon	5	NO
43	28.06.04	Van (Pick-up)	6.5	NO
44	28.06.04	Van (Matatu)	6	NO
45	28.06.04	Van (Matatu)	6	NO
46	28.06.04	Van (Matatu)	6	NO
47	12.06.04	Saloon	5	NO
48	13.06.04	Van (Matatu)	6	NO
49	13.06.04	Van (Matatu)	6	NO
50	14.06.04	Canter	10	NO

	Date	Vehicle	Litres drained	Oil taken away
51	14.06.04	Van (Matatu)	6	NO
52	14.06.04	Van (Matatu)	6	NO
53	14.06.04	Van (Matatu)	6	NO
54	14.06.04	Van (Matatu)	7	NO
55	14.06.04	Van (Matatu)	6	NO
56	14.06.04	Van (Matatu)	6	NO
57	14.06.04	Van (Matatu)	6	NO
58	14.06.04	Saloon	3	NO
59	14.06.04	Van (Matatu)	6	NO
60	14.06.04	Van (Matatu)	6	NO
61	15.06.04	Van (Matatu)	6	NO
62	15.06.04	Van (Matatu)	6	NO
63	16.06.04	Van (Matatu)	6	NO
64	16.06.04	Van (Matatu)	6	NO
65	16.06.04	Van (Matatu)	6	NO
66	16.06.04	Van (Matatu)	6	NO
67	17.06.04	Van (Pick-up)	6	NO
68	17.06.04	Van (Matatu)	6	NO
69	17.06.04	Van (Matatu)	6	NO
70	17.06.04	Van (Matatu)	6	NO
71	17.06.04	Van (Matatu)	6	NO
72	18.06.04	Van (Matatu)	6	NO
73	18.06.04	Van (Matatu)	6	NO
74	18.06.04	Van (Matatu)	6	NO
75	18.06.04	Van (Matatu)	6	NO
76	18.06.04	Van (Matatu)	6	NO
77	18.06.04	Van (Matatu)	6	NO
78	19.06.04	Saloon	5	NO
79	19.06.04	Saloon	5	NO
80	20.06.04	Van (Pick-up)	5	NO
81	01.07.04	Van (Matatu)	6	NO
82	01.07.04	Van (Pick-up)	6	NO
83	01.07.04	Van (Matatu)	6	NO
84	01.07.04	Van (Matatu)	6	NO
85	01.07.04	Van (Matatu)	6	NO
86	01.07.04	Van (Matatu)	6	NO
87	01.07.04	Van (Matatu)	6	NO
88	02.07.04	Van (Matatu)	6	NO
89	02.07.04	Van (Matatu)	6	NO
90	02.07.04	Van (Matatu)	6	NO
91	02.07.04	Van (Matatu)	6	NO
92	02.07.04	Van (Matatu)	6	NO
93	02.07.04	Van (Matatu)	6	NO
94	02.07.04	Van (Matatu)	6.25	NO
95	05.07.04	Van (Matatu)	6	NO
96	05.07.04	Van (Matatu)	6	NO
97	05.07.04	Van (Matatu)	6	NO
98	05.07.04	Van (Matatu)	6	NO
99	05.07.04	Van (Matatu)	6	NO
100	06.07.04	Van (Matatu)	6	NO

	Date	Vehicle	Litres drained	Oil taken away
101	06.07.04	Van (Matatu)	6	NO
102	06.07.04	Van (Matatu)	6	NO
103	06.07.04	Van (Matatu)	6	NO
104	07.07.04	Van (Matatu)	6	NO
105	07.07.04	Van (Matatu)	6	NO
106	08.07.04	Van (Matatu)	6	NO
107	08.07.04	Van (Matatu)	6	NO
108	08.07.04	Van (Matatu)	6	NO
109	08.07.04	Van (Matatu)	6	NO
110	08.07.04	Van (Matatu)	6	NO
111	10.07.04	Van (Matatu)	6	NO
112	11.07.04	Van (Matatu)	6	NO
113	11.07.04	Van (Matatu)	6	NO
114	12.07.04	Van (Matatu)	6	NO
115	12.07.04	Van (Matatu)	6	NO
116	13.07.04	Van (Pick-up)	6	NO
117	13.07.04	Van (Matatu)	6	NO
118	13.07.04	Van (Matatu)	6	NO
119	13.07.04	Van (Matatu)	6	NO
120	14.07.04	Van (Matatu)	6	NO
121	14.07.04	Van (Matatu)	6	NO
122	14.07.04	Van (Matatu)	6	NO
123	14.07.04	Van (Matatu)	6	NO
124	14.07.04	Van (Matatu)	6	NO
125	14.07.04	Van (Matatu)	6	NO
126	14.07.04	Van (Matatu)	6	NO
127	14.07.04	Van (Matatu)	6	NO
128	14.07.04	Van (Matatu)	6	NO
129	15.07.04	Van (Matatu)	6	NO
130	15.07.04	Van (Matatu)	6	NO
131	15.07.04	Van (Matatu)	6	NO
132	15.07.04	Van (Matatu)	6	NO
133	15.07.04	Van (Matatu)	6	NO
134	15.07.04	Van (Matatu)	6	NO
135	15.07.04	Van (Matatu)	6	NO
136	15.07.04	Van (Matatu)	6	NO
137	16.07.04	Van (Matatu)	6	NO
138	16.07.04	Van (Matatu)	6	NO
139	16.07.04	Van (Matatu)	6	NO
140	16.07.04	Van (Matatu)	6	NO
141	16.07.04	Van (Matatu)	6	NO
142	16.07.04	Van (Matatu)	6	NO
143	18.07.04	Lorry	25	NO
144	18.07.04	Van (Matatu)	6	NO
145	18.07.04	Van (Matatu)	6	NO
146	18.07.04	Van (Matatu)	6	NO
147	18.07.04	Van (Matatu)	6	NO
148	18.07.04	Van (Matatu)	6	NO
149	19.07.04	Van (Matatu)	6	NO
150	19.07.04	Saloon	5	NO

	Date	Vehicle	Litres drained	Oil taken away
151	19.07.04	Van (Matatu)	6	NO
152	20.07.04	Van (Matatu)	6	NO
153	20.07.04	Van (Matatu)	6	NO
154	20.07.04	Van (Matatu)	6	NO
155	20.07.04	Van (Matatu)	6	NO
156	20.07.04	Van (Matatu)	6	NO
157	20.07.04	Van (Matatu)	6	NO
158	24.05.04	Van (Matatu)	6	NO
159	24.05.04	Lorry	13	NO
160	24.05.04	Lorry	13	YES
161	24.05.04	Van (Pick-up)	5	YES
162	24.05.04	Saloon	3	NO
163	24.05.04	Canter	8	NO
164	24.05.04	Van (Matatu)	6	NO
165	24.05.04	Canter	8	NO
166	24.05.04	Lorry	18	YES
167	24.05.04	Saloon	3	NO
168	24.05.04	Saloon	4	NO
169	24.05.04	Saloon	3	NO
170	24.05.04	Canter	8	NO
171	24.05.04	Canter	8	NO
172	24.05.04	Canter	9	YES
173	24.05.04	4x4	7	NO
174	24.05.04	Canter	9	YES
175	24.05.04	Lorry	30	NO
176	24.05.04	Van (Matatu)	5	YES
177	24.05.04	4x4	7	NO
178	24.05.04	Mini Bus	12	YES
179	27.05.04	Lorry	35	YES
180	27.05.04	Van (Matatu)	6	NO
181	27.05.04	Lorry	13	NO
182	27.05.04	Saloon	3	NO
183	27.05.04	Saloon	3	NO
184	27.05.04	Van (Matatu)	6	YES
185	27.05.04	Lorry	13	NO
186	27.05.04	Saloon	3	NO
187	27.05.04	Lorry	3	NO
188	27.05.04	Saloon	3	NO
189	27.05.04	Van (Matatu)	5	NO
190	27.05.04	Van (Matatu)	5	NO
191	27.05.04	Van (Matatu)	6	NO
192	27.05.04	Mini Bus	9	NO
193	27.05.04	Mini Bus	9	NO
194	27.05.04	Saloon	3	NO
195	29.05.04	Saloon	3	NO
196	29.05.04	Saloon	3	NO
197	29.05.04	Mini Bus	9	NO
198	29.05.04	Saloon	3	NO
199	29.05.04	Lorry	13	NO
200	29.05.04	Saloon	3	NO

	Date	Vehicle	Litres drained	Oil taken away
201	29.05.04	Saloon	3	NO
202	29.05.04	Lorry	12	NO
203	29.05.04	Saloon	3	NO
204	29.05.04	Mini Bus	9	YES
205	29.05.04	Saloon	3	NO
206	29.05.04	Mini Bus	7	NO
207	29.05.04	Lorry	12	NO
208	29.05.04	Saloon	3	NO
209	29.05.04	Mini Bus	7	NO
210	29.05.04	Mini Bus	9	NO
211	29.05.04	Van (Matatu)	4	NO
212	29.05.04	Mini Bus	8	NO
213	29.05.04	Mini Bus	7	NO
214	29.05.04	Mini Bus	7	NO
215	29.05.04	Lorry	13	NO
216	29.05.04	Lorry	13	NO
217	29.05.04	Mini Bus	7	NO
218	30.05.04	Mini Bus	7	NO
219	30.05.04	Lorry	13	NO
220	30.05.04	Mini Bus	9	NO
221	30.05.04	Van (Matatu)	6	YES
222	30.05.04	Lorry	25	NO
223	30.05.04	Mini Bus	7	NO
224	30.05.04	Canter	9	YES
225	30.05.04	Van (Matatu)	6	YES
226	30.05.04	Lorry	13	YES
227	30.05.04	Mini Bus	7	YES
228	30.05.04	Mini Bus	7	YES
229	30.05.04	Mini Bus	7	YES
230	30.05.04	Mini Bus	8	NO
231	30.05.04	Mini Bus	8	NO
232	30.05.04	Mini Bus	7	NO
233	30.05.04	Mini Bus	9	YES
234	30.05.04	Mini Bus	7	NO
235	30.05.04	Mini Bus	12	NO
236	30.05.04	Mini Bus	7	NO
237	30.05.04	Mini Bus	8	NO
238	30.05.04	Van (Matatu)	6	YES
239	30.05.04	Lorry	30	NO
240	30.05.04	Mini Bus	7	NO
241	30.05.04	Lorry	20	NO
242	30.05.04	Saloon	3.5	NO
243	30.05.04	Van (Matatu)	6	YES
244	30.05.04	Lorry	12	NO
245	30.05.04	Mini Bus	7	NO
246	04.06.04	Lorry	12	YES
247	04.06.04	Mini Bus	7	NO
248	04.06.04	Mini Bus	7	NO
249	04.06.04	Lorry	13	NO
250	04.06.04	Mini Bus	7	NO

	Date	Vehicle	Litres drained	Oil taken away
251	04.06.04	Lorry	13	NO
252	04.06.04	Lorry	13	NO
253	04.06.04	Van (Matatu)	6	NO
254	04.06.04	Mini Bus	12	NO
255	04.06.04	Mini Bus	7	NO
256	04.06.04	Mini Bus	8	NO
257	04.06.04	Mini Bus	12	YES
258	04.06.04	Mini Bus	8	NO
259	04.06.04	Saloon	3	NO
260	04.06.04	Lorry	15	NO
261	04.06.04	Van (Matatu)	6	NO
262	04.06.04	Van (Matatu)	6	NO
263	04.06.04	Saloon	3	NO
264	08.06.04	Lorry	13	NO
265	08.06.04	Lorry	18	NO
266	08.06.04	Van (Pick-up)	4	NO
267	08.06.04	Lorry	13	NO
268	08.06.04	Van (Matatu)	6	NO
269	08.06.04	Mini Bus	7	NO
270	08.06.04	Mini Bus	7	NO
271	08.06.04	Mini Bus	8	NO
272	08.06.04	Mini Bus	7	NO
273	08.06.04	Saloon	3	NO
274	08.06.04	Van (Matatu)	6	NO
275	08.06.04	Lorry	13	YES
276	08.06.04	Van (Matatu)	6	YES
277	08.06.04	Van (Matatu)	6	YES
278	08.06.04	Mini Bus	7	NO
279	13.06.04	Mini Bus	7	NO
280	13.06.04	Mini Bus	7	NO
281	13.06.04	Mini Bus	7	NO
282	13.06.04	Van (Matatu)	6	YES
283	13.06.04	Mini Bus	9	NO
284	13.06.04	Van (Matatu)	6	NO
285	13.06.04	Mini Bus	12	NO
286	13.06.04	Mini Bus	7	NO
287	13.06.04	Lorry	25	NO
288	13.06.04	Lorry	25	NO
289	13.06.04	Van (Matatu)	6	YES
290	13.06.04	Van (Matatu)	6	YES
291	13.06.04	Lorry	13	NO
292	13.06.04	Lorry	30	NO
293	13.06.04	Lorry	13	NO
294	13.06.04	Mini Bus	9	NO
295	21.06.04	Saloon	3	YES
296	21.06.04		10	NO
297	21.06.04	Van (Matatu)	6	NO
298	21.06.04	Mini Bus	7	NO
299	21.06.04	Saloon	3	NO
300	21.06.04	Van (Matatu)	6	NO

	Date	Vehicle	Litres drained	Oil taken away
301	21.06.04	Mini Bus	7	NO
302	21.06.04	Lorry	13	YES
303	21.06.04	Van (Matatu)	6	NO
304	21.06.04	Van (Matatu)	6	NO
305	21.06.04	Mini Bus	7	NO
306	21.06.04	Mini Bus	7	NO