

PILOT STUDY OF USED OILS IN NIGERIA



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PREFACE

At the sixth Conference of the Parties (COP6), the African group requested for the establishment of a comprehensive work programme for a Global Partnership for Used Oil in Africa. The Basel Convention and its Regional Centres (in Nigeria, South Africa, Senegal, and Egypt) were thereafter charged with the responsibility for the development of a close partnership with major oil companies operating in the region, to put in place environmentally sound management practices for used oil in order to protect the environment and human health in Africa, similar to the partnership announced during the COP6 on end-of-life mobile telephones. The principal objective of the used oil project is the development of an African Regional Management Plan for used oil. Towards this end Nigeria was chosen as a case study, to better define a strategy for the management of used oils in Africa.

Presented in this report is the result of the pilot study on used oils in Nigeria conducted by the Basel Convention Regional Coordinating Centre in Nigeria. It is basically a diagnosis of the situation of the management of used oils in Nigeria involving the identification of: the main sources of used oils; an estimate of the quantities and types of used oils produced, stored and disposed of; the main actors in the production, storage and disposal of used oils, and the existing disposal and treatment facilities.

The Report contains an executive summary of the major findings, the details of the study objectives, the framework adopted for the research, the findings, and analysis within the framework of the terms-of-reference for the study.

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EXECUTIVE SUMMARY

The major findings of the Study are presented thematically herein within the framework of the terms of reference stipulated for the study, namely:

- a) Identification of the main sources of used oils in the country and estimations of the quantities and types of used oils produced, stored and disposed.
- b) Identification of the main actors in the used oil market in the country (mainly those in the production, distribution, storage, refining and utilisation).
- c) Identification of existing disposal and treatment facilities and their capacity.
- d) Survey on the informal sector working with used oils.

A1: Main Sources of Used Oils in the country

A1.1 The main sources of used oils in the country identified in this study are in two main categories: industry and transportation.

A1.2 The industries that generate the most used oils are manufacturing industries including beverages, breweries, food processing, etc; construction companies; metal recycling plants among others using heavy equipment and power generating plants consuming large quantities of virgin engine oils. The used oils are generated from various uses: wear resistance, hydraulic systems, cooling systems, anti-rust, lubrication, etc.

A1.3 Automotive sources of used engine oils in the transport industry include cars, buses, motorcycles, heavy duty trucks and equipment; they all use different grades and types of oils in their engines, gears, transmissions and hydraulic systems. Amounts and types of used engine oil generated depend on the kind, age and size of the vehicles.

A2: Estimated quantities of used oils generated in the country

A2.1 The quantities of used oils generated in the country have been estimated from a combination of:

- Field survey of principal sources to establish their characteristics.

- Estimates based on the size of virgin oil market in the country.

- Estimates based on the number of registered vehicles in the country.

A2.2 Different grades of virgin oils - SAE 40, SAE 30, SAE 50, SW 50, ISW 50, 20W50, Rubier H, Rubier S, Oleum XL, Oleum HD, Oleum SP (imported blended oil), HD40, Super 20W/50, Super XHP, industrial oils (Delvac Series - 1200,1210,1230,1340, etc., DTE series - 24,25,26,AA,BB, etc. , GARD Series - 430,450,570,448, etc.), etc. – are produced by the major marketers (Mobil, Total, AP, Texaco, Conoil and Oando) with established local plants to blend imported base oils.

A2.3 From the data supplied by the major as well as independent marketers in the industry, a total of 377 million litres per annum (mlpa) of base oils were imported into the country by these major actors. Assuming that at least 80% of these base oils are blended into

different grades of virgin oils, the virgin oil market is estimated at about 300 mlpa, including the figures of direct importation of virgin oils.

- A2.4 Experiences from similar studies of other African countries (e.g. Egypt) showed that used oil generation could be estimated at 50% of virgin oil while the figure of collectible used oil could be as low as 30%. The latter arises from the reality of unsafe disposals such as identified in this study as well as alternative uses. Thus, volume of used oils in Nigeria is estimated at about 150 mlpa with a maximum of 90 mlpa being collectible for re-processing or re-refining.
- A2.5 The level of generation of used oils was also estimated from the analysis of used crankcase oils based on the total vehicle registrations in the country. From the Federal Road Safety Commission (FRSC), the total number of vehicles registered in Nigeria between January 1999 and July 2004 was 5,828,900. The estimated total number of registered vehicles was 6.0 million. Assuming 70% of the vehicles are cars and the rest being trucks/buses, the estimated used crankcase oil was 150 mlpa. Industry-based used oil was estimated at 50 mlpa, leading to a total national used oil generating capacity of 200 mlpa.

B Main Actors in the Used Oil Market in Nigeria

B1: Dealers in Used Oils

- B1.1 There were several small scale dealers in used oils out of which 35 were surveyed in this study. These actors sourced used oils from industry, vehicle service stations and mechanic villages spread over the country. It was apparently a profitable market for the operators. There were also several used oil generators, particularly in the mechanic villages, selling directly to the end-users. Volume of sales varied from as little as 12 litres of used oil per week to as high as 2,500 litres per week.
- B1.2. There were several industrial actors generating large quantities of used oils but internally utilized as boiler or furnace fuels supplement.
- B3.3 Grading of used oils by the dealers was based mainly on the perceived quality of the source – oils from companies and established service stations attracting higher premium than those from mechanic villages and others. Sale prices for used oils varied from ₦20 to as high as ₦150 per gallon (US \$1 = ₦139).
- B1.4: Treatment of used oils by the dealers did not transcend mere settling to remove particulate matter, and, in limited cases, open air heating to evaporate entrained water.
- B1.5. Oil storage was mainly in metallic and plastic containers (jerry cans and drums). However the surrounding was generally polluted with limited care for the environment by the operators. Cases of polluted streams and drainages were noted in this study.

B2: Uses of Used Oils in the country

- B2.1 There are lots of reuse practices which are mostly not environmentally friendly. Those that reuse the used engine oils procure them with little or no reprocessing and use oils directly for different purposes.
- B2.2 Uses of used oils identified in this study were:

🚦 Direct reuse as lubricant in vehicles with old and worn engines as engine oil.

- ✚ Boiler fuel – some industries use the used engine oils as fuel for their boilers.
- ✚ Bakery – used in the furnace as fuel.
- ✚ Weed killer – poured on the ground to control weeds.
- ✚ Dust control – poured on the ground and roads to suppress dusts.
- ✚ Block and Balustrade making - used as lubricant in mould equipment.
- ✚ Wood preservation – used to prevent termites from destroying the wood.
- ✚ Gear oil – used engine oil is mixed with grease to produce gear oil.
- ✚ Hair cream – used to protect the scalp from the burning sensation of hair relaxers.
- ✚ Hydraulic oil – used in heavy duty vehicles equipped with tipping mechanism.
- ✚ Road construction – used in addition to bitumen by some construction companies.
- ✚ Rust prevention – used for this purpose by those selling motor spare parts.
- ✚ Ball joint oil – seldom used by some mechanics.
- ✚ Sawmill – as wood preservative.
- ✚ Wound treatment – some people actually use used engine oils in treatment of open wounds as they believe it makes the wound heal better, this is common among motor mechanics.
- ✚ Cooking – used as fuel in cooking with firewood.
- ✚ Diesel production – sometimes kerosene is mixed with used engine oils to produce diesel.

B2.3 The rather harsh economic situation has encouraged some of the above uses. Used oil still with calorific value comparable to that of diesel or LPFO is a welcome candidate as a source of fuel at cost as low as N25 per litre for good quality compared with diesel, for example, at above N60 per litre when available in the market. Such alternative usage is therefore driven by economic consideration with little regard for environmental impacts.

C. Existing Disposal and Treatment Facilities

- C1. From the pilot study it was noted that there was little or no organized disposal practices. The disposal methods varied from indiscriminate dumping on land, pouring down the sewers, storage in plastic containers like kegs, jerry cans and drums where they were left until a use was found for them or they were eventually sold to dealers or direct users. The handling and disposal of used engine oil is a widespread source of environmental degradation and ecological damage in the Nigerian environment.
- C2. There was no organized treatment facility in the country for oil re-cycling. There was however significant effort by two private companies - the Lube Oils Limited, Otta, Lagos and Boskel Nigeria Limited, Port Harcourt and in the public sector, the Federal Ministry of Environment.
- C3. In 1996, Lube Oils Limited, with the assistance of UNIDO, assessed the techno-economic importance of refining used lubricating oil. The study recommended the establishment of used oil recycling plants in the country. The detailed feasibility study was carried out by Triple E Associates, an environment and energy consultancy company in Nigeria.

- C4. Suffice it to note that several years after the project conception, it has not taken off for the following reasons, among others:
- The project, based on an Italian Process design, increased in cost from the initial projection of ₦500 million to close to ₦4.0 billion (US \$1 = ₦138).
 - There was problem with getting sufficient quantity and quality of used oils to make the project economically viable.
- C5. Lube Oils Limited, still very much interested in investing in used oil recycling, has decided to invest in the local development of appropriate process technology. Towards this end, it has entered into research agreement with the Department of Chemical Engineering, University of Lagos to develop the process technology in stages: first, a plant to process used oil to fuel oil; then, to diesel oil in the second stage; and finally, a re-refining plant to produce base oils.
- C6. Boskel Nigeria Limited, a thermal engineering company, has completed the testing of its locally designed and fabricated pilot plant for oil re-processing and re-refining. The plant, with capacity to produce 50-100 litres of fuel oil per hour is undergoing further development prior to launching into the market.
- C7. The Federal Ministry of Environment has also been very much interested in recycling used oils. The Ministry recently invited bids for the fabrication of a refining plant based on the acid/clay process technology. The contract for the fabrication has since been awarded to a fabricator. It is hoped that the Ministry will make provision for the very much needed research and technological backup for such project whose requirements for success transcend mere fabrication.
- D. Legislative Aspects of the management of used oils in the country
- D1. Decree No 58 of 1988 established the Federal Environmental Protection Agency (FEPA) and now Federal Ministry of Environment (FMENV) with full legal responsibility to control and oversee the state of the Nigerian environment.
- D2. FEPA has put in place several regulations among which, of relevance to used oil disposal, is the National Environmental Protection (Pollution Abatement in Industries and Facilities Generating Wastes) Regulations S.I.9 of 1991 which has the following relevant provisions:
- S 15 (2) stipulates that "no oil in any form shall be discharged into public drain, rivers, lakes, sea, or underground injection without a permit issued by FME or any organisation designated by the FEPA"
 - S11 (1) states that "the collection, treatment, transportation, and final disposal of waste shall be the responsibility of the industry or facility generating the waste."
 - S 17 states that "An industry or facility which is likely to release gaseous, particle, liquid, or solid untreated discharges shall install into its system, appropriate abatement equipment in such manner as may be determined by FEPA".
- D3. The existing legislation is adequate for the environmentally sound management of used oil in Nigeria as the Generator's liability has been expressly confirmed in the provisions. However, it might be necessary to enact a new legislation to take care of the peculiarities of the used oil management practices against the present knowledge of the sector.

SECTION 1

STUDY OBJECTIVES AND CONCEPTUAL FRAMEWORK

1.1 Preamble

Oil is a common and highly visible form of pollution. Oil and water are immiscible and even a small spillage can cause significant pollution. Studies have shown that 5 litres can cover a small lake. Oil pollution has three main effects:

- it forms a film on the surface of water, reducing the level of oxygen needed by fish, shell fish and other living organisms that comprise the aquatic food chain;
- it coats plants and animals that come into contact with it; and
- in large quantities, it can make water sources unfit for drinking as hazards from waste oil contaminated water range from mild symptoms of accumulation of toxic compounds in the liver to complete impairment of body functions and eventually death (NoIn et. al).

Fig. 1.1 shows a stream heavily polluted by indiscriminate disposal of used engine oil from a service bay for luxurious buses in the country. The cover page of this report also shows a heavily polluted dumping ground for used oil.

There are different types of oils, but of particular interest in this project are used lubricating oils defined as:

"Any petroleum-based lubricating oil which, through use, storage or handling, has become unsuitable for the purpose for which it was originally designed, in particular used oil from combustion engines and transmission systems, as well as mineral oils for machinery, turbines and hydraulic systems"

Fig. 1.0: Stream polluted by used engine oil



1.2 Study Background and Objectives

Several countries in the world have put in place policies and plans to manage the disposal of their used oil to protect their environment. Unfortunately the appropriate management of used oil is a common problem for many African countries, including Nigeria, where much of the wastes have negative environmental and human health risks because of inadequate systems for collection, storage, recycling, disposal etc. The need to put in place policies and plans for the management of used oil in the country informed the present initiative and sponsorship by the Secretariat of the Basel Convention. The Basel Convention and its Regional Centres aim to develop a close partnership with major oil companies operating in the region, to put in place environmentally sound management practices for used oil in order to protect the environment and human health in Africa.

The principal objective of the project is to gather information in the African region using Nigeria as a case study, to better define a strategy for the management of used oils in Africa.

The Basel Convention Regional Coordinating Centre (BCRC) located at the Federal Ministry of Environment-University of Ibadan Linkage Centre and UNEP/SBC are to investigate and develop recycling possibilities and potential uses of used oils in Africa with the University of Ibadan BCRC coordinating the project and working in close collaboration with the BCRCs in South Africa, Egypt and Senegal respectively towards the development of an African Regional Management Plan for used oil.

Although the development of technical guidelines for the management of waste oil in any country is expected to be based on the real situation in such country, the present Regional project has taken off with the present pilot phase study of Nigeria being used as a microcosm of the Africa Region.

The outcome of this study shall be used to undertake estimations with statistical basis of the different indicators of the amounts of used oils and their flows in the formal and informal sectors in Nigeria, the sub-regions and the region. This is basically the information gathering stage which is critical to others stages in the development of waste oil management system. Thus, the experience gained shall be used to identify problems and difficulties with the management of used oils in Nigeria, the sub-regions and the regions leading to the development of practical projects of regional significance. The project will also increase coordination between the BCRCs in Africa and strengthen them to decide on a common approach and a strategy for the BCRCs on the management of used oils in Africa.

1.3 Terms of Reference

The pilot study has been carried out against the following identified terms of reference:

- a) Identification of the main sources of used oils in the country and estimations of the quantities and types of used oils produced, stored and disposed.
- b) Identification of the main actors in the used oil market in the country (mainly those in the production, distribution, storage, refining and utilisation).
- c) Identification of existing disposal and treatment facilities and their capacity.
- d) Survey on the informal sector working with used oils.

Arising from the above, the basic information being sought in this study includes:

- Producers of virgin oils/level of production
- Virgin oil importers and levels of importation
- Market for lubricants
- Level of generation of used oil
- Uses of the generated used oils
- Current sales prices of virgin oils and prices of used oils
- Legislation governing the management of used oil, the storage, and the environmental controls for the collection and recycling
- Companies with capacity to invest and operate used-oil recycling plant

1.4 Conceptual Framework for the Conduct of the Study

The oil market in Nigeria in terms of the various activities from lubricant production to sales in the different market outlets leading to the generation of used oils is conceptually shown in Fig. 1.1. Due to the rather epileptic operation of the four oil refineries in the country, all the requirements (base oils and additives) for the local lube oil blending processes to produce different grades of lubricants and greases are imported into the country by two groups of actors: the major oil marketers (Total, Mobil, Conoil, African Petroleum, Texaco, Oando) and the so-

called independent marketers (including Romi, Ibetto, Pract Oil, Dazzy, A-Z, Zenon, etc.). Different types and grades of oil to be found in the different market outlets (including petrol stations, service stations, road side points of sales) include engine oils, hydraulic oils, gear oils, and industrial oils for turbines and compressors. Whilst several lube oil blending plants exist in the country, more are being established by the independent marketers. Also, there are small operators producing poor quality lubricants mainly from base oils without any additives. The various uses of oils in the country are in four main categories: crankcase oil; hydraulic system; transmission system; and gears. The users of the virgin oils are in two main categories:

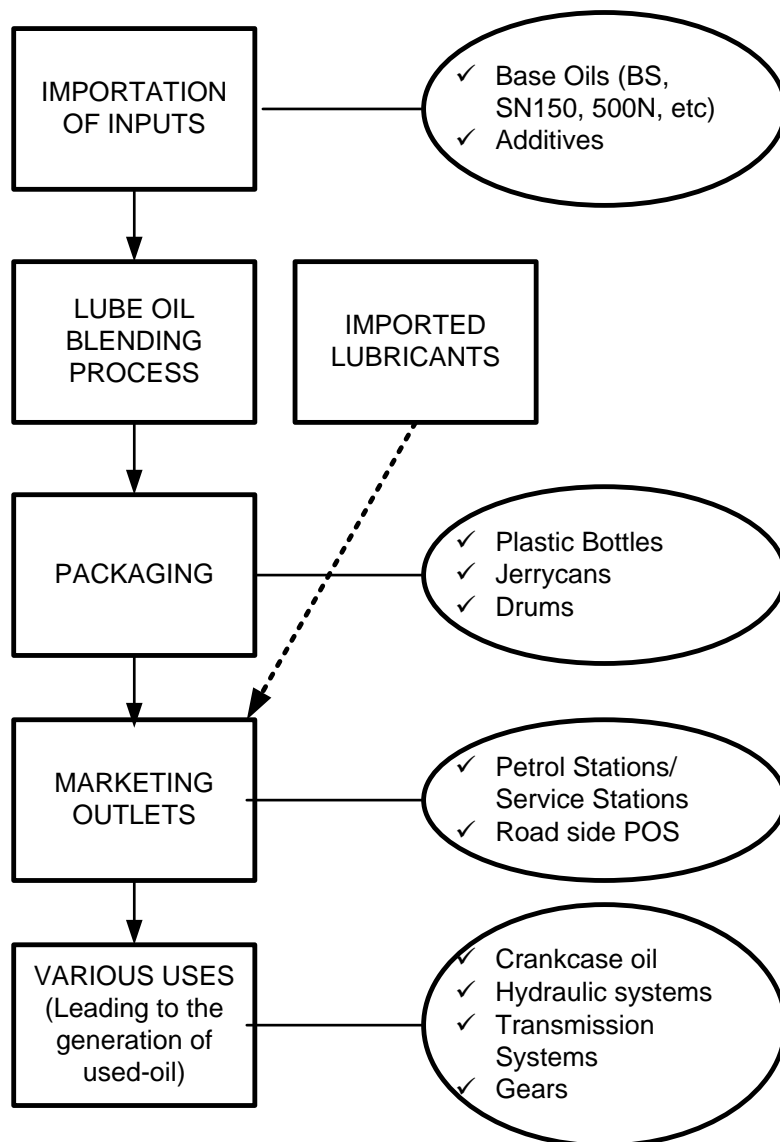
✓ TRANSPORTATION

- ❖ Automobiles
- ❖ Motorcycles
- ❖ Buses
- ❖ Trucks

✓ INDUSTRIAL

- ❖ Chemical and allied products
- ❖ Rubber and plastic products
- ❖ Machines (except electrical)
- ❖ Electrical equipment (transformers)

**FIG. 1.1: NIGERIAN OIL MARKET:
CONCEPTUAL FRAMEWORK FOR ANALYSIS**



1.5 Methodology

The research, taking due cognizance of the above framework of the oil market in Nigeria, was carried out using a combination of desk study, primary data collection through the development and administration of questionnaires, and field visits.

Primary Data Collection

Data Sources

Primary data sources were explored to generate the information required for various aspects of the study. The survey instruments to obtain primary data were sets of questionnaires addressed to the following groups of respondents:

- i. The producers/importers of virgin oils
- ii. The sellers of virgin oils
- iii. The users of virgin oils/generators of used oils
- iv. The dealers in used oils
- v. The users of used oils

Five sets of structured questionnaires (see Appendix) were prepared for the five different groups. They were aimed, among others, at the:

- Estimation of virgin oil production
- Estimation of levels of usage of the different lubricants
- Estimation of the levels of generation of used oils from the different uses
- Determination of the roles of each actor in the management of used oils in the country

Survey Sampling Procedure

The country was divided into three zones: South West (involving Ibadan, Lagos and their environs), South-East/South-South (involving Aba and Port-Harcourt) and the Core/Central North (involving Kaduna, Kano and Jos). These cities were pre-selected based on their established high level of industrial activities coupled with being the highest consumers of petroleum products, by extension, lubricants in the country. The geographical spread of the surveyed cities is illustrated in Fig. 1.2.

Data Collection

The survey was carried out by university lecturers and postgraduate students. The researchers visited and administered questionnaires to the five categories of actors indicated above.

Desk Study

The nature of information from desk study is as follows:

- The legislative, economic, technical and environmental aspects of the management of used oils in the country,
- Main sources of used oils and estimations of quantities and types of oils produced, stored and disposed.
- Identification of main actors in the used oil market, dealing with any aspect of the management cycle of oils.
- Identification of existing disposal and treatment facilities and their ownership

The above information was sourced from:

- Governmental Institutions
- International organisations
- Private sector
- Previous Reports on used oils
- NGOs

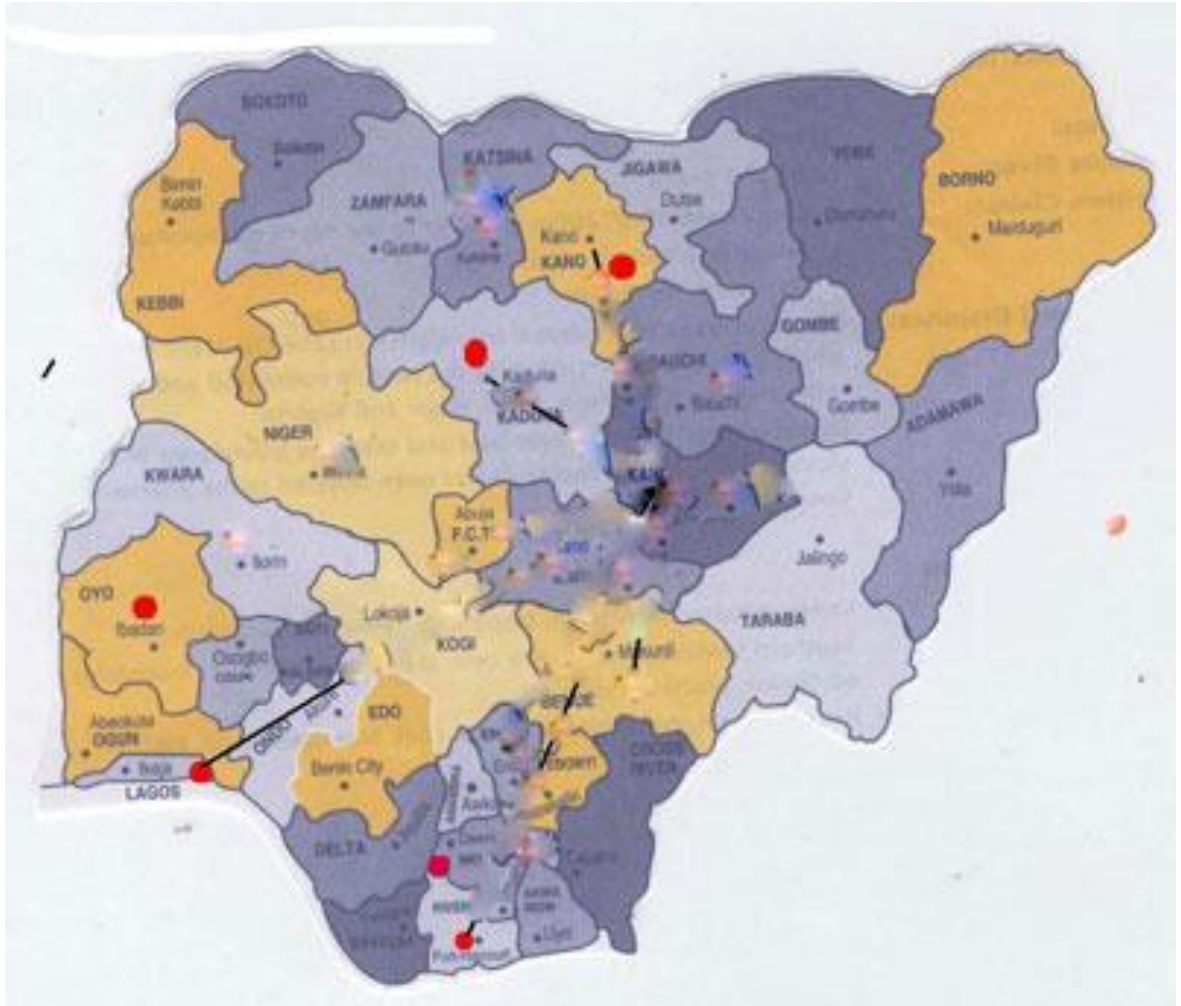
Analytical Technique

This involved the development of computerised database for data storage as well as computer-based analysis of data and report generation to provide answers to the basic underlying questions of the Pilot Study. Simple statistics such as frequency distribution, percentages and correlation were utilized. Where critical data were unavailable, recourse was made to the best practice as reported in the literature, especially in similar African countries.

1.6 Report Presentation

An executive summary is presented to encapsulate the major findings of the study. Section 1 is devoted to the study objective and the underlying conceptual framework of the study. The market of virgin oils in Nigeria is presented in Section 2. Section 3 is devoted to the sources of generation of used oils as precursor to the presentation of market of used oils in Section 4. The used oil management options in Nigeria are presented in Section 5 while the existing legislation on used oil management is covered in Section 6.

Figure 1.2
USED OIL SURVEY: LOCATIONS OF KEY ACTORS VISITED
(Indicated in Red Circles)



SECTION 2

THE MARKET OF VIRGIN OILS IN NIGERIA

2.0 Preamble

There are two categories of actors in the de-regulated Nigerian market for virgin oils: the *major marketers* and the so-called *independent marketers*. The major marketers dominate the petroleum and petroleum product markets with established plants for blending base oils and additives to produce different grades of lubricants for the Nigerian market. These companies, basically multinationals, supply branded products to several outlets spread throughout the country. The independent marketers came into being in response to government policy initiative aimed at increasing local participation in the oil sector. They are growing both in number and also in the level of activities. Most are involved with the importation of base oils and additives for sale to blending plants. Some of them have however started investing in the establishment of blending plants to produce lubricants. For example, Romi, an independent marketer, will soon commission its blending plant to produce different grades of lubricants.

It is pertinent to note that whilst Nigeria can probably boast of adequate oil blending plant capacity, a few actors also do import virgin oils into the country.

Our interest in establishing the level of virgin oils entering the Nigerian market in this study stems from the fact that it is a useful basis for estimating the level of generation of used oils. Consequently, the major marketers and the independent marketers were surveyed in this study with the study findings as presented below.

2.1 Virgin oil production and supply in Nigeria

2.1.1 Level of base oil importation

The major producers of virgin oils in the country are Mobil Oil Nigeria Plc, Total Nigeria Plc, Texaco, African Petroleum Plc (AP), Conoil and Oando. All these marketers, excepting Oando with its blending plant located in Kaduna, have blending plants in Lagos. These Lagos plants were visited in the course of this study with the data provided by them reflected in Table 2.1. As shown in Table 2.1, all these companies import base oils for blending into different grades of lubricants. The independent marketers, as shown in Table 2.1, are mainly importers of base oils which they sell to blending plants and other users. Oando could not supply any information because they claimed that their production plant is in Kaduna and it is only at the plant that reliable information could be obtained. Total Nigeria Plc could not quantify the amount of base oil being imported because they receive base oil periodically from their headquarters and they also have plants located in other parts of the country. Only Texaco and Conoil sell part of the base oil imported by them.

The level of base oil importation by the major actors covered in this study was 264.4 million litres per annum (mlpa). We have cause to believe that those covered in this study will probably account for about 70% of base oil import. Thus, the level of importation of base oil is estimated at close to 370 mlpa.

2.1.2 Level of Production/Supply of Virgin Oils

Different grades of oils are produced by the major marketers for the Nigerian market. Identified grades of virgin oils in the market include: SAE 40, SAE 30, SAE 50, SW 50, ISW 50, 20W50, Rubier H, Rubier S, Oleum XL, Oleum HD, Oleum SP (imported blended oil), HD40, Super 20W/50, Super XHP, industrial oils (Delvac Series - 1200,1210,1230,1340, etc., DTE series - 24,25,26,AA,BB, etc. , GARD Series - 430,450,570,448, etc.), etc. Mobil alone has an installed blending capacity of 460,000 barrels¹ or 73.1 mlpa whilst its annual virgin oil production was given as 14.6 mlpa (a mere 20% capacity utilisation).

Out of the six major marketers covered in this study, only AP imports engine oil and also produces locally, all the others produce engine oil locally. Level of importation by AP was however only 1.0 mlpa, equivalent to 10% of its local production. The total of about 60 mlpa of virgin oils entering the Nigerian market through the surveyed actors is indeed much smaller than the actual market size based on the following observations:

- Not all the blending plants have been visited in this study.
- There are some actors involved with importation, e.g. Coscharis Motors Ltd. (Petrochemical) which imports close to 3.2 mlpa of virgin oils for sale and in-house use.
- If it is assumed that at least 80% of imported base oils of 377 mlpa is used to produce virgin oils of different grades, then the market size of virgin oils is estimated at close to 300 mlpa. [This figure shows a modest increase from the 1998 by Triple E (a Nigerian consulting with interest in establishing a used oil re-refining plant) figure of about 230 mlpa demand for base oil destined for lubrication in Nigeria.]

¹ 1.0 barrel is equal to 159 litres

Table 2.1: Major Actors in the Virgin Oil Production and Supply in Nigeria

Company Name	Level of importation of base oils	Blending plant capacity	Grades of lubricants produced	Level of Production/Sales
	(Million Litres/Annum)	(Million litres/annum)		(Million litres/annum)
Major Marketers				
Mobil Oil Nigeria Plc.	12.4	73.1	Monograde, Multigrade, Marine lubricant, Industrial lubricants	14.6
Total Nig. Plc.	-	n.a	Petrol and diesel engine oils, hydraulic oils	11.0
African Petroleum Plc.	8.0	n.a	Auto transmission oils, industrial gear oils, automotive engine oils, industrial lubricants.	11.0
Texaco	9.0	n.a	Engine oils, industrial oil (turbines/compressors), gear oils	8.0
Conoil	15.0	n.a	Engine oils	15.0
Oando	n.a	n.a	Engine oils	n.a
Independent Marketers				
Romi	30.0		Engine oils	n.a
Ibeto	60.0		-	-
Pract Oil	40.0		-	-
Dozzy	50.0		-	-
A-Z	40.0		-	-
Zenon			-	-
TOTAL	264.4			59.6

Source: Present Survey

Supplies and Prices of virgin oils

Virgin oils are sold in different packages – gallons (4 Litres), jerrycans (25 Litres) and drums (200-209 Litres) as well as bulk sales in tankers. Market outlets include individuals, commercial vehicle operators/transporters, garages/workshops, marketer's own retail outlets, and distributors. Direct supplies are also made to the big industrial consumers e.g. Cadbury, Nigeria railway Corporation, Cement manufacturers, construction companies. Prices varied considerably being dictated by the grades of oil and the market outlet. However prices quoted by the marketers for supplies to the different market outlets varied as follows: gallons (₦900 to ₦1,100); jerrycans (₦3,600 – ₦5,880); and drums (₦35,000 – ₦45,000). (US\$1 = ₦138)

Market outlets and prices of virgin oils in Nigeria

There are several market outlets for the purchase of virgin oils in Nigeria. Virgin oils are being purchased mainly from petrol stations whilst there are some sellers operating from road side with sales to the less discerning customers such as motor cyclists and old taxi cab operators due to the relatively cheap prices. A number of these outlets were surveyed in the three zones. As shown in Table 2.2, there are several grades of virgin oils in the market with varying prices. Prices for similar products varied with geographical locations with the South-Western Zone and the Northern Zone having the lowest and highest prices respectively.

It is significant to note that some of the outlets were selling base oils at prices ranging from ₦700 to ₦880. Also, since no plant has been established in the country for the production of recycled lubricants from used oils, there was no trace of such oils in the market.

Table 2.2: Grades/prices of Virgin Oils in Nigerian Market

NAME OF OUTLET	LOCATION	GRADES	Prices (Naira) for 4 Litre Gallons		
			20W-50 (Extra Treatment)	20W-50 Ordinary	SAE 40
Conoil Petrol Station	Ibadan	20W 50,SAE 40 DIESEL OIL	1,210	1,000	810
Golden Wallet	Ibadan	SAE 40, DIESEL OIL			890
Mobil	Ibadan	20W 50,SAE 40 DIESEL OIL	1,300	1,090	970
Bovas	Ibadan	20W 50,SAE 40 DIESEL OIL		900	850
Coscharis	Ibadan	SAE40,SAE50,GL5,Motor oil.			800
BB Petrol oil	Ibadan	SAE40,SAE30,BS.			
Ainrin Enterprise	Ibadan	SAE40,SAE30,Raw oil(base&thick).			700
Olona pet.	Ibadan	SAE40,SAE30,20W50,URSA Oil.		800	700
Lubebay filling sta.	Ibadan	Oleum XL,HD,SP,SAE40,PS.			600
Azeez Ayinla f.sta.	Ibadan	SAE40,SAE30,20W50,5W50.	1,100	870	
Obat serv. Sta.	Ibadan	SAE40,20W50,5W50,15W50.			650
Jafes Oil	Ibadan	SAE40,SAE30,20W50.			600
BB Petrol Oil	Ibadan	Sae 40, Sae 50 Sae 30 Base oil			650
Road side	Ibadan	SAE 40, 20W/50			1,100
Road side	Ibadan	SAE 40, 20W/50	1,200		1,100
AVERAGE PRICE (N/Gallon)	Ibadan		1,203	932	802
Rug oil	Aba	MUZ SG40,MUS SH40,SAE40			720
Total oil	Aba	SAE40,SAE30,API SDI SAE40/50W.			820
Texaco oil	Aba	UESA SAE,Havoline 3ST,Havoline SD			1,200
Ozen Industries	Aba	PS-SG,PD-SF,PC-GH.			800
Total oil	Aba	API SDI,SAE40,SAE30.			1,200
Mosac int, Agenises	Port-Harcourt	A-Z,SAE40,SAE10.			1,000
Oando plc	Port-Harcourt	Oleum XP,XL,HD,GR/GRS	1,150	980	870
Texaco oil	Port-Harcourt	20W-50,SAE 40 Diesel,SAE 40	1,200		
Con oil	Port-Harcourt	Golden super,SAE40,SAE 40 Diesel,SAE30		980	
AP Oil	Port-Harcourt	Visco 200,Super V,SAE40,SAE40 Diesel	1,350		
Maimeze & CO	Port-Harcourt	Oil Plus,Some unknown graded oil		970	
OK 2000,oil seller	Port-Harcourt	Visco 2000,Havoline,Quadro Premium	1,250	1,100	
Ojukwu oil Trader	Port-Harcourt	All Havoline, Ungraded Oil in Kegs	1,200		
Road Side	Aba	Havoline-SI,SAE 40,SAE 40 Diesel		1,100	
Road Side London	Aba	Rulna Oil SAE40 Diesel,SAE30,SAE40/50W.			620
Con oil	Aba	SAE40,SAE30,SAE40 Diesel SAE 10			980
AP Oil	Aba	Visco Oil SAE40,SAE40 Diesel,Super V OIL			1,350
Sesip Oil	Aba	Brado-SAE 40,SAE 40 Diesel SAE 30			640
Road side	Aba	Oil Plus,raw oil(no label),SAE 20W/50SAE 40,SAE 30			920
AVERAGE PRICE (N/Gallon)	Aba/PH Axis		1,230	1,026	927
Oando	Kano	Monograde-SAE30,Multigrade-SAE40,20W50.		980	1,150
Semice Total	Kano	monograde-SAE30,multigradeSAE40,heavyduty20W50.		735	1,200
Con oil	Kano	diesel,SAE40,20W50,PRENIUM,QUATRE.		1,000	900
Texaco	Kano	URSA TDX, URSA, HAVOLINE, FORMULAR			
Conoil	Kano	Quatre ultra,quatre pre,golden super plus,diesel,r	1,300	1,200	960
Oando	Kaduna	Oleum-sp. sz and hp		870	1,150
Uche Interbiz	Kaduna	Motor oil, lubricol,lubco,whiz oil.		850	950
Mobil	Kaduna	Super,XHP,HD40.		1,110	1,320
HP PLC	Kaduna	UISCO 2000, SUPER U,SAE40.	1,550	1,350	1,000
Total Service	Kaduna	Motor oil,total oil,quartz 7000,5000 & 2500.rubia.	3,000	1,200	880
Total Service	Sokoto	SAE40,Quartz 5000 &2500.	1,200	880	880
Oando/Unipetrol	Sokoto	SP 20W50,XL20W50,Heavy duty unilube.	1,150	1,000	900
AVERAGE PRICE (N/Gallon)	Northern Aixs		1,640	1,016	1,026

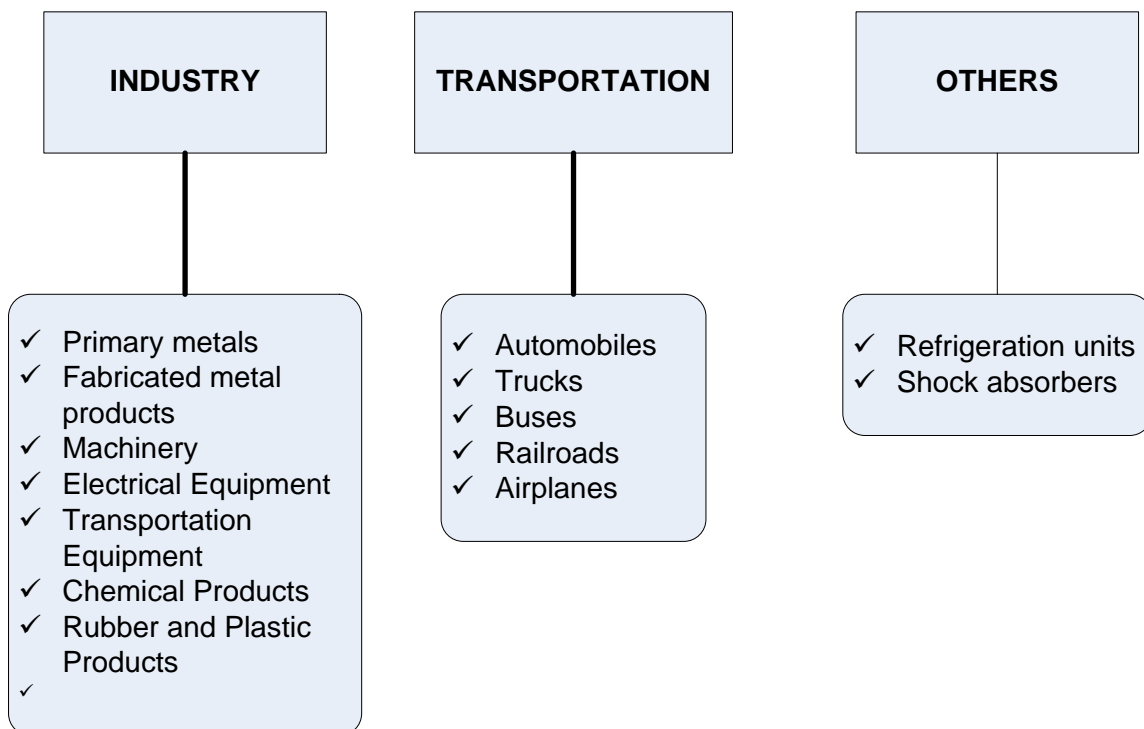
SECTION 3

GENERATION OF USED OILS IN NIGERIA

3.1 Preamble

Of paramount importance in this study is the determination of the sources, kinds, levels, fates of used oils in the country. Previous studies were of great help in identifying sources, kinds and fates of used oils but were rather inadequate in respect of levels of generation. To provide a practical insight into all the above parameters of used oils of interest in this study, due cognizance was taken of the three principal sources of used lubricants – industrial, transportation, and others – as encapsulated in Fig. 3.1.

Fig. 3.1: SOURCES OF USED OILS



Industrial Sources

The industries that generate the most used oils are indicated in Fig. 3.1. The types of used oils vary widely according to the specifications for particular applications. Metalworking oils range from 100% oil (so-called neat oil) to oil-water emulsions (called soluble oils) with a low percentage of oil. Both formulations require as many as half a dozen additives, e.g. to reduce wear on cutting and grinding tools. Quenching oils, used to cool hot metals, contain oxidation inhibiting additives (e.g. barium sulfonate, zinc compounds, sodium nitrate). Steel rolling and stamping oils vary but are often combinations of naphthenic mineral oils and tallow oils, with sulphur and phosphorous additives to reduce wear on the rollers. Hydraulic oils, used for example in die-casting, steel foundry operations and automobile production, usually consist of paraffinic base stocks with only rust and oxidation inhibiting additives (e.g. a hindered phenol) and sometimes an antiwear additive (e.g. zinc dithiophosphate). Transformer oils are straight mineral oils with no additives. Lubricating oils for turbines are similar to hydraulic oils, although high temperature oxidation inhibiting additives are also needed.

Transportation

Automobiles, trucks, buses, motorcycles and heavy machine equipment all use oil in their engines, gears, transmissions and hydraulic systems. Consequently, service stations (see Fig. 3.2) and mechanic villages generate used oils. Amounts and types vary with the kind, age and size of the vehicles. New passenger cars produce a few gallons (4 to 6 litres) of drained motor oil (crankcase oil) due to infrequent servicing. Old cars, of which there are many in Nigeria, are serviced more frequently. Ordinarily such should lead to the generation of considerable used oil, but, the economic situation in Nigeria dictates otherwise with some car owners resorting to fairly used oils during oil change as opposed to virgin oil. Diesel engine oils for large and small trucks are another category of automobile lubricants. Several additives are contained in these lubricants, often making up to 15% by volume.

In used lubricating oils, these additives are physically and chemically changed, and the oil itself is contaminated with rust, soot, dirt, dust, lead, engine wear metal particles and water (condensed from vapour) due to contact with bearings, seals and other engine parts. These contaminants are hazardous to humans. Railroads and airplanes also use lubricants.

Fig 3.2: A well managed service station bay for oil change



Other oils

Other sources of used lubricating oils are refrigeration units and shock absorbers. These oils are usually made from naphthenic base stocks. Naphthenic base stocks are also used to make process oils used in rubber manufacturing. Air compressor oils are similar to turbine oils. They are made from paraffinic base stocks and have low levels of additives. Rock drill oils, used for jack hammers, air hammers and underground drills are similar to industrial gear oils. They contain additives to modify friction as well as anti-wear and extreme pressure additives.

3.2 Estimates of level of generation of used oils

Estimates of quantities of used lubricating oils would have to be based on detailed knowledge of the size, location and disposal practices of the above sources. The following three approaches have been adopted towards obtaining reasonable estimates of quantities of used oils in the country:

- ✚ Field survey of principal sources.
- ✚ Estimates based on the size of virgin oil market in the country.
- ✚ Estimates based on the number of registered vehicles in the country.

3.2.1 Field Survey

Presented in Tables 3.1a, b and c are the used oil generation characteristics of 76 actors in the industrial and transport sections in the three zones surveyed in this study. Fleet operators in the transport industry (e.g. The Young Shall Grow, ABC) generate considerable used oil which is sold. Construction companies also have high level of used oil generation for sale. Noteworthy is Cadbury, a food and beverages manufacturing company based in Lagos, with used oil generating capacity of 830 litres per week from its generating plants and other machines. The company

mixes such internally generated used oil with Low Pour Fuel Oil (LPFO) to fire its boilers to generate process steam. However, this practice is expected to stop with the recent switching over to industrial gas to fire their boilers.

Mechanic villages, often dispersed in cities, are characterized by relatively low level of used oil generation for sale, recycle for use in worn engines without any treatment, mixing with grease to make gear oil, and ordinarily pouring on ground to reduce dust level. However, it is pertinent to note that crankcase used oils are generated in service stations or mechanic villages patronized by motor vehicle owners since do-it-yourself oil changes are not a practiced technique in the country.

Whilst most used oil generators store their used oils in metallic/plastic containers before disposal, there were yet others, particularly in the mechanic villages with no storage facilities. This is particularly so in isolated vehicle repair bays (see Fig. 3.3), several of which exist in the country as there are limited mechanic villages in most cities in the country.

From the survey, it was found that prices for used oil varied from ₦20 per gallon to ₦100 per gallon.

Overall, although the levels of waste oils generated by the actors covered in this limited survey could not by any means be meaningfully extrapolated to obtain figures of used oil generation in the country, the importance of the survey findings is derived from the fact that they have helped to establish the following important facts:

- The level of used oil available for re-processing/re-refining is considerably reduced by the present alternative uses, particularly as fuel, in industry.
- Used oil has commercial value in the country and will therefore attract cost as input to any planned re-processing or re-refining plant. This is because whether a used oil producer sells or not will be dictated by the cost-benefit analysis of selling instead of its usage as fuel in-house, for example. The rather high cost of energy in the country may tilt the decision in favour of internal use as fuel supplement for companies with energy-intensive operations.
- Re-processing of used oil to fuel oil will be quite an attractive used oil management option in view of the high cost of energy.

Fig. 3.3: An isolated service bay polluting the environment



Table 3.1a: Used Oil Generation Characteristics in the South-Western Zone

S/N	Company Name	Category	Generated Used Oil (Litres/week)	Method of Storage Before Disposal	Method of Disposal
1	Mechanic workshop	Transport	150	None	Sale, Pouring on ground.
2	Mechanic workshop	Transport	90	None	Pouring on ground, Mixed with grease and used as gear oil for transporters
3	Mechanic workshop	Transport	150	None	Sale, Pouring on ground.
4	Mechanic workshop	Transport	150	None	Reuse(for worn engines), Pouring on ground(to reduce dust)
5	Mechanic workshop	Transport	180	Drums	Sale, Reuse(for worn engines)
6	Mechanic workshop	Transport	120	Drums	Sale, Pouring on ground(to enhance tyre grip)
7	Mechanic workshop	Transport	360	None	Sales
8	Reynolds const. company	Industry	1,045	metal drums	Collection centres
9	Moshood olayinka	Transport	200	plastic kegs	Sale to individuals.
10	Uslad Nig Ltd.Sawmil division	Industry	160	plastic kegs	Sale
11	Mechanic workshop	Transport	20		Sale,to kill weeds,Lubrication
12	Kopek Construction	Industry	10,000	metal drums	
13	Neimeth International Pharmacy	Industry	30	metal drums	Sale
14	Brian Munro Nig Ltd	Industry	10		
15	Young Shall Grow Transport	Transport	418	Metal Tanks	Sale
16	BMW Workshop	Transport	12	metal bowls	Pouring on ground(weed control)
17	Vulcanizing workshop	Transport	18	draining directly on the ground	Pouring on ground(weed control)
18	ABC Transport ltd	Transport	180	plastic drums	Sale
19	Mechanic workshop	Transport	105	metal drums	Re-use in other vehicle
20	Power of God	Transport	92	plastic keg	Sale
21	Mechanic workshop	Transport	24	plastic keg	Sale
22	Cadbury Nig PLC	Industry	830	Metal Tanks	Firing of Boiler
	TOTAL (Litres/Week)		14,344		

Table 3.1b: Used Oil Generation Characteristics in the Northern Zone

S/N	Company Name	Category	Generated Used Oil (Litres/week)	Metod of Storage Before Disposal	Method of Disposal
1	Jabaili Bros Engr. Ltd.	Industry	436	metal drums	Collection centers
2	Dangote Transport	Transport	240	plastic drums	mechanics, give it to someone who uses it.
3	Gentech Power Supply Ltd.	Industry	150	plastic kegs and drums	sewers, sale to wood preservers
4	Automotive port ind. Ltd	Transport	155	plastic kegs.	pouring on ground.
5	Azeez automobile workshop	Transport	51	plastic kegs.	mechanics, give it to someone who uses it(apprentice).
6	Vinco mechanic workshop	Transport	12	plastic kegs.	Sale
7	Total service	Transport	200	METAL DRUMS	Sale
8	Amunua engr company	Transport	128		sale, pouring on ground.
9	Chachagi motors	Transport	280	metal and plastic drums	give to block makers.
10	Dat company	Transport	648	plastic kegs	Sale
11	Niyi Motors	Transport	12	plastic kegs	Sale
12	Al mustapha Mende Motors	Transport	400	plastic kegs	Give it out
13	Sarata Ahmed	Transport	42	Metal Tanks	Sale
14	AbdulRaheem Motor	Transport	15	Metal Tanks	Sale
15	PrimePower Ltd	Industry	80	plastic drums	Sale
16	Total service	Transport	240	plastic kegs and drums	Sale
17	Tracte Nig Ltd	Industry	150		Sewers
18	Nigerian Spannish Eng Ltd	Industry	1,600	Metal Drums	Used as fuel to be burnt in reheating furnace
19	Dangote Flour Mill Kano	Industry	144	Collection centers	Used within for maintenance of ball bearings and preservation of wood
20	Gilmore / Kano	Industry	120	plastic kegs and drums	Collection centers
21	Conoil	Industry	66	Metal Tanks	Sewers,sold to people in the villages
22	Pal Pharma Ind Ltd	Industry	3	plastic kegs	Sewers, used for cooling roofing planks and other woods
	TOTAL (Litres/Week)		5,174		

Table 3.1c: Used Oil Generation Characteristics in the Eastern Zone

S/N	Company Name	Category	Generated Used Oil (Litres/week)		Method of Disposal
1	Abia Line (Transport Company)	Transport	144	Plastic Kegs	Landfills
2	VitaFoam Nig Plc Aba	Industry	230	Metal Drums	Sale
3	LiveStocks Feeds Aba	Industry	36	Metal Drums	Sale, Mechanics
4	Egbono Mechanical W/Shop	Transport	35	Plastic Kegs	Pour it away
5	Stan Vono Specialist	Industry	40	Plastic Kegs	Sale
6	BYC Company	Industry	36	Plastic Kegs	Sale, Mechanics
7	Ibeto Industry	Industry	120	Metal Drums	Mechanics
8	Njamanze Moor Mechanic	Transport	30	Plastic Kegs	Pouring on the ground
9	Young Shall Grow	Transport	90	Metal Drums	Sale
10	Mr Biggs Aba	Industry	72	Metal Drums, Plastic Kegs	Mechanics
11	Abia State Hotel Limited	Industry	0	Plastic Kegs	Mechanics
12	Hotel Enitora Limited	Industry	72	Plastic Kegs	Sale
13	West African Oil Field Service Ltd	Industry	0	Metal Tanks	Sale
14	Automobile Rescue Mission	Transport	36	Plastic Drums	Landfills
15	Star Paper Mill Ltd	Industry	0	Metal Drums	Pouring on the ground, Mechanics
16	Nigerian Brewery PLC	Industry	216	Metal Drums	Re-use for lubrication and maintenance of Roller Gates
17	Chisco Company	Transport	150	Metal Drums	Sale, Pouring on the ground and burn
18	Ifesinachi Motor Company	Transport	108	Metal Drums	Sale
19	Rivers Transport Company	Transport	150	Plastic Kegs	Sale, Pouring on the Ground, Mechanics
20	Cross Country Transport Service	Transport	72	Plastic Kegs	Pouring on the Ground, Mechanics
21	Mosac Filling station	Industry	72	Plastic Kegs	Pouring on the ground, give it out to prevent ants infestation
22	Ekene Dili Chukwu Motors	Transport	216	Metal Drums	Sale
23	Wasco Oil Services company	Industry	108	Plastic Kegs	Landfill, Sale and Pouring on the ground
24	MTN Communications	Industry	0	Metal Tanks	Sale, Pouring on the ground
25	May and Baker	Industry	0	Metal Drums	Mechanics
26	River State Govt. Power Station	Industry	72	Metal Drums	Sale, Mechanics
27	Asphalt Construction Company	Industry	36	Plastic Kegs	Re-use
28	Wasco Oil Services company	Industry	180	Plastic Kegs	Pouring into the bush
29	Control Lane Motor Mechanics	Transport	72	Plastic Kegs	Sale
30	Juchi Nigeria Ltd	Industry	30	Plastic Kegs	Pouring on the ground to prevent weeds growth and ants infestation, Landfills
31	WW Whyte International Ltd.	Industry	30	Metal Drums	Pouring on the ground, to paint woods to prevents ants infestaion
32	Mantern Motor Mechanic	Transport	30	Tins	Sale, Pouring on the Ground
	TOTAL (Litres/Week)		2,483		

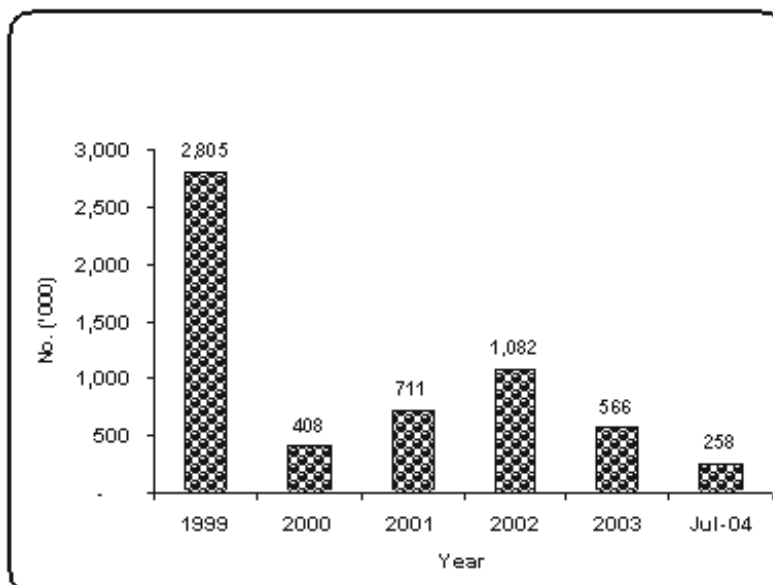
3.2.2 Estimate of used oil generation from virgin oil market size

A fairly reasonable estimate of used oil generation in the country could be obtained from figures of the market size of virgin oils involving figures of local production and import. The total lubricant market was estimated at close to 300 mlpa in Section 2. Experiences from African countries (e.g. Egypt) showed that used oil generation could be estimated at 50% of virgin oil while the figure of collectible used oil could be as low as 30%. The latter arises from the reality of unsafe disposals as well as alternative uses. Thus, the level of used oil generation in Nigeria is estimated at 150 mlpa with a maximum of 90 mlpa being collectible for re-processing or re-refining. And, of course, the latter is dispersed through the system such that any planned re-processing or re-refining will have to be based on a detailed analysis of the geographical locations of the major producers.

3.2.3 Motor vehicle registration and estimate of used vehicle crankcase oil

A useful method for the estimation of used crankcase oils is by looking at the total vehicle registrations in the country. From the Federal Road Safety Commission (FRSC), the total number of vehicles registered in Nigeria between 1999 and July 2004 was 5,828,900 with breakdown as shown in Fig. 3.2. The rather high figure of 2,808,000 registered vehicles in 1999 arose from 1999 being set as the deadline for the registration of all vehicles in the country by FRSC. The subsequent years showed vehicles coming freshly into the transport system of the country. However, there are still a very small percentage of vehicles plying Nigerian roads and not yet registered by FRSC. The total number of registered vehicles by the end of this year is estimated at 6.0 million.

Fig. 3.4: Total number of Vehicles Registered in Nigeria (1999-July 2004)



Assuming the following scenarios, the total lubricant market was estimated at approximately 200.0 mlpa in Table 3.2:

- The total number of registered vehicles was estimated at 6.0 million
- 70% of the vehicles were assumed to be cars with estimated oil change per annum of 10 litres.
- The estimated oil change per annum for trucks and buses was assumed to be 60 litres.
- Because of the rather low level of industrialisation, industrial oils to crankcase oils were estimated to be in the ratio 1:3 in other words transportation-related activities are assumed to constitute by far the largest consumption of lubricant in the country.

The estimated figure of 200 mlpa of used oils is probably an upper bound.

Table 3.2: Estimate of annual rate of used oil generation

No of registered vehicles	6,000,000
Percentage of Cars	70
Total No. of cars	4,200,000
Total no. of Buses/Trucks	1,800,000
Estimated Oil change per car (litres/annum)	10
Estimated used oil generated by cars	42,000,000
Estimated Oil Change per truck/buses/annum	60
Estimated used oils generated by trucks/buses (litres/annum)	108,000,000
Total used oils by cars/trucks/buses	150,000,000
Ratio of used industrial oils to crankcase oils	1:3
Estimated used oils from industry	50,000,000
ESTIMATED TOTAL USED OILS (litres/annum)	200,000,000

SECTION 4

MARKET OF USED OILS IN NIGERIA

4.1 Preamble

There is indeed market for used oils in Nigeria driven by the increasing demand for different end uses as identified in this study. Also of significance is the existence of used oil dealers collecting used oils from diverse sources for sale. Re-processing by such dealers is very rare and where it takes place it is limited to settling to remove particulate matter, boiling to remove entrained water vapour, and mixing with grease to produce gear oil.

Some dealers and a number of users have been surveyed in this study.

4.2 Dealers in used oils

Thirty five dealers spread over the three zones (see Table 4.1) were surveyed during the study. 95% of them admitted that they went into the business to make money as they considered it to be lucrative. Dealers obtained their used oils from different sources with the breakdown as follows: mechanic villages (16); service stations (16), industry (20), and self generation (10). 24 dealers claimed to be grading their used oils on the basis of source while all others did not feel the need to grade. Alhaji Aminu from Orogun in Ibadan did not see the need for grading since according to him 'used oil is used oil!' And, in any case, he was selling to less discerning clients such as those involved with application of used oil for wood treatment and anti-rust.

Most of the dealers stored their oils in metal drums as well as plastic containers. Worthy of note was the high degree of spillage and resultant pollution of the environment (see Figs. 4.1a and b) in the depots operated by the dealers.

Alhaji Aminu with the highest volume of 2,508 litres per week was sourcing his supply mainly from industrial establishments at cost which he was not ready to disclose. He had to carry out some re-processing to remove water (using firewood to heat the oil in open air) and sediments.

Prices for used oils varied considerably from N20 per gallon to N100 per gallon with variation based on some form of 'quality'. Most of the buyers were individuals and transporters.

Table 4.1: Some Dealers in Used Oils in Nigeria

Name	Location	Source	Quantity Sold Per Week (Litres)	Price Per Gallon (₦)
Adeoye Mech Engrg	Ibadan	Mechanic Village/Own Supplier	50	100
Osimatech Nigeria Ltd.	Ibadan	Self generation	50	
Oyolorun Oils	Ibadan	Mechanic Village	32	80
Hope Mechanics	Ibadan	Self generation	50	100
Alhaji Aminu	Ibadan	Industry	2,508	
Oando Service Station	Ibadan	Self generation	12	100
Blessed Mechanics	Ibadan	Self generation	32	150
Dugbe bus terminal mechanics	Ibadan	Self generation	40	100
(Roadside)	Aba	Service Station/Industry	n.a	20
BENO Oil Nig. Ltd.	Aba	Service Station/Industry	n.a	20
Daniel Oil & Spare Parts Co.	Aba	Service Station/Industry	n.a	
Ogbor Hill Mechanic section	Aba	Industry	n.a	
Total Oil	Aba	Service Station/Self generation	n.a	
Cat Construction Company	Aba	Self generation/Industry	n.a	
(Roadside)	Aba	Mechanic Village/Service Station	n.a	60
Mechanic/Volvo Section	Aba	Mechanic Village/Service Station	n.a	
AC Okorie & Company Ltd.	Aba	Mechanic Village/Service Station/Industry	n.a	40
Edo Nigeria Ltd.	Aba	Mechanic Village/Service Station/Industry	n.a	
Fezoy Nig. Ltd.	Aba	Mechanic Village/Service Station	n.a	80
Mba & Co.	Aba	Service Station/Self generation	n.a	80

Table 4.1 continued

(Roadside)	Port-Harcourt	Mechanic Village/Service Station/Industry	n.a	50
Decanal Company Ltd.	Port-Harcourt	Mechanic Village/Industry	n.a	45
ABC Oil & Petroleum Mktg Ltd.	Port-Harcourt	Industry/Self generation	n.a	50
ABM Quarries Ltd.	Port-Harcourt	Industry	n.a	50
Mechanic	Port-Harcourt	Mechanic/Service Station	n.a	50
(Roadside)	Port-Harcourt	Mechanic Village/Service Station/Industry	n.a	50
King Size filling station	Port-Harcourt	Mechanic/Service Station	n.a	60
Jetimo Nig. Ltd.	Port-Harcourt	Mechanic/Service Station	n.a	
Kemtech Industry Nig.	Port-Harcourt	Mechanic Village/Service Station/Industry	n.a	50
Kinik Co, Nig. Ltd.	Port-Harcourt	Industry	n.a	
Kerry Fonte Nig. Ltd.	Port-Harcourt	Industry	n.a	60
Mohamadu Sani	Kano	Self generation	n.a	
Alhaji Isa Idris	Kano	Mechanic Village, Self generation, Industry	80	80
Condemn Only	Sokoto	Mechanic Village	200	80
Alhaji Aminu Ahmed	Sokoto	Self generation	50	50

Fig. 4.1a: Depot of a used oil dealer



Fig. 4.1b: The polluted environment of a used oil depot.



Fig. 4.2: Another Depot of a Used Oil Dealer



4.3 Users of used oils

The identified uses of used oils from the survey, as reflected in Table 4.2 are:

- ✚ Direct re-use as engine lubricant
- ✚ Fuel for firing boilers and furnaces
- ✚ Hair cream production
- ✚ Dust suppressor
- ✚ Gear oil production
- ✚ Hydraulic oil production
- ✚ Weed killer
- ✚ Lubrication of block making moulds
- ✚ Wood preservative
- ✚ Anti-rust for metallic surfaces

Fig. 4.3a shows the application of used oil on wooden planks to preserve them against termite attack.

The cost of purchase varied from N20 to N150 per gallon. The level of usage also varied considerably.

Table 4.2: Users of used oils

Name	Location	Uses	Quantity used	
			Per week (Litres)	Gallon (Naira)
Adelad Creations	Ibadan	Casting	25	100
Anjola Block's Industry	Ibadan	Lubrication of block mould	25	
Ogo Oluwa Carpentry & Joinery	Ibadan	Wood preservative	4	
Zona 4 (AD20)	Ibadan	Wood preservative	4	100
Block AZ	Ibadan	Fuel	4	150
Isopako Igbajo Timber Association	Ibadan	Lubricant	2	100
Ade Million Nig. Ltd.	Ibadan	Anti-rust	4	
	Ibadan	Anti-rust	4	100
Progressive Tippers Association	Ibadan	Hydraulic oil production	4	100
Road Transport Employers Assoc. of Nig, Tipper Chapel	Ibadan	Hydraulic oil production	4	80
Elephant Baluster	Ibadan	Lubrication of block mould	28	100
Road Transport Employers Assoc. of Nig, Tipper Chapel	Ibadan	Lubricant/Hydraulic oil	2	100
Bamidele & Sons Arts Creation (BSAC)	Ibadan	Cement production	4	100
Hope Haircare Beauty Salon	Ibadan	Hair cream		
Scorpio Beauty Salon	Ibadan	Hair cream		
Reynolds Construction Company	Ibadan	Lubrication/Weed killer		
Blessed Mechanics	Ibadan	Weed killer		
Kopek Construction Company	Ibadan	Hydraulic oil production		
Unity Brothers Mechanics	Ibadan	Ball joint operation		
Engineer Mechanics	Ibadan	Weed killer		
AP Filling Station	Ibadan	Gear oil production		
Oando Service Station	Ibadan	Gear oil production		
Bovas Petrol Station	Ibadan	Gear oil production		
Fade Ventures	Ibadan	Lubrication of block mould	4	100
Akinola Block Industry	Ibadan	Lubrication of block mould	10	100
Oluseun Professional Block Industry	Ibadan	Lubrication of block mould	4	100
Diamould Block Industry	Ibadan	Lubrication of block mould		
Omofade Ventures	Ibadan	Lubrication of block mould	20	100
Oluyemi's Frandiy Company	Ibadan	Lubrication of block mould		
Zazareal Block Industry	Port-Harcourt	Lubrication of block mould		100
Cassava Processing Industry	Aba	Operation of Hydraulic jack	8	50
Garri Production Industry (Mike)	Aba	Operation of Hydraulic jack	1	
Stan Building Industry	Aba	Fuel, hydraulic oil		
Brick/Block Making Industry	Aba	Lubrication of block mould	8	40
Wood Packers Co, Nig. Ltd.	Aba	Wood preservative		50
Nigerian Breweries Plc.	Aba	Boiler fuel		
Garri Processing Village	Aba	Operation of Hydraulic jack		
Ebubem No Naka Chi & Co. Ltd.	Aba	Hydraulic oil production		80
B&K Block Industry	Aba	Lubrication of block mould		
Wood Seller Association (Mkt)	Aba	Wood preservative		50
Steel & Steel Co. Ltd.	Aba	Anti-rust		
Osioma Taxi Park.	Aba	Lubricant		50
Nagarta Block Industry	Kano	Lubrication of block mould	40	40
Dala Block Industry	Kano	Lubrication of block mould	170	30
Olasco Block Industry	Kaduna	Lubrication of block mould	2	50
Jajese Blocks	Kaduna	Lubrication of block mould	20	50
Timber Shed (Mallam Sodenge)	Sokoto	Anti Rust	4	20

Fig. 4.3a: Application of used oil to wood treatment



Fig. 4.3b: Pallets treated with used oil in block making



Fig. 4.3c: Used oil application as dust suppressant



SECTION 5

USED OIL MANAGEMENT ALTERNATIVES FOR NIGERIA

5.1 Preamble

The principal objective of any waste management plan is to ensure safe, efficient and economical collection, transportation, treatment and disposal of wastes, as well as satisfactory operation for current and foreseeable future scenarios, (Nema and Modak, 1998). Recycling of used oil entails acquisition and processing to regain useful material. In recycling process, a number of stages are possible depending on original source of the used oil, the level of contamination, and the sophistication of technology deployed. Ogbonna and Ovuru 2000 (Table 5.1a) and Adebayo et al 2004 (Table 5.1b) carried out chemical tests on samples of virgin oils and used oils in the Nigerian market. The test results showed remarkable increase in calcium, lead, copper and iron concentrates in the used oil samples compared with the result for the virgin oil. Of course, qualities of contaminants in used oils depend on several factors including type of original detergents and dilutants added to the virgin oil, storage location, and management practices.

As the country contemplates different options for the management of used oils, it helps to draw lessons from other countries that have advanced in the development of used oil management system. In this context, the following three alternatives of used oil management that seem to be gaining currency and relevant to the Nigerian situation are presented:

- ✓ Re-processing into fuel oil
- ✓ Re-refining into lube oil
- ✓ Destruction

Table 5.1: Results from Used Oil/Virgin Oil Analysis**(a) Virgin Oil without lead**

S/N	TEST PARAMETERS	USED OIL (A)	USED OIL (B)	VIRGIN OIL
1	Specific Gravity @15.6°	0.901	0.8952	0.8782
2	API Gravity @ 15.6 °	25.55	26.57	29.63
3	Copper (mg/litre)	1.09	1.18	1.01
4	Chromium (mg/Litre)	0.06	0.07	0.04
5	Nitrate (mg/Litre)	10	4	4
6	Calcium (mg/Litre)	80.6	80.6	28.75
7	Iron (mg/Litre)	81.8	72.7	14.1
8	Barium (mg/Litre)	4	4	2
9	Magnesium (mg/Litre)	0	0	0
10	Phosphorus (mg/Litre)	0.36	0.58	0.34

Source: Ogbonna & Ovuru 2000

(b) Virgin oil with lead.

S/N	TEST PARAMETERS	VIRGIN OIL	USED OIL
1	Specific Gravity @60 ° F/60 °F	0.899	0.903
2	Viscosity (Cst) @ 100 °F	171.3	101.48
3	@210 °F	16.9	12.02
4	Dynamic Viscosity (Cp) @ 100 °F	152.87	90.97
5	@ 210 °F	15.08	10.77
6	Ash, %	0.2	0.75
7	Sulphated Ash, %	0.35	0.85
8	Flash Point oC	250	146
9	API Gravity	25.95	25.25
10	Nitration products	3	1
11	Nitro-compunds	3	0
12	Water %	5	14
13	Oxidation products %	9	16
14	Glycol %	0	0
15	Fe (ppm)	1.04	98.95
16	Cu (ppm)	0.31	20.09
17	Pb (ppm)	5.70	604.9
18	Cr (ppm)	0.20	1.27
19	Ba (ppm)	604.9	608.04
20	Zn (ppm)	1630.2	1724.19
21	Ca (ppm)	1200	1300.21

Source: Adebayo et al. 2004

Used oil management options for Nigeria

Re-processing into fuel oil

The unit processes involved in re-processing into fuel oil and also re-refining into lube oil are compared in Fig. 5.1. Used oil used as a direct source of energy must undergo basic treatment to remove water and particulates before it is fit for use as fuel². This is to ensure that it does not clog burners, foul boiler tubes, or cause sediment build-up in customer tanks. As such, the process requires filtration and removal of coarse solids that can pose environmental hazard or operational problems. Treatment options include mainly physical processes like settling, centrifugation, filtration, or a combination of these operations. Unfortunately, these processes alone are not sufficient to remove all chemical contaminants in the oil, and inclusion of further treatment processes such as clay contacting and distillation would place fuel processors at a competitive disadvantage.

In this study we identified some companies that have been utilising unprocessed used oil as fuel for power generation, firing of boilers to generate process steam. Such combustion of used oils has been shown to result in atmospheric pollution and increased hazards to human health as a result of the relatively low temperature combustion of contaminants such as heavy metals and chlorides. Experience from the United Kingdom U.K. showed that higher levels of pre-treatment can remove water, sediments, heavy hydrocarbons, metals and additives.

Re-refining

Recycling falls into two categories: regeneration and laundering. These basically differ only in the degree, and possibly the type of processing or cleaning required to recover reusable material from the waste product. Usually laundering applies to less heavily contaminated materials, which can be returned to original use with production of relatively little by-product. Regeneration applies to more heavily contaminated, or complex lubricating products which, when processed, produce a base stock and, usually, a greater proportion of by-products.

The process typically involves, but is not limited to, pre-treatment by heat or filtration, followed by either vacuum distillation with hydrogen finishing or clay, or solvent extraction with clay and chemical treatment with hydro-heating. The vacuum distillation option followed by clay contacting offers a less polluting and more economic solution to the re-refining process, particularly for small scale plants with a capacity range between 10,000 and 30,000 tonnes (Fadel and Khoury 2001).

A variety of proprietary technologies has been tried for regeneration with mixed success and various yields of base oil and by-products. They all seek to recover the base blending fluid, predominantly mineral hydrocarbon with growing amounts of synthetic petrochemical material, by separating it from additive chemicals and any breakdown products that arise during use. Invariably, there is a trade off between the quality of the recovered base oil and the sophistication of the technology.

The capital outlay for re-refining process is becoming exorbitant due to the fact that lubricant requirements are becoming more severe, particularly in automotive applications as vehicles are subject to longer service intervals, smaller sumps and higher operating temperatures. The

² A litre of used oil re-processed as fuel contains about 8,000KJ of energy, which is enough energy to light a 100W bulb for 1 day or to operate a 1000W electric heater for 2 hours. Also while 67 litres of crude oil are needed to obtain a litre of motor oil, only 1.6 litres of used oil are required to produce the same amount of motor oil (EPA, 1996)

proportion of additives and synthetic components in lubricating oil is increasing, thus setting higher standards for recycled base oil.

Re-refining creates by-product streams that, in the case of the lighter components, may be used as fuel. The heavier residual stream, containing additives and carbonaceous species, may be used as a blending component in the bitumen industry, for incorporation into construction products such as road surfaces.

Thus, re-refining requires modern processes which are expensive to operate when all safety and environmental considerations are included into the overall operating system.

Destruction

In case the waste oil is highly contaminated, particularly with polychlorinated biphenyls (PCBs) and polychlorinated terphenyls (PCTs), it is preferable to adopt a destruction process rather than re-processing or re-refining. In the absence of hazardous waste incinerators, controlled high-temperature incineration at cement factories is recommended. Temperatures at the flame end of rotating cement kilns ranges between 2000 and 2400°C. This high temperature is adequate to destroy organics and neutralize acid compounds. The heavy metals content is reduced considerably as their concentrations remain very low compared to those found in the natural material used in the cement production process. However, continuous monitoring of gas emissions at the cement factories would be required to ensure compliance with air quality standards.

Overall, a comparative assessment of the three options, from the work of El-Fadel and Khoury (2001) on waste oil management in Lebanon adapted to the Nigerian situation, is presented in Table 5.2.

Fig. 5.1: Typical Re-processing and Re-refining processes

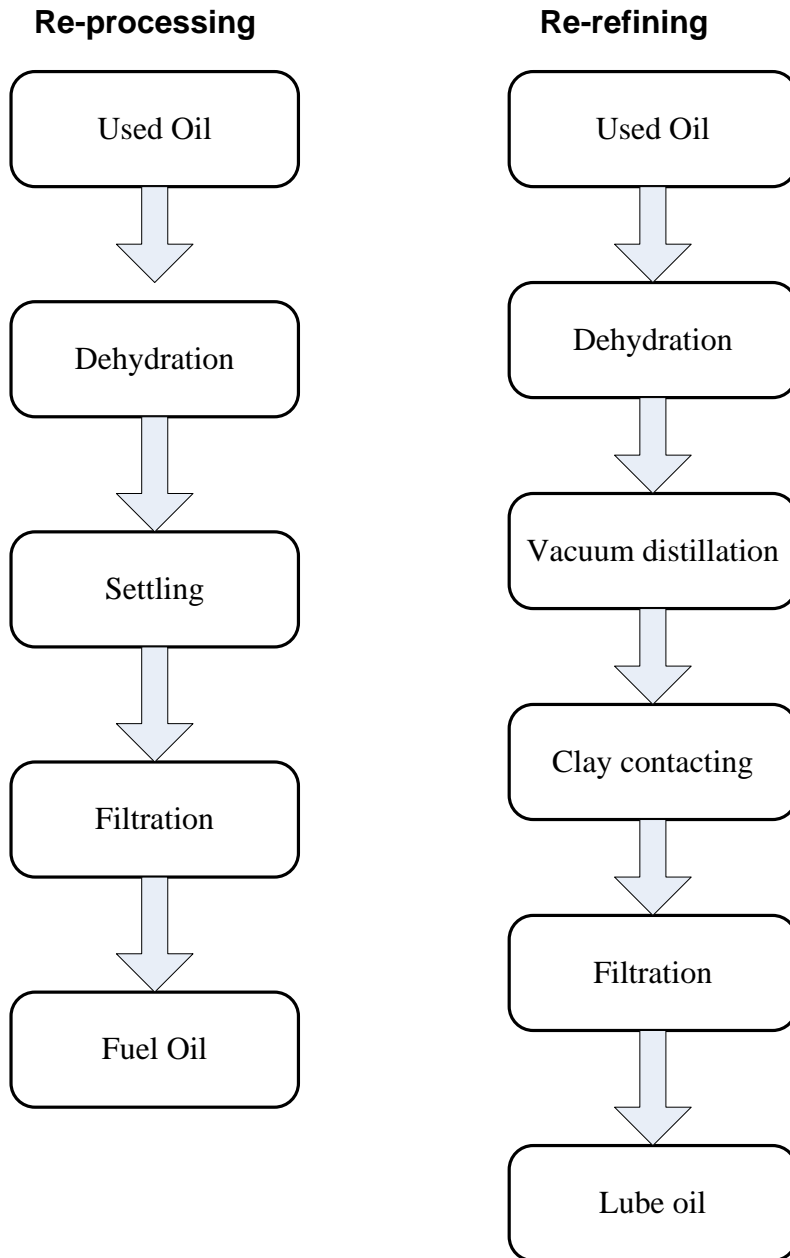


Table 5.2 Comparative assessment of the three alternative options of used oil management options

Options	Advantages	Disadvantages
Re-refining into lube oil	<ul style="list-style-type: none"> • Environmentally sound long-term solution • Creates jobs locally • Reduces the amount of imported base oils for local blending 	<ul style="list-style-type: none"> • Requires a well-developed waste-oil collection system to be established • Recycled lube oil requires a well-developed market • Requires extensive capital investment • The re-refining option requires a reputable recycling company to ensure the marketability of the product • Proper disposal of end-waste residues is costly and problematic
Re-processing into fuel oil	<ul style="list-style-type: none"> • Benefits from a well-established demand in Nigeria for fuel substitute • Creates jobs locally • Limits the negative effects of the current practice of uncontrolled burning of used oil • The quality control of the re-processed fuel oil is monitored by the purchaser 	<ul style="list-style-type: none"> • Requires a well-developed waste-oil collection system to be established • Requires extensive capital investment • Proper disposal of end-waste residue is costly and problematic
Destruction	<ul style="list-style-type: none"> • Economically feasible at lower processing volumes • Cement factories may be willing to procure the used oil • Less capital intensive than the previous options • Concentrates used oil disposal to limited sites that can be more easily regulated and controlled. 	<ul style="list-style-type: none"> • Air emissions, although minimal, will still need to be addressed • May face stiff opposition by local residents

5.2 Oil Re-refining Projects in Nigeria

There is as yet no oil re-refining plant in Nigeria. However there have been significant attempts by three key organizations identified in the study to install such plant. These are the Lube Oils Limited, Boskel Nigeria Limited and the Federal Ministry of Environment.

The Lube Oils Limited, Otta

In 1996, Lube Oils Limited, with the assistance of UNIDO assessed the techno-economic importance of refining used lubricating oil. UNIDO has been promoting the sustainable management of used oils through the adoption of industrial cleaner production techniques. A major recommendation was the establishment of used oil recycling plants. The identified derivable benefits from the project included a cleaner environment, cheaper lube oil, job creation and poverty reduction, and foreign exchange savings for Nigeria. The feasibility study for the establishment of used oil recycling plant was carried out by Triple E Associates, an environment and energy consultancy company in Nigeria. Suffice it to note that several years after the project conception; it has not taken off for the following reasons, among others:

- The project, based on an Italian Process design, increased in cost from the initial projection of ₦100 million to over ₦1.0 billion.
- There was problem with getting sufficient quantity and quality of used oils to make the project economically viable.

The company, still very much interested in used oil recycling process, has decided to invest in the local development of appropriate process technology. Towards this end, it has entered into research agreement with the Department of Chemical Engineering, University of Lagos to develop the technology in stages: first, a plant to process used oil to fuel oil; then, to diesel oil in the second stage; and finally, a re-refining plant to produce base oils.

Boskel Nigeria Limited

This is a thermal processing engineering company based in Port-Harcourt. The company, established in 1989, now with staff strength of 75 Nigerians, provides to oil companies various technical services, including the handling wastes such as used oils. The desire of the company to recycle used oils led to its investment in the development of a pilot plant to re-process and re-refine used oils. Whilst further developmental efforts are still required, the company has however successfully developed a plant with capacity to produce 50-100 litres of fuel oil per hour. The company hopes to enter the market soon with its plant.

The Federal Ministry of Environment

The Federal Ministry of Environment (FMENV) has also been very much interested in recycling used oils. A few months ago, the Ministry invited bids for the fabrication of a refining plant based on the acid/clay process technology. The contract for the fabrication has since been awarded to a fabricator. It is hoped that the Ministry will be in position to provide the very much needed research and technological backup for such project whose requirements for success transcend mere fabrication. This is particularly important bearing in mind the fact that the process technology is not really yet in the public domain with researches still on-going even in developed economies.

5.3 Techo-Economic factors in investing in oil recycling

As the nation contemplates investment in recycling systems, whether in the private or public sector of the economy, there are a few techo-economic factors that must be considered. From the desk study conducted in this project, the selection process of environmentally sound reuse or recycling options of used oils should be based, *inter alia*, on the following considerations:

- *Feedstock (upstream) quality*: degree and nature of contamination and environmental/health risks associated with handling and processing, volumes and types.
- *Treatment processes* for getting appropriate quality feedstock for downstream industries or users, impacts on resource conservation, percentage of the product recovered, energy savings.
- *Impacts of treatment processes* on public health and environmental media.
- *Final disposal* of end-of-the-pipe output of treatment processes in the framework of environmentally sound management of hazardous wastes.
- *Economics* (economic viability/sustainable market and commercial feasibility; product value).
- *Technology and techniques* (treatment capacity, feedstock capability) and their potential impacts on the environment.
- *Location* of existing or planned facilities.
- *Infrastructure* for clean and efficient collection, storage, and transport of used oils.
- *Public perception*.
- *Legislation* (i.e. on air emissions).
- *Socio-economic benefits* (i.e. employment opportunities).
- *Knowledge of cases or processes* which have gone wrong in the past.
- *Availability* of cleaner production methods and clean technologies.

There is no doubt that a proper feasibility study will have to be carried out taking due cognizance of the above factors.

SECTION 6

LEGISLATIVE ASPECTS OF USED OIL MANAGEMENT IN NIGERIA

The legislative instruments developed by the Federal Ministry of Environment to halt environmental degradation arising from any pollution source including oil related activities are:-

- The National Policy on the Environment Nov 1989 revised in 1999
- Nigeria's National Agenda 21 of 1999
- The National Effluent Limitations Regulations 5.1.8 of 1991
- Pollution abatement in industries and facilities generating waste regulation 5.1.9 of 1991
- Waste management regulations 5.1.15 of 1991
- Environmental impact assessment (EIA) Decree No of 1992
- National guidelines and standards for environmental pollution control in Nigeria 1991.

The National Policy on the Environment generally describes guidelines and strategies for achieving the policy goal of sustainable development by:

- securing for all Nigerians a quality of environment adequate for their health and well being;
- Conserving and using the natural resources for the benefit of present and future generations;
- Restoring, maintaining and enhancing the ecosystem and ecological processes essential for the preservation of biological diversity;
- Raising public awareness and promoting understanding of the essential linkages between environment and development ; and
- Cooperating with other countries and international organizations and agencies to achieve the above.

The National Agenda 21

Redressing the backlog of environmental problems, however remains a central concern for both the people and the different levels of government of Nigeria; therefore in line with the global objectives of "Agenda 21", the blue print of action from 1992 into the 21st century and beyond", Nigeria fashioned out its own National Agenda 21 which sought to:

- (i) integrate environment into development planning at all levels of government and the private sector;
- (ii) intensify the transition to sustainable development;
- (iii) address sectoral priorities, plan policies and strategies for the major sectors of the economy; and
- (iv) simultaneously foster regional and global partnerships

Specifically, it addresses in section 2.6 the rational use of oil and gas resources through a set of objectives and programmes to generate wealth for development without compromising environmental integrity including inventorising contaminated sites arising from oil-related activities in its bid to ensure the proper use and management of all chemicals for sustainable human development.

The National Effluent Limitations Regulations 5.1.8 of 1991 makes it mandatory

for industrial facilities to install anti pollution equipment, makes provision for effluent treatment and prescribes maximum limits of effluent parameters allowed for contravention including oil and grease from various manufacturing/industrial or service sector. It further prescribes limit for discharge of oil and grease into surface water (10mg/l) and for land application (20mg/ml).

The Pollution Abatement in industries and Facilities Generating Waste Regulation 5.1.9 of 1991 among other things imposes restrictions on the release of toxic substances and stipulates requirements for monitoring of pollution to ensure that permissible limits are not exceeded while unusual and accidental discharge's contingency plans, generator's liability and strategies for waste reduction the safety are put in place. Section (1) stipulates that "No oil in any form shall be discharged into public drain, rivers, lakes, sea or underground injection without a permit issued by the agency or any organization designated by the Agency (Federal Ministry of Environment).

Section 11 subsection (1) states that the collection, treatment, transportation and final disposal of waste shall be the responsibility of the industry or facility generating the waste.

Furthermore section 17 states that "*An industry or a facility which is likely to release gaseous, particle, liquid or solid untreated discharges shall install into its system, appropriate abatement equipment in such manner as may be determined by the Agency (Federal Ministry of Environment).*"

Waste management Regulations of 5.1.15 of 1991 regulates the collection, treatment and disposal of solid and all forms of hazardous wastes from municipal and industrial sources and gives the comprehensive list of chemical and chemical wastes by toxicity categories.

Some non specific sources listed in Schedule 12 of Hazardous /Dangerous waste sources include:

FEK 048 Dissolved Air Floatation (DAF) floats from the petroleum refining industry.

FEK 049 Slop oil emulsion from the petroleum refining industry

FEK 050 Heat exchanger bundle cleaning sludge from the petroleum refining industry

FEK 051 API separator sludge from the petroleum refining industry.

FEK052 Tank bottoms (leaded) from the petroleum refining industry.

Concluding Remarks

Used oil resources identified in Nigeria are mainly industrial and transportation based. A national used oil generating capacity was estimated to be 200 million litres per annum (mlpa) in course of this investigation, which are put to several uses from direct use to the bizarre, as additives to hair cream. In recognition of the used oil as a resource, there are reported efforts by private Companies for establishment of treatment facilities and an invitation bid for the fabrication of a refining plant based on acid/clay process technology by the apex ministry on environment in the country being the Federal Ministry of Environment. It is hoped that the Ministry will make provision for the very much needed research and technological backup for such project whose requirements for success transcend mere fabrication.

From the foregoing it apparent that used oil recycling is feasible in the country with the right framework policy from government to stakeholders. The existing legislation is adequate for the environmentally sound management of used oil in Nigeria, as the Generator's liability has been expressly confirmed in the provisions. However, it might be necessary to enact a new legislation similar to that which exists in the European Union vide Council Directive 87/101/EEC of 22 December 1986 regulating the safe collection and disposal of waste oils.

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APPENDICES

APPENDIX A
QUESTIONNAIRE ON THE MANAGEMENT OF USED OILS IN NIGERIA:
SELLERS OF VIRGIN ENGINE OILS

Dear Sir/Madam,

This questionnaire is for the collection of data in respect of research work on the management of used oils in Nigeria. This study is mainly for academic purpose and all information supplied will be treated with strict confidence.

Honest, clear and objective responses to the questions would be highly appreciated.

INSTRUCTION

Please tick as appropriate.

SECTION A

INDIVIDUALS

1. Sex
Male Female
2. Educational qualifications
Primary S.S.C.E NCE / OND
B.Ed. / B.Sc. / HND Others
3. Age
18-24 years 25-31 years 32-38 years
39-45 years 46 years and above
4. Marital status
Single Married Divorced Widow

INDUSTRIES

1. Name of Company _____
2. Address/Location _____
3. Year Established _____

SECTION B

1. What types/grades of engine oils do you sell?
 - a. -----
 - b. -----
 - c. -----
 - d. -----

2. What are your unit of sales of these oils? State volumes in the brackets
Gallons()_____ Jerry cans()_____ Drums()_____
Others (specify)

3. What are the prices for each unit of sales mentioned in (2) above?
Gallons_____ Jerry cans_____ Drums_____
Others (specify)

4. In a week of good sales what quantity, on the average, of each of these units of sale do you sell?
Gallons_____ Jerry cans_____ Drums_____
Others (specify)

5. Who are the major customers?

APPENDIX B
QUESTIONNAIRE ON THE MANAGEMENT OF USED OILS IN NIGERIA:
GENERATORS OF USED OILS

Dear Sir/Madam,

This questionnaire is for the collection of data in respect of research work on the management of used oils in Nigeria. This study is mainly for academic purpose and all information supplied will be treated with strict confidence.

Honest, clear and objective responses to the questions would be highly appreciated.

INSTRUCTION

Please tick as appropriate.

SECTION A

INDIVIDUALS

1. Sex

Male [] Female []

2. Educational qualifications

Primary [] S.S.C.E [] NCE / OND []

B.Ed./B.Sc./HND [] Others []

3. Age

18-24 years [] 25-31 years [] 32-38 years []

39-45 years [] 46 years and above []

4. Marital status

Single [] Married [] Divorced [] Widow []

INDUSTRIES

5. Name of Company

6. Address/Location

7. Year Established

SECTION B

1) What do you use virgin engine oil for?

Private vehicles [] Commercial Vehicles []

Private generating plants [] Commercial generating plants []

Industrial machines [] Heavy duty vehicles []

Others (specify)

2) What quantity of engine oil do you use?

Litres [] Gallons [] Drums [] Tons []

3) How often do you change your oil?

Monthly [] 3 months [] 6 months [] Specify []

- 4) Who changes your oil?
 Self [] Mechanics [] Technicians []
 Service stations [] Specify []
- 5) What quantity of used engine oil do you produce per change?
 Litres [] Gallons [] Drums [] Tons []
- 6) For motor/generator mechanics, how many vehicles/generators do you service in a week?

- 7) What quantity of used engine oil do you generate weekly?
 Litres [] Gallons [] Drums [] Tons []
- 8) How do you store your oil before disposal?
 Metal drums [] Plastic Kegs [] Plastic drums []
 Metal tanks [] Other containers (specify)
- 9) How do you dispose of the used engine oil?
 Sewers [] Landfills [] Collection centres []
 Sale [] Pouring on the ground [] Mechanics []
 Specify
- 10) Are you aware of recycling? Yes [] No []
- 11) If yes, which recycling method(s) are you familiar with?
 Settling [] Filtration [] Evaporation []
 Blending directly with other oils [] Re-processing []
 Re-refining [] Others (specify)
- 12) Do you take your used engine oil to a collection centre for recycling?
 Yes [] No []
- 13) If yes, which collection centre do you use?
 Mechanic workshops [] Petrol stations [] Private collectors
 [] Others (specify)
- 14) If no, do you recycle your used engine oil for reuse?
 Yes [] No []
- 15) If yes, which recycling method do you use?
 Settling [] Filtration [] Evaporation []
 Blending directly with other oils [] Re-processing []
 Re-refining [] Others (specify)
- 16) What quantity of the used engine oil generated do you recycle?
 Litres [] Gallons [] Drums [] Tons []

APPENDIX C
QUESTIONNAIRE ON THE MANAGEMENT OF USED OILS IN NIGERIA:
DEALERS IN USED OILS

Dear Sir/Madam,

This questionnaire is for the collection of data in respect of research work on the management of used oils in Nigeria. This study is mainly for academic purpose and all information supplied will be treated with strict confidence.

Honest, clear and objective responses to the questions would be highly appreciated.

INSTRUCTION

Please tick as appropriate.

SECTION A

INDIVIDUALS

1. Sex

Male [] Female []

2. Educational qualifications

Primary [] S.S.C.E [] NCE / OND []

B.Ed. / B.Sc. / HND [] Others []

3. Age

18-24 years [] 25-31 years [] 32-38 years []

39-45 years [] 46 years and above []

4. Marital status

Single [] Married [] Divorced [] Widow []

INDUSTRIES

5. Name of Company _____

6. Address/Location _____

7. Year Established _____

SECTION B.

1) Why did you go into used oil business?

Commercial [] Environmental [] Other (specify)

2) Where do you get the used engine oil?

Mechanic garages [] Petrol Stations [] Individual suppliers []

Industries [] Other sources (specify)

3) Do you grade the used oil? Yes [] No []

4) If yes, on what basis do you grade the used oil?

Grading based on quality [] Grading based on sources []

Others (specify)

- 5) How much of the used engine oil do you get in a week?
 Litres [] Gallons [] Drums [] Tons []
- 6) How do you store the used oil?
 Metal drums [] Plastic Kegs [] Plastic drums []
 Metal tanks [] Other containers (specify)
- 7) Do you mix new stock with old stock? Yes [] No []
- 8) How much of the used engine oil do you sell in a week?
 Litres [] Gallons [] Drums [] Tons []
- 9) Who are the buyers of the used engine oil?
 Individuals [] Transporters [] Industries []
- 10) What in your own opinion is the used engine oil used for?
 Direct re-use as engine oil in other vehicles/equipments []
 Reuse as boiler fuel [] Reuse as furnace fuel []
 Hair cream production [] Road oiling/Dust suppressant []
 Gear oil production [] Weed killer [] Cooking []
 Cement production [] Block making [] Wood preservation []
 Rust prevention [] Others (specify)
- 11) Do you know about recycling? Yes [] No []
- 12) If yes, which recycling method(s) are you familiar with?
 Settling [] Filtration [] Evaporation []
 Blending directly with other oils [] Re-processing []
 Re-refining [] Others (specify)
- 13) Do you recycle the used engine oil before selling?
 Yes [] No []
- 14) If yes, which recycling method do you use?
 Settling [] Filtration [] Evaporation []
 Blending directly with other oils [] Re-processing []
 Re-refining [] Others (specify)
- 15) What quantity of the used engine oil do you recycle in a day?
 Litres [] Gallons [] Drums [] Tons []
- 16) Do buyers prefer the recycled oil? Yes [] No []
- 17) How much does a litre of the used engine oil cost?
- 18) How much does a litre of the recycled engine oil cost?

APPENDIX D
QUESTIONNAIRE ON THE MANAGEMENT OF USED OILS IN NIGERIA:
BUYERS/USERS OF USED ENGINE OILS

Dear Sir/Madam,

This questionnaire is for the collection of data in respect of research work on the management of used oils in Nigeria. This study is mainly for academic purpose and all information supplied will be treated with strict confidence.

Honest, clear and objective responses to the questions would be highly appreciated.

INSTRUCTION

Please tick as appropriate.

SECTION A

INDIVIDUALS

1. Sex

Male [] Female []

2. Educational qualifications

Primary [] S.S.C.E [] NCE / OND []
B.Ed. / B.Sc. / HND [] Others []

3. Age

18-24 years [] 25-31 years [] 32-38 years []
39-45 years [] 46 years and above []

4. Marital status

Single [] Married [] Divorced [] Widow []

INDUSTRIES

5. Name of Company _____

6. Address/Location _____

7. Year Established _____

SECTION B

1) Where do you get the used engine oil?

Dealers [] Individuals [] Service station []
Industries [] Mechanics [] Specify

2) If you buy, how much do you buy the used engine oil per litre?

3) What quantity of the used engine oil do you buy weekly?

Litres [] Gallons [] Drums [] Tons []

- 4) What do you use the used engine oil for?
- Direct re-use as engine oil in other vehicles/equipments []
- Reuse as boiler fuel [] Reuse as furnace fuel []
- Hair cream production [] Road oiling/Dust suppressant []
- Gear oil production [] Weed killer [] Cooking []
- Cement production [] Block making [] Wood preservation []
- Rust prevention [] Others (specify)
- 5) Do you know what recycling means? Yes [] No []
- 6) If yes, which recycling method(s) are you familiar with?
- Settling [] Filtration [] Evaporation []
- Blending directly with other oils [] Re-processing []
- Re-refining [] Others (specify)
- 7) Do you buy recycled engine oil? Yes [] No []
- 8) If no, do you recycle the used engine oil after buying? Yes [] No []
- 9) If yes, which recycling method do you use?
- Settling [] Filtration [] Evaporation []
- Blending directly with other oils [] Re-processing []
- Re-refining [] Others (specify)
- 10) Do you prefer the recycled oil to the un-recycled oil? Yes [] No []
- 11) If yes, why?
- Better quality [] Less contamination []
- Others (specify)
- 12) Can you compare the recycled oil with virgin oil?
- Virgin oil has better quality []
- Recycled oil has better quality []
- They both have the same quality []
- Cannot make a comparison []