# USED OIL RECYCLING MARKETS AND BEST MANAGEMENT PRACTICES IN THE UNITED STATES

**October 27, 1992**

Presented to:
the National Recycling Congress
September 15, 1992
Boston, MA

This report was developed and written by Rob Arner, Solid Waste Management Planner, for the Northern Virginia Planning District Commission. Any assessments and conclusions contained in this report represent the results of staff's technical investigation, and do not represent policy positions of the Northern Virginia Planning District Commission unless so stated in an adopted resolution of said Commission.

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## TABLE OF CONTENTS

## APPENDICES

## TABLES



## INSERTS

# FOREWORD

There are nearly three quarters of a million used oil generators in the United States today. Of this amount a large percentage are small businesses either in the vehicle maintenance sector or in other types of small quantity generators of industrial oils. This paper will address current used oil market opportunities to both foster increased commerce and protect the environment.

A spirit of cooperation needs to be renewed and focused toward the conservation of our precious petroleum supplies. Used oil is a precious resource that if used improperly will become a hazardous waste. Individuals create this problem and are also part of the solution. It is our responsibility to redirect this wasted resource by acknowledging that all Americans participate in saving our land and preserving its resources for future generations.

The two-fold purpose of this paper is to explore the current market for which used oil is handled and to provide to both public officials and consumers some idea on how to best manage this valuable resource and protect it from becoming a hazardous waste. Used oil recycling can serve as a model of how important it is to promote pollution prevention. This paper will evaluate a number of potential best management practices based on the specific needs of used oil generators.

This paper does not advocate one technology over another since economic forces dictate different decisions at the local level. Since used oil markets differ depending upon specific settings, an individual generator should find out how to best manage his or her used oil.

It can not be over-emphasized that numerous other automotive and industrial chemicals should not be mixed with used oil. Also, good housekeeping techniques, coupled with finding disposal/recycling options for the contaminants that are mixed with used oil, are critical to ensure this material is fully source separated.

***The Author***

## ABOUT THE AUTHOR

Mr. Robert Arner, Solid Waste Program Manager for the Northern Virginia Planning District Commission, has hands-on experience in all aspects of used oil recycling, having been one of the first National Recycling Coalition (NRC) members; national environmental organizer (Earth Day' 80; state representative, Washington, DC); assisted in founding the Association of Government Oil Recycling Officials and the National Oil Recyclers Association; used oil collector; recycling plant manager, and a concerned citizen.

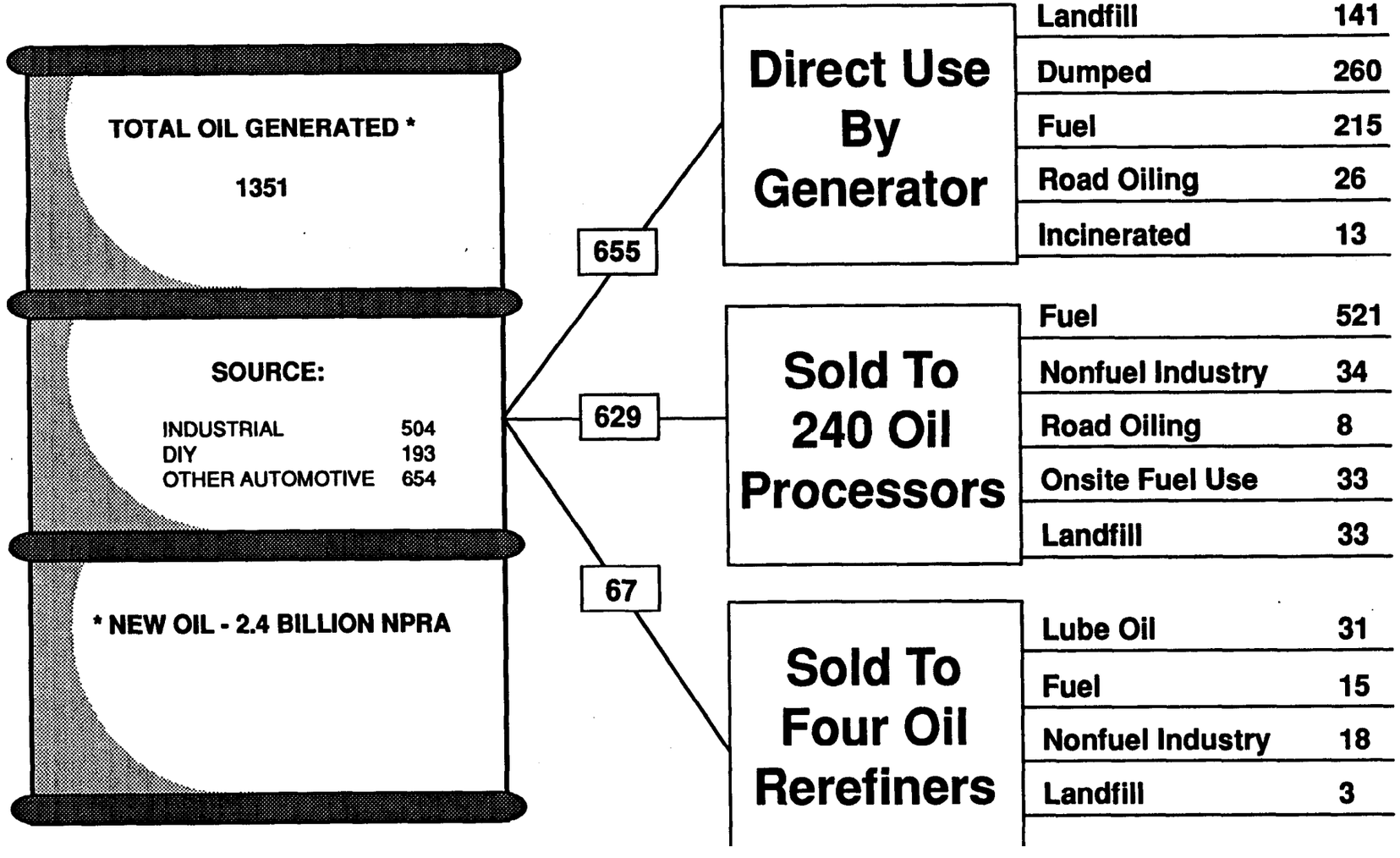
For over fifteen years, Mr. Arner has dealt with numerous used oil technical, policy and public education (technology transfer) issues working closely with the Association of Petroleum Re-refiners and the American Petroleum Institute. Recruiting such spokespeople as Peter Jennings, Jack Anderson and Wes Unseld, Rob Arner has developed numerous innovative avenues of public education. For the U.S. Environmental Protection Agency, Mr. Arner has co-authored numerous community action newsletters, brochures, and a "how to manual" for community action. Mr. Arner has worked with numerous state motor vehicle agencies to inform consumers on how to recycle their used oil.

Mr. Arner has experience in various used oil recycling technologies, including experience as a builder and plant manager of a used oil recycling facility and visiting numerous other reprocessing and re-refining operations. As such, he supervised processing and final testing of used oil, environmental pollution controls, permit applications and supervised, procured and installed plant equipment. Also, Mr. Arner has worked as a consultant for other used oil recycling firms.

Besides testifying before the USEPA in 1979 and Congress in 1981 on the Used Oil Recycling Act of 1980, representing state government (National Association of Oil Recovery Coordinators), Mr. Arner has assisted in developing used oil legislation for Congressman Torres(CA), and the states of California, Florida, and Virginia.

Mr. Arner has written and spoken extensively on this topic throughout the United States and has a B.S. from the University of Maryland.

# USED OIL DISPOSITION IN THE UNITED STATES - 1988
# (Millions of Gallons)




Source: Lubrizol

# USED OIL RECYCLING MARKETS AND BEST MANAGEMENT PRACTICES IN THE UNITED STATES

## 1.0 INTRODUCTI0ON TO THE USED OIL MARKET IN THE UNITED STATES

Americans are awakening to the realization that innovative solutions will be required for our modern-day environmental problems. The improper utilization and disposal of used oil is one critical environmental problem which offers valuable lessons for regulatory reform.

The need for sound scientific data that is objectively presented to the public is essential. Additionally, proper design and quality control are important in preventing adverse health and environmental damage that can be caused by used oil. Used oil as a potential "non-point source" pollutant requires economic incentives to be properly managed and controlled. Simply reflecting on the fact that one gallon of used oil is enough to pollute one million gallons of water can be a somber realization.

The used oil recycling market offers a case study into the complexity of defining and regulating one area of recycling. Before we can understand the secondary oil market (represented by recycled oil), we must understand the primary one. Roughly, 230 billion gallons of crude virgin oil are estimated to be processed in the United States each year. Of this amount, only l/2 to l/4 of one percent becomes used oil. With the advancements in modern petro-chemical technology, refiners can produce many different products depending upon what the market demands. Oil refiners currently refine seven percent of virgin oil into fuel and one percent into lubricants and coolants.

The often repeated statement that "it takes 42 gallons of crude oil to yield the same 2 and l/2 quarts of lubricating oil provided by re-refining one gallon of used oil," is misleading. This is because other useful end products are made when crude oil is refined. Sophisticated refining technology can transform crude oil to cater to practically any market demand (see Table A).

Each year, the United States generates approximately 1.351 billion gallons of used oil from roughly 2.4 billion gallons of new refined lubricating oil. Only 57 percent of this used oil is accounted for by recycling (Federal Register, 9/23/91, pg. 48003). People who change their own oil, the so called do-it-yourselfers (DIYs), are a major source of improper disposal of used oil. It is

estimated that between 193 to 400 million gallons of used oil are released into the environment each year in this manner.[1]

Few other recycling markets in this country have gone through such vast fluctuations as used oil. The roller coaster fluctuations experienced in petroleum prices coupled with ever-changing environmental regulations has, in many cases, only added insult to injury. Moreover, a new sensitivity to how governmental policy acts upon free markets is emerging. Heavy-handed regulations, even when well-intentioned, can cause an increase in improper disposal, and alter the collection infrastructure. Increased handling cost in these heavily regulated states depresses collection efforts for very small quantity generators and DIY oil changers. The stigma of used oil being potentially classified as a hazardous waste has destroyed tens of thousands of collection centers overnight as a result of increased insurance and liability costs.

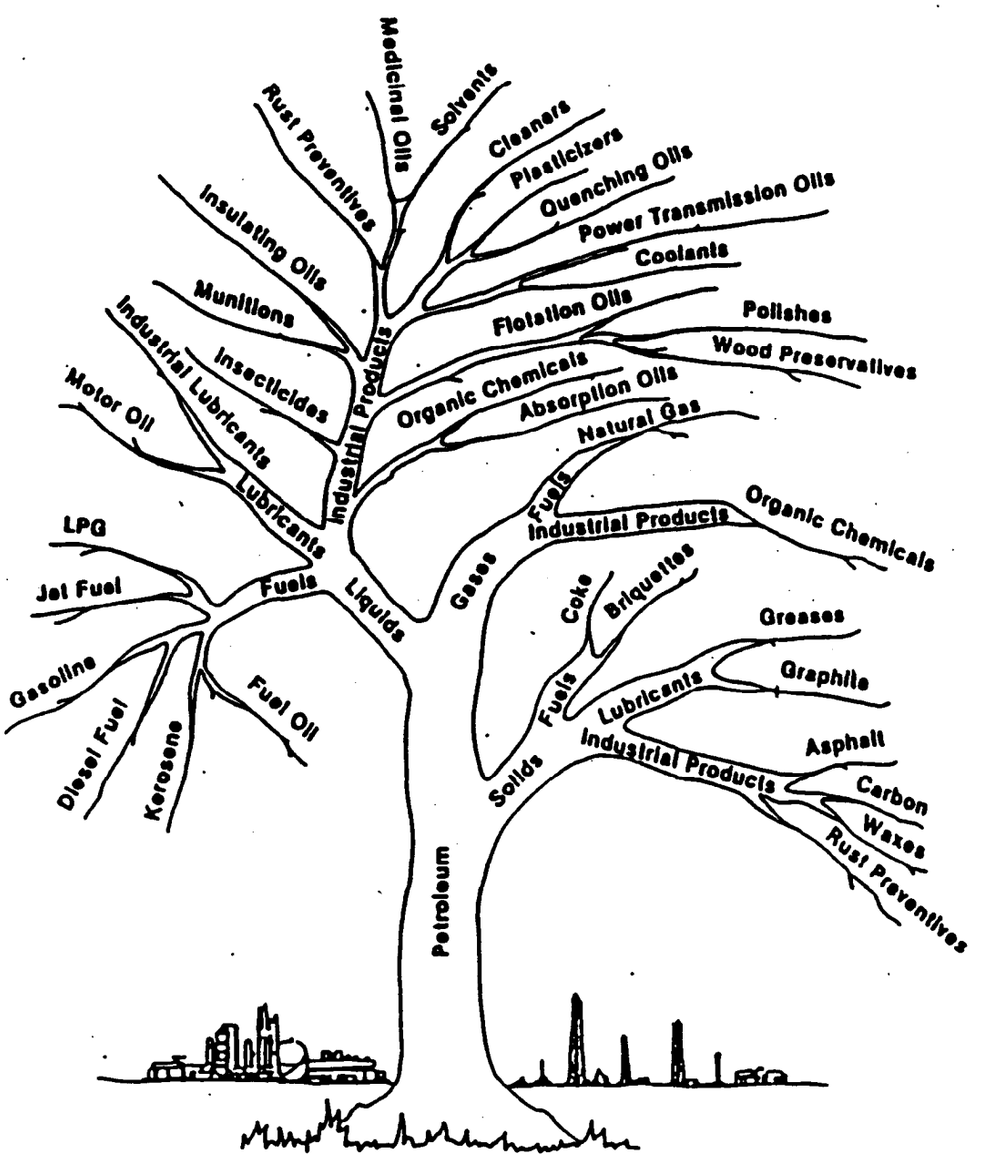
Used oil has been identified as a constituent of concern at less than half of the 63 NPL Superfund sites managing used oil and other wastes. However, this black liquid has served as an ideal mask to hide numerous highly hazardous chemicals that have caused many serious environmental problems (these may include PCBs, and chlorinated solvents). Used oil does not only originate from the crankcase drainings of cars, trucks, motorcycles, buses, lawn mowers, boats, and planes, but from all types of machinery and industrial applications as well.

It is important to educate those in the environmental movement on how to deal with the complexities of such a ubiquitous waste. Sensationalizing the problem and attacking major oil corporations only encourages greater polarization in an era where private and public cooperation is critical to protecting our environment.

[1] **Mercer Management Revised 1992-EPA Used Oil Data, telephone conversation with Kevin Dietly, September 1992.**

Table A

**PETROLEUM TREE**




**Source: GSI Used Oil Seminar, 9/3/91**

## 1.1 Regulatory History and Definition of Used Oil

One of the greatest challenges in the waste industry has been to define recycling and waste reduction. Since used oil contains an array of petroleum by-products, there has been little agreement on the definition of this material. The chemical compositions range from industrial oils to automotive crankcase drainings.

On September 23,1991, the EPA published a Supplemental Notice of Proposed Rulemaking for the identification and listing of used oil (56 PR 48000). Three options were presented for identifying used oil as a hazardous waste. Roughly one thousand cornmentors provided the EPA with information similar to the Agency's 1985 proposed hazardous listing of used oil.

The vast majority of commentors again supported Option Three, not to list used oil as **a** hazardous waste, but to rely on management standards instead. Many of these cornmentors suggested that regulating used oil as a hazardous waste would have a negative effect on the entire used oil recycling system, especially voluntary DIY programs. Commentors stressed the need to encourage recycling through education, proper collection, and strong management standards.

In May of 1992, the EPA determined that hazardous listing of used oil destined for disposal was unnecessary. The EPA also determined that listing all used oils as hazardous unfairly subjects them to stringent Subtitle C regulations. On August 15, 1992, the EPA promulgated recycled used oil final management standards for controlling the potential risks from the "no hazardous waste" listing. The EPA specifically noted that its decision not to Iist recycled used oil as a hazardous waste was based solely upon its evaluation of technical listing criteria contained in 40 CPR 261.11(a)(3).

The EPA's August 1992 decision also provides a regulatory definition for "used oil" at 40 CPR 260.10 as follows (p. 45).

> *Used oil means any oil that has been refined from crude oil, or any synthetic oil, that has been used and as a result* **of** *such use is contaminated by physical or chemical impurities.*

This regulatory definition covers the majority of used oil which was a result of lubricants, coolants (non contact heat transfer fluids), emulsions, and other oils contaminated through use. Specific types of used oils, however, are not identified in the definition, as was proposed in 1985.

### 1.2 Definition of "Recycled Oil"

Used oil, however, is considered to be **a** solid waste. As such, Congress and then President Carter interpreted recycling and signed into public law a definition of "recycled oil." The Used Oil Recycling Act of 1980 (PL 96-43) makes the statutory distinction in §3. §1004 of the Solid Waste Disposal Act, amending it with a new paragraph (37),

> *"The term* 'recycled oil' *means any used oil which is reused, following its original use, for any purposes (including the purpose for which oil was originally used). Such terms include oil which is re-refined, reclaimed, burned, or reprocessed."*

### 1.3 Used Oil Recycling Rate

The EPA calculates used oil recycling by updating the Franklin Associates methodology to estimate the parameters of the used oil industry with modest changes by the Temple, Barker and Sloan (TBS) 1988 Generation and Flow Report. The rate is calculated from the used oil generation formula provided in the Franklin Associates' 1983 Used Oil Analysis.

Table B

**SUMMARY OF NORA FUEL SURVEY**

Printing Date, Feb. 21, 1992

Respondents, 48

Total Gals./Year - 263,480,000

Total On-8pec.* - 239,940,000 (91%)
Total Off-8pac.* - 23,540,000 (9%)

Lead Level Incoming - 42.95 ppm average
Lead level Outgoing - 34.35 ppm average

# USED OIL END USE

| TYPE CUSTOMER | GALLONS/YEAR | PER CENT |
|---|---|---|
| Industrial Furnaces* | 111,060,000 | 42.1 |
| Industrial Boilers * | 66,580,000 | 25.3 |
| Institutional | 350,000 | 0.1 |
| Residential | -0- | 0.0 |
| Blenders - Off Site | 23,250,000 | **8.8** |
| Other Commercial & Industrial Burners * | 4,920,000 | 1.9 |
| Fuel Total - | 206,480,000 | 78.2 |
| Non-Fuel Total - | 57,320,000 | 21.8 |
| Grand Total - | 263,480,000 | 100.0 |

* Meeting the requirements of 40 CFR Part 260 - 266.

## 1.4 The Lead Question

Most used oil is on specification ("on spec," or meeting standards) under the current definition of 100 parts per million of lead because of the lead phase out in gasoline. According to the data the EPA collected to characterize used oil constituents and estimate the levels of such constituents in used oil, most used oil does not exceed the 100 parts per million (ppm) limit on lead, a specification limit for lead in used oil fuel that could be burned in non-industrial boilers and furnaces. There are, however, isolated exceptions such as aviation and some marine used oil where lead runs above 100 parts ppm. 1988 was a transition year because of the phase out of lead in gasoline. In a recent survey by the National Oil Recyclers Association, it was found that lead concentrations were less than one half of the 100 ppm "on-spec" standard (see Table B).

Today a vast majority of used oil is now "on-spec" (less then 100 ppm) or very close to it. Specific accounting has been conducted of how much used oil is "on-spec," although blending of used oil with new refined oil so that it meets "on-spec" requirements is a common practice.

Several national environmental organizations have made claims that burning used oil is the number one source of lead emissions in the air. A Congressional Reference Service memo from May 18,1992 by Linda Schierow to the Senate Energy and Natural Resources Committee documents the EPA's most current findings that of the 1989 U.S. emissions of lead to air, only 200 (tons/year (t/y)) were from used oil out of 7,200 (t/y) total, or less than 3%.

## 1.5 DIY-Generated Used Oil

One of the most significant types of used oil disposition comes from the very small generator or the DIY. The DIY is an individual who removes used oil from a motor vehicle, utility engine or farm equipment owned and operated by such an individual for personal use. Many communities have enacted curbside collection of used oil or informed the public where to drop used oil off for recycling. Some states have required retailers to either post signs informing the public where to drop used oil off for recycling or have required the business selling used oil to collect DIY-generated used oil. Such states as Texas (2 cents a quart) and South Carolina (8 cents a gallon) tax retailers that sell oil and divert the funds into a grant program for local DIY programs. Other states such as New York and Massachusetts require service stations who sell oil to accept DIY used oil. There are roughly 50 million Americans - from blue collar workers to affluent car buffs - who change oil from their own

vehicles [2]. Often, however, other types of very small quantity generators (e.g., farmers, and very small businesses) are not in this category, making a precise accounting of this activity difficult.

The Resource Conservation and Recovery Act of 1976 (RCRA) does not provide any authority to EPA to regulate waste generated by individuals or households (e.g., people who change their used oil and filters). The EPA has, however, developed numerous educational publications addressing this issue and is striving to improve this oil collection system.

The EPA cites that 193 million gallons of used oil, or roughly twenty percent of the total, are not recycled from the DIY sector. The newly promulgated rule covering recycled used oil may encourage DIY oil collection by service stations. In the future, EPA may develop incentives to stimulate additional collection of DIY-generated used oil.

Listing used oil as a hazardous waste would have discouraged collection of DIY-generated used oil for recycling because many facilities would have had to pay to ship DIY-generated used oil to the recycler as a hazardous waste. Liability concerns may have resulted in many collection stations discontinuing this voluntary service to the public.

In 1961, service stations accounted for about 70% of all sales of lubricating oil for passenger cars. Today, retail outlets command this market, with DIYs purchasing roughly 60% of all lubricating oil sold. The present economic slump in this county also has increased the DIY population. In effect, the mass consumer market has grown while the number of collection stations for used oil until recently has decreased.

Numerous major oil companies and retailers have responded to the problem by sponsoring DIY collection programs. Certain environmental groups have attacked these efforts, claiming this constitutes false environmental advertising since most of this used oil is used as a fuel and therefore this is not true recycling.

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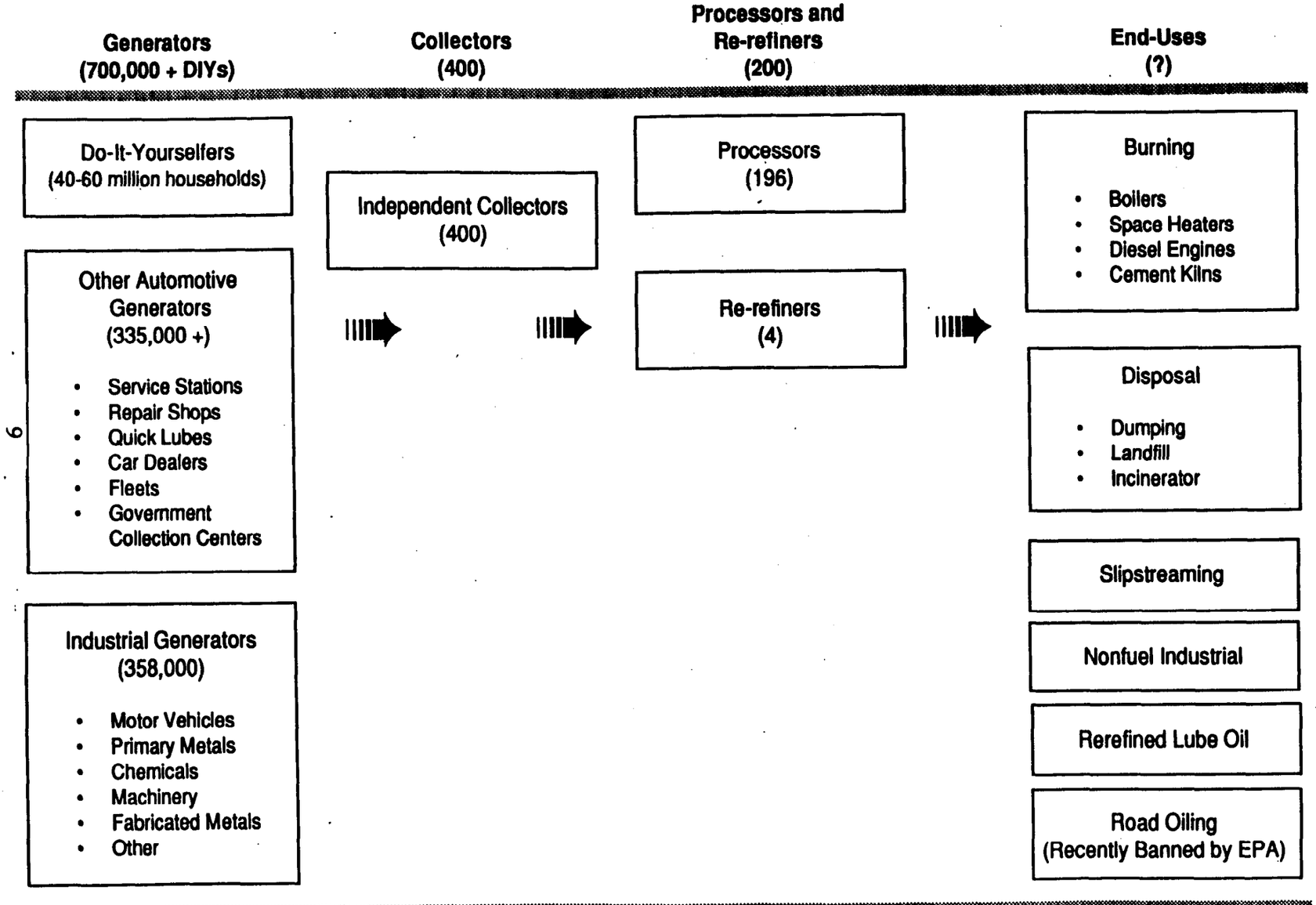
**[2] Standard Scenarios for Estimating Exposures to Chemical Substances During Use of Consumer Products, Volume II, Versar, Inc., prepared for USEPA Office of Toxic Substances, 9/86, p. A-9.**

# USED OIL MANAGEMENT SYSTEM OVERVIEW




Source: Mercer Management, Kevin Dietly, 9/92

## 2.0 THE U.S. USED OIL UNIVERSE AND INDUSTRY

*The oil* business, *you know, is liable to sudden and violent fluctuations.*
*- John D. Rockefeller*

The used oil recycling industry includes generators and users of spent automotive lubricants, industrial oils, hydraulic oils, metalworking oils and industrial process oils, and other miscellaneous oils. The used oil recycling industry has no formal structures, per se. The used oil fuel market is closely tied to the virgin petroleum fuel market. Re-refiners (firms that make used oil into lubricants) are also tied to the virgin lubricant market. The present used oil industry ranges from small automotive garage operators who will provide auto maintenance services, to one of the nation's largest refineries which processes crude oil.

Many used oil recyclers are forced to sell used oil fuel 15 to 20 percent below virgin fuel oil prices. The used oil recycling market is to a great extent determined by virgin fuel oil price. Currently, if the price of virgin fuel oil goes above 53 cents per gallon for fuel oil, the generators get paid for their used oil. If this price stays at 53 cents per gallon, the used oil is picked up for free. lf the price of fuel oil drops below 53 cents per gallon for fuel oil, then the generator is charged for pick-up. It costs about 5 cents per gallon to collect used oil and approximately 20 cents per gallon to m-process it (see Table C).

The used oil industry is unique and very complex. It includes a wide range of professions, recycling methods and operations. Some used oil is used directly from collection trucks to be blended at large fuel companies, provided the oil contains little water.

The recycled used oil market operates on both a regional and local level. It is also a local matter catering to the specific needs of the individual used oil generators. The northeast region of the U.S. is still marketing heating oil, whereas the rest of the nation is using natural gas.

About half of the oil sold is returned to the recycling system as lubricants. Some of the oil is lost during equipment/engine operation, and some is lost due to mismanagement by DlYs and used oil industry participants.

### 2.1 The Used Oil Generator

There are approximately 700,000 facilities in the U.S. that qualify as used oil generators. Used oil generators encompass a wide range of industrial sectors.

# EFFECT OF VIRGIN FUEL OIL PRICE FLUCTUATIONS ON PRICE OF USED OIL FUEL

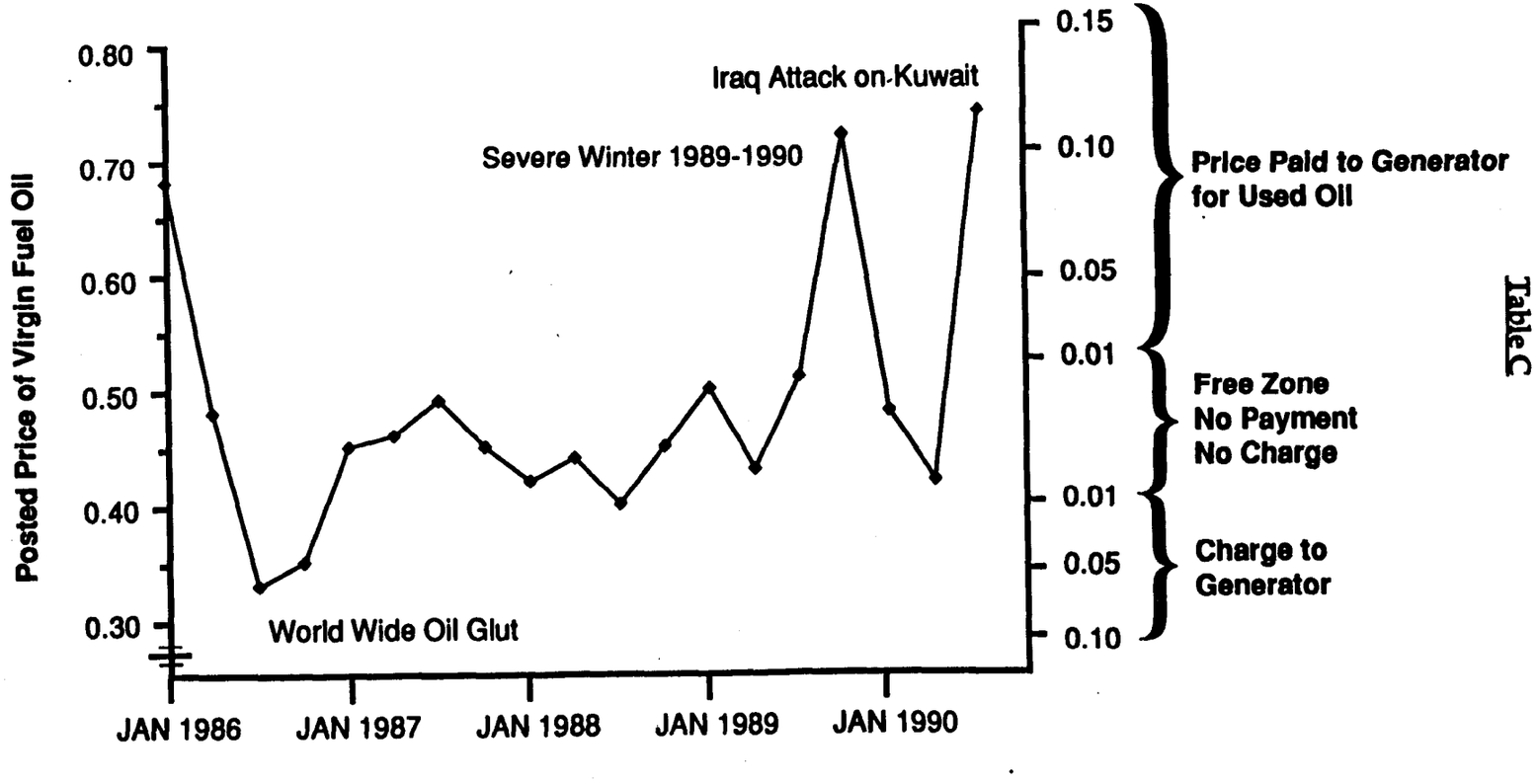



Table C

Source: Eastern Oil Company

A large portion of these generators are small businesses, although there are several distinct types of used oil generators, such as the DIY oil changers, commercial oil changers (auto repair shops, quick lubes, auto dealerships), industrial generators and governments (federal, state and local). There are businesses or sectors which produce used oil through commercial and industrial operations, or collect used oil from various types of activities such as: service stations, repair shops, new and used auto dealers, fleets, non-service retailers, air/marine/railroad operations, and public collection centers.

The EPA requires generators to: store used oil in aboveground tanks and containers that are in good condition; label storage tanks; clean up any used oil spills or leaks into the environment; and use a transporter with an EPA ID number when the used oil is transported off site for recycling.

Service station dealers (30,000) who accept DIY used oil and who do not mix used oil and other hazardous waste, and who comply with the new EPA management standards in the U.S., are not liable for the third-party response costs or damages resulting from subsequent management of oil (CERCLA §114 (c) exemption). This is a significant development in attracting more service stations to collect used oil from the DIY sector.

### 2.2 DIY Used Oil Collection Centers

The EPA defines used oil collection centers in §279.1 in the new management standards. DIY Used Oil Collection Centers are defined as:

> *Any site or facility registered/licensed/permitted/recognized by a state/county/municipal government to collect used oil from the regulated generators prior to pickup of used oil transporter with an EPA identification number for off site recycling.*

A used oil collection center accepting only DIY oil must comply with the generator standards of Part 279, C.

For additional information or to order a copy of the *Federal Register* notice, contact the RCRA Hotline, Monday through Friday, 8:30 a.m. to 7:30 p.m. EST. The national, toll-free number is (800) 424-9346; TDD (800) 553-7672 (hearing impaired). In Washington, DC, the number is (703) 920-9810; TDD (703) 486-3323. Copies of documents applicable to used oil may be obtained by writing: RCRA Information Center (RX), U.S. Environmental Protection Agency, Office of Solid Waste (OS-305),401 M Street, SW, Washington, DC, 20460.

## 2.3 Used Oil Collectors/Transporters

There are currently 400 transporters and collectors that have an EPA identification number. This sector of the industry must: maintain storage tanks and containers in good condition, appropriately label the oil as “used”; store used oil in areas with oil-impervious flooring and secondary structures (such **as** berms or retaining ditches); clean up any used oil spills or leaks which are released to the environment; and track quantities of both incoming and outgoing used oil. Any transportation processing (treating) used oil to produce specification fuel is considered used oil processing/re-refining and must comply with those requirements. A critical factor in the evaluation of a collector is whether or not they test the used oil for contaminants (e.g., halogens), and manage used oil containing hazardous waste (e.g., chlorinated solvents) as a hazardous waste.

Over the last decade, used oil collectors have become more environmentally sophisticated. Today, many collectors separate various types of used oil since this reduces processing costs and the separated oil is more economically attractive to the market. A large portion of the industry also collects spent dry cleaning chemicals, anti-freeze, parts-cleaning solvents, degreasing fluids, and used oil filters. Since stringent tank requirements have taken effect, many transporters have to make more runs for collecting used oil and other hazardous waste at separate times or invest in tanks or trucks that are partitioned (i.e., one to hold used oil and the other to hold hazardous waste).

The used oil industry is comprised of a number of collectors who may not process at all but merely sell to various elements of the fuel markets, and they must comply with the used oil standards for marketers of used oil fuel.

According to several industry sources, the small collectors, sometimes referred to as “mom and pop” operations, collect roughly 30 percent of the total U.S. volume of used oil. It has been speculated that a portion of these small transporters are causing‘ some environmental problems. Some collectors/processors pick up untested and untreated used oil and sell it unprocessed.

## 2.4 Waste Minimization

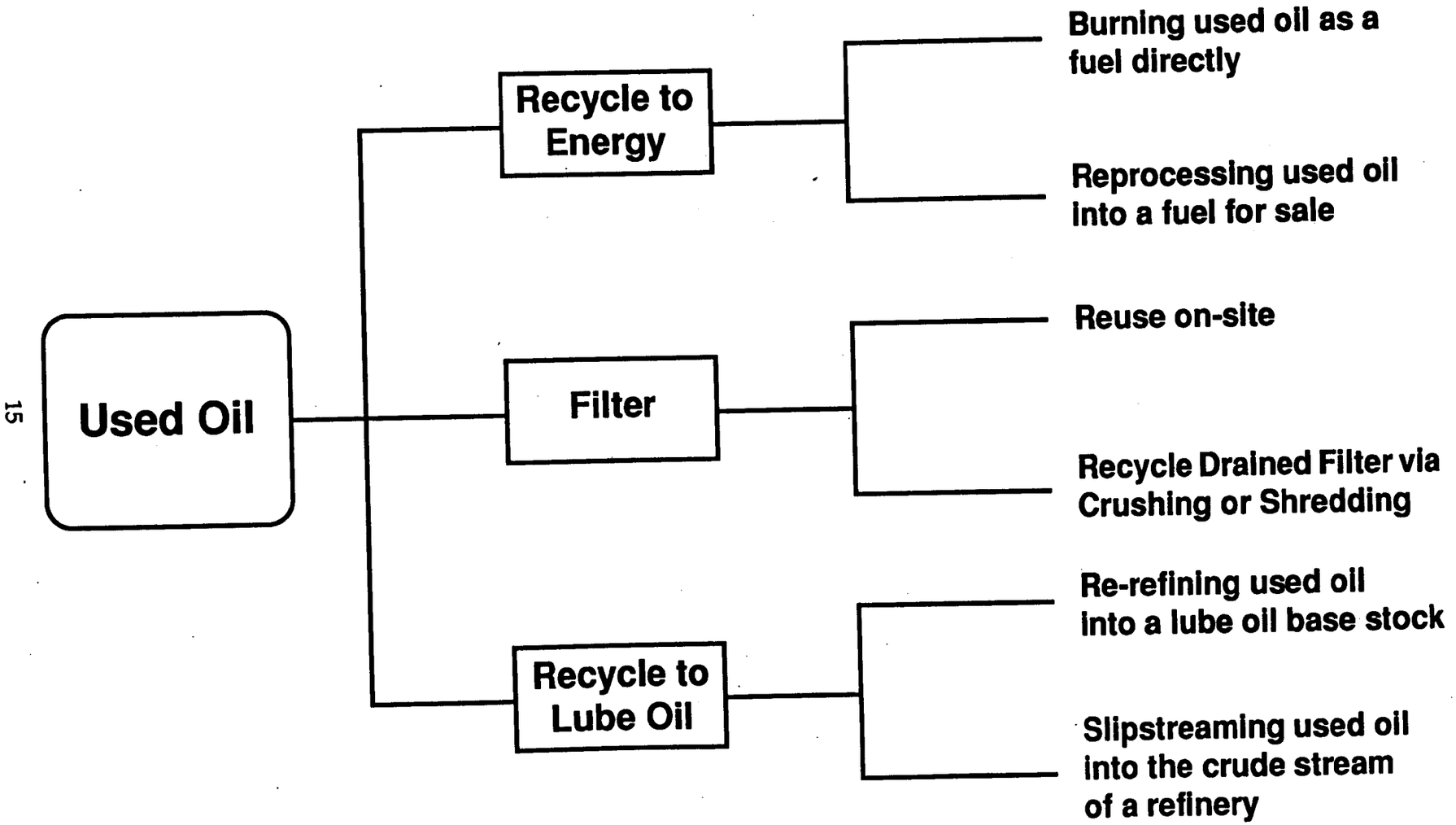
Another area of change is caused by the new waste minimization rules cited by various industry experts, which creates either an incentive to burn used oil or reuse the lubricants on site. Firms of all sizes have the incentive to decrease the volume of the waste leaving their facility by recycling them on site in units approved by EPA for burning of used oil and hazardous waste for energy recovery.

There are numerous waste reduction methods that either reuse existing oils or employ synthetic oils which extend the oil's life and use. These techniques both result in extending the use of existing oils and lessening the intervals at which new oils must be added.

### 2.5 Road Oiling

Used oil used for road oiling has had **a** history of major environmental problems (e.g., Times Beach). Although not commonly practiced, 24 million gallons of used oil are still placed on roads every year to suppress dust in the United States. There was overwhelming support from the most recent round of used oil comments for **a** ban on the use of used oil for road application and dust suppression. In September 1992, the EPA decided to prohibit the use of used oil as a dust suppressant under part §279.82 However, certain states can petition EPA to exempt their state from the national ban.

# SUMMARY OPTION DIAGRAM




Note: Reprocessing is defined as treating so as to remove solids and water (e.g., heating, gravity settling, filtration/centrifugation)

# 3.0 USED OIL RECYCLING TECHNOLOGIES

There are various used oil recycling technologies in existence. The following is an overview of used oil recycling technologies essential in the end marketing of this energy resource and recyclable waste.

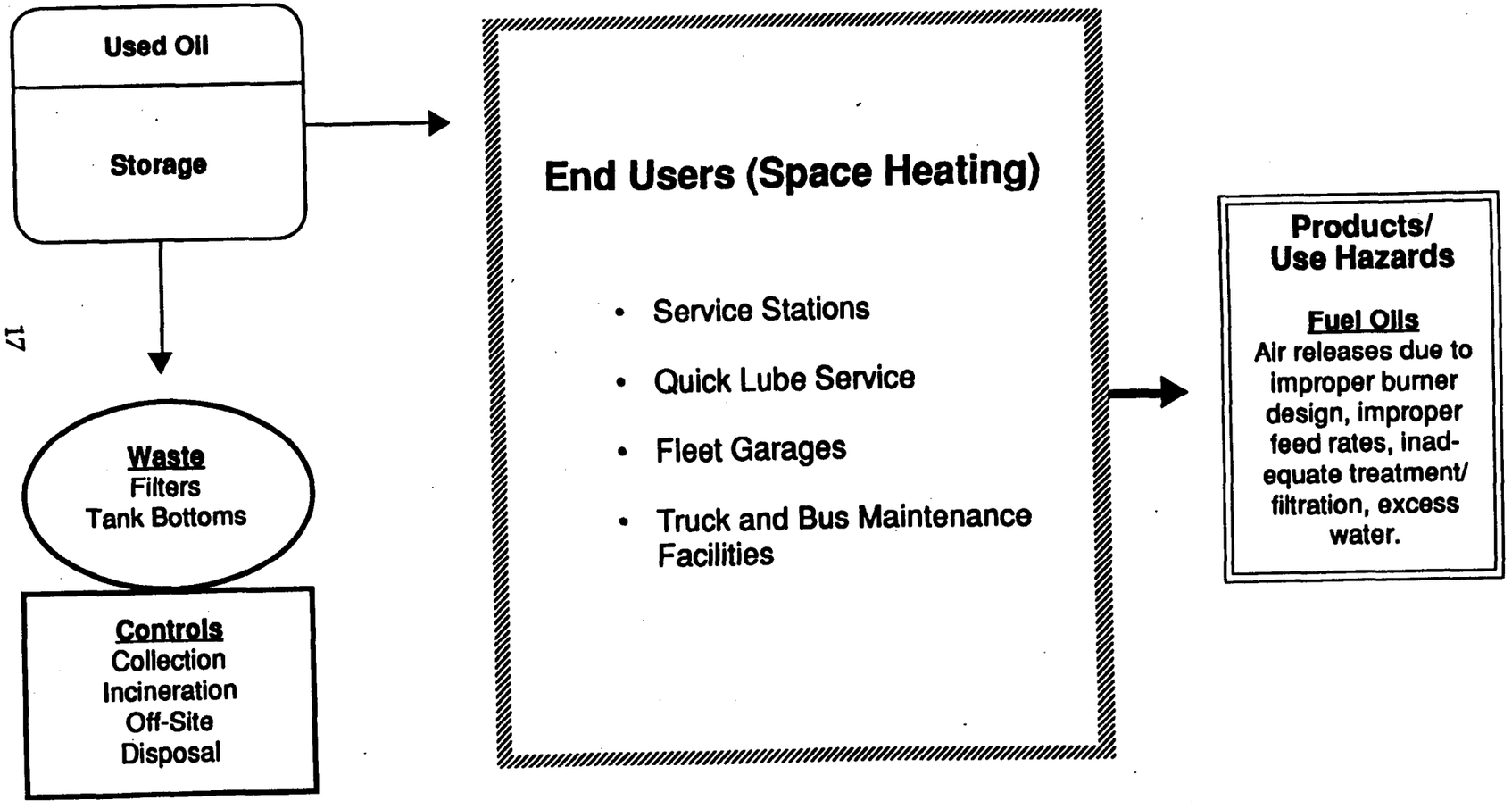
## 3.1 Direct Burning

Used oil utilized directly as a fuel is commonly put to use in oil-fired space heaters. The direct burning of used oil in the United States occurs both on site in space heaters and off site in industrial and non-industrial boilers and furnaces. On site burning of used oil is acceptable provided that the used oil burned is generated at the site or accepted from DIY. No other hazardous waste may be burned in these space heaters. Specially designed burners (e.g., vented units or units with air pollution controls) are required to bum used oil properly. Large industrial or commercial operations may choose to bum the used oil they generate on site, depending upon the composition and quantity of the used oil they generate in their own boilers or furnaces. The burning of off-spec in non-industrial boilers is prohibited by the EPA.

Direct burning is a significant used oil market. There are 70,000 small used oil heaters burning upwards of 120 million gallons of used oil a year; The extent of additional on site burning of used oil from a total of 700,000 generators is difficult to ascertain since every mode of transportation generates used oil. Today, nearly all small used oil heaters are atomization units while a decade ago three-quarters of these heaters were vaporization units. Industry sources cite that waste minimization/pollution prevention measures have created increased incentives to reduce waste leaving a facility. Small used oil heaters are generally used by fleet service centers, service stations, automobile dealerships, truck and bus service centers, auto body shops/garages, and small metalworking shops.

Clean Burn, Inc., a used oil heater manufacturer, sells space heaters to forty to fifty percent of the market, according to industry sources. Each small used oil heater can burn an average of 1,750 gallons of used oil a year. These units sell for approximately $4,500 each, including installation charges, and last about seven years. A 250 gallon storage tank is used to store used oil fed into the heater; cost per tank is $750. Small used oil heaters replace Number 2 fuel oil, natural gas and electrical heating sources. Maintenance is required on these heaters at every 1,000 gallons of used oil burned. This bi-annual service requirement costs the owner about $200 to clean out the ash and heat exchangers. Estimates that these pay for themselves in 2.5 years were based on the cost of picking used oil up in states where used oil is listed as a hazardous waste ($1.0-$1.25 per gallon).

# DIRECT BURNING/ENERGY RECOVERY




Source: Clean Burn, Inc.

In 1983, Franklin Association Appendices indicated that used oil heaters burned primarily automotive oils since they are usually located at automotive generator sites. It was estimated that about 30,000 heaters were in the U.S. with a typical rating of 250,000 BTUs/hr. Based on this rating a typical unit would burn 1,140 gallons per year or 34.2 million gallons in 1983. Nine companies manufacture space heaters, all less then 500,000 BTUs/hr. Vaporization heaters are by far the most common type. The average life of these heaters was 10 years. Sales of these companies ranged from $3,500 - $18 million dollars. Service stations and some automotive repair garages also purchased these units.

Systems for firms that generate 2,000 - 10,000 gallons of used oil a year have a nominal output of 450,000 BTUs/hr. Two units can heat 8,000 - 10,000 ft. sq. The initial premium for the used oil heater over a virgin fuel heater is comfortably recovered within two years from fuel savings.

The outlet for smaller used oil burning units is more heavily concentrated in regions of the U.S. where it is colder, there are higher prices for alternative fuels, and the cost for used oil collection is more expensive. Direct burning is attractive when fuel prices and disposal prices increase.

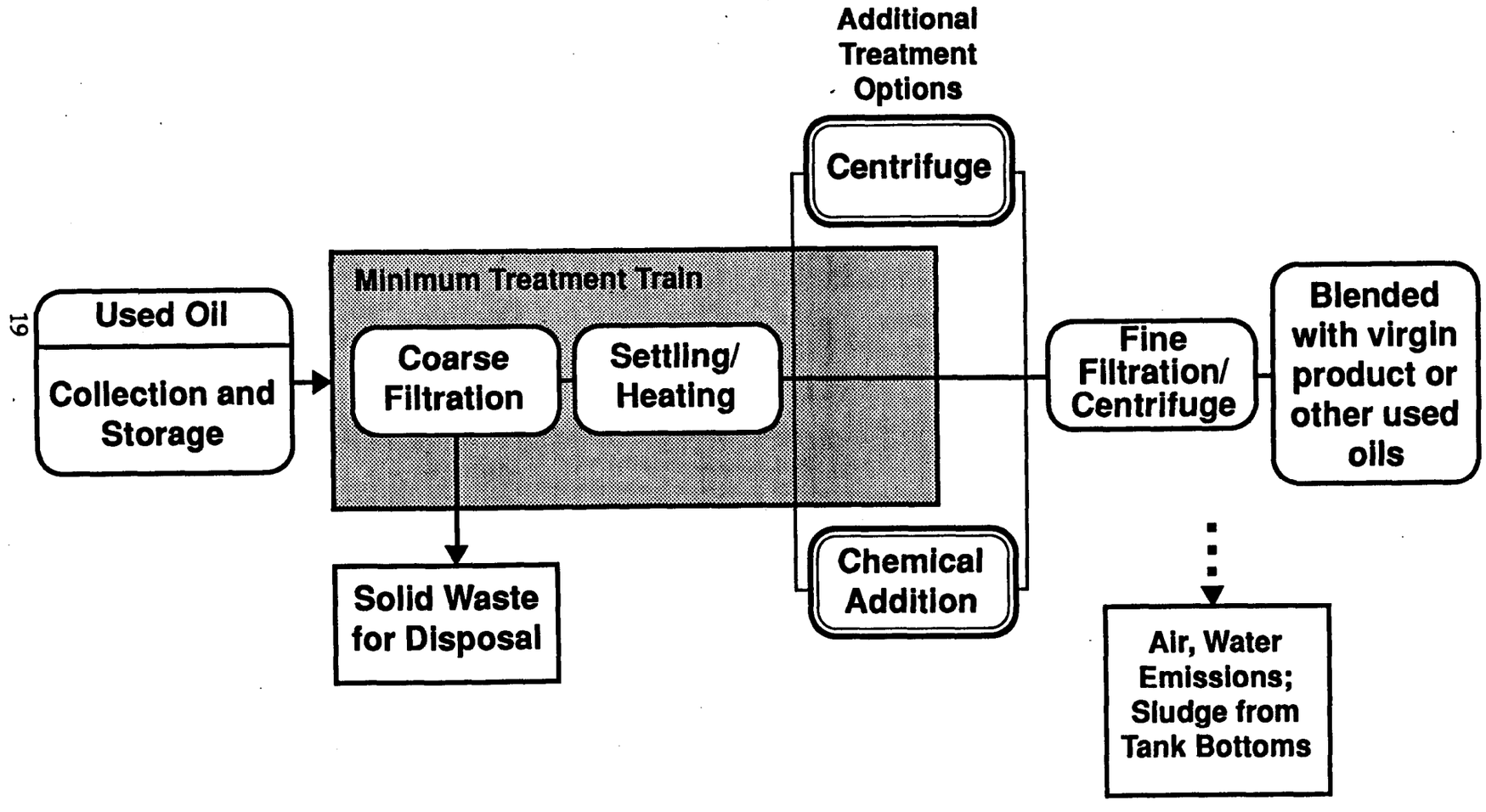
It is important to note that these heaters should only burn separated used oil that was generated on site or DIY accepted used oil. Burning solvents and other contaminants can cause burner problems, not to mention the resulting contamination resulting to the air basin and ash residual. Also, these units require cleaning of the combustion chamber and heat exchangers every 1,000 gallons burned.

### 3.2 Reprocessors

Used oil destined for fuel is usually reprocessed in the United States. Various treatment steps are involved in reprocessing including settling, filtration and dehydration. Many reprocessors may do more than this physical treatment either by using chemical treatment or centrifuge to remove sediments/solids, water, and improve the used oil's flash point. Reprocessors may even blend the used oil with virgin oil to market various fuel oils. The technology employed to reprocess ranges from simple filtering and settling to sophisticated forms of distillation. Most reprocessors operate additional environmental operations besides used oil recycling, since this is a marginal enterprise.

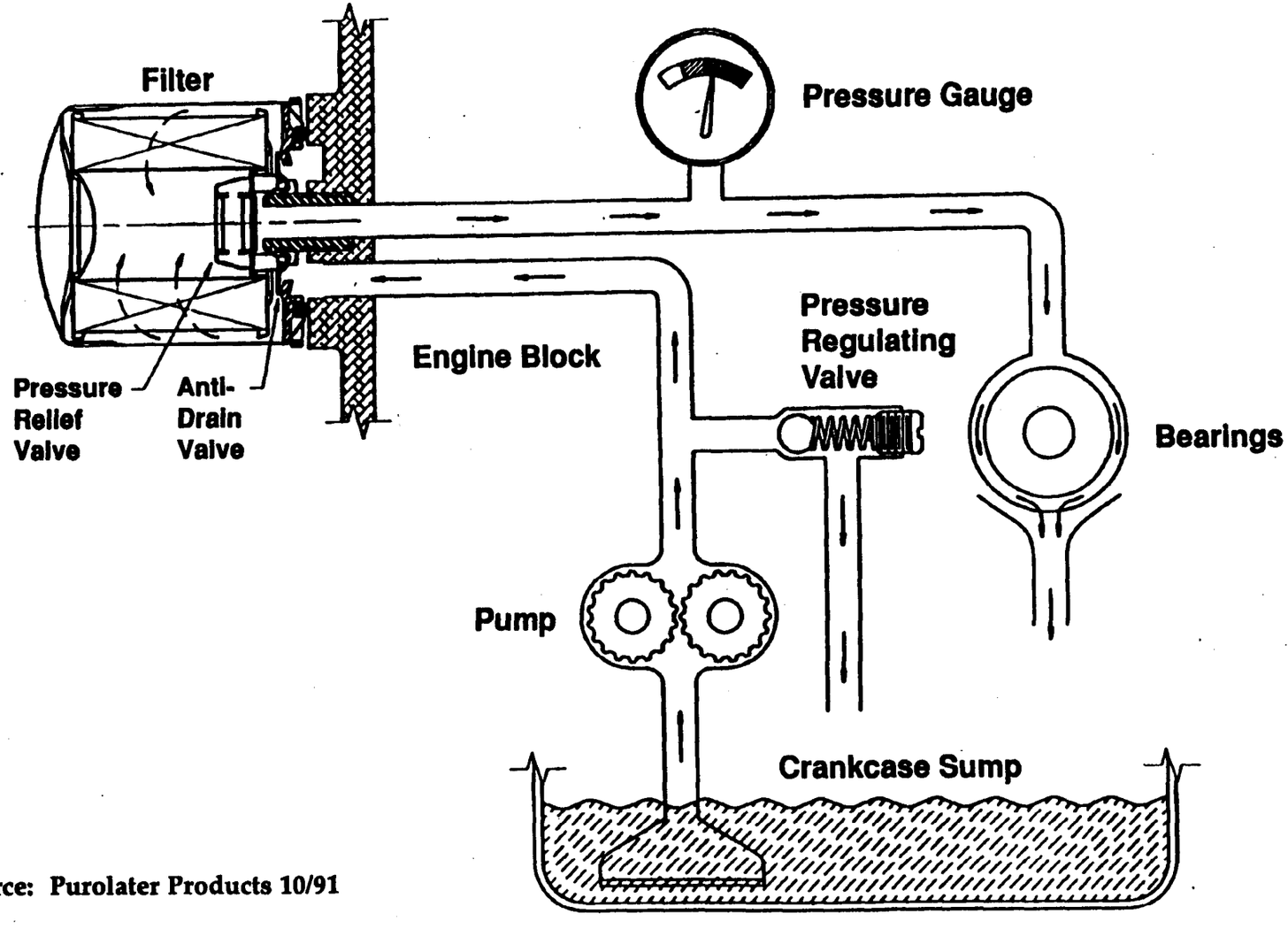
Most of the reprocessing business is based on dehydration. There was a time when the industry mixed all sorts of other material into the used oil, but today most of the reprocessors prefer to accept "clean used oil" if they are not RCRA permitted hazardous waste management facilities.

# FUEL OIL REPROCESSING




Source: Eastern Oil

# TYPICAL AUTOMOTIVE LUBRICATION SYSTEM




Source: Purolater Products 10/91

There are roughly 200 reprocessors in the United States. There are many diverse types of reprocessing facilities and no one common recycling method. Everything is catered to the local generator's needs. What is available and what is the finished product needs to be determined up front. The majority of these used oil recyclers are National Oil Recyclers Association (NOW) members. NORA represents most major used oil fuel processors, about 75 of the 200 processors in the U.S. NORA represents the major capacity of the used oil recycling industry. Information concerning the remaining 50 or so processors is sketchy.

A 1991 survey of NORA was conducted to determine its members' end markets and customer base (see Table B on page 5). In general the fuel oil market has not changed in the last ten years. In Florida a significant amount of used oil is used in the phosphate industry. There has been an increase in on-site burning of used oil in various factories, utilities and plants, which take the fleet oil they generate and use it to lessen their operating costs.

Greenhouse operators are another generator that utilizes used oil as a secondary fuel source. Paper Mills and steel mills also burn used oil. Cement kilns are a minor recycled fuel end market because the companies that operate them get more money to burn hazardous waste and other costly liquids. Used oil, burned as a bunker fuel, represents less than 15% of the overall used oil fuel market, and is only significant in geographical areas where there are large shipping ports (i.e., CA, LA, WA, NJ, etc.).

Used oil prices fluctuate with the quality and quantity of the used oil. Price does depend on the finished product. Reprocessors strive toward a quality finished fuel product with only l/2% of water. Generators are usually charged when their used oil contains a lot of water or sludge.

## 3.3 Used Oil Filters

This area of market analysis deals with two distinctly different sub-areas; one is oil life extension by filtration technology (i.e., mobile oil refiners) while the second section addresses used oil filter recycling.

There are many types of oil filters depending upon the used oil generated. In the industrial sector there are fine and large barrier filters. Oil contamination not only shortens the life of the machines using these lubricants but can cause high maintenance costs. There are numerous forms of oil filters that extend oil life by screening material such as sand, metal chips, metal oxides, water, grinding compounds, acids, oxides and other undesirable solids and liquids, and gases separated from the oil. Oil filters have numerous environmental benefits primarily in the area of air pollution by lessening the wear of engines resulting from less frequent oil filter changes.

*The best fibrous matter filter now commercially available will block passage of solid particles down to 3 µm (Godfrey, 1989). For a description of them, refer to Needleman (1980) and Fitch and Tessman (1975). As a comparison, Consumer Reports (1987) has shown that some common, inexpensive automotive filters may remove only 60% of the particles down to 20 µm. Depth filters, consisting of clay beds or rolls of paper, are effective in removing particles in the 1 µm range, but they are very limited in flow capacity so that very large or many filters in parallel are required.* [3]

### *3.3.1 Mobile Oil Refiner Filtration Technology*

Mobile oil refiners have been around for over thirty years. One industry source stated that this technology had been perfected in the early 1980s. These mobile oil refiners eliminate regular oil changes and claim to reduce maintenance costs and capital expenses by extending the life of an engine.

The mobile oil refiner removes liquid and solid contaminants. A normal oil filter becomes clogged with contaminants, allowing in some instances unfiltered oil to circulate through the engine. A by-pass filter can make up for this since it is more sophisticated and thorough in cleaning the oil, although by-pass filters do not remove all the liquid contaminants such as water, fuel, anti-freeze, and acids. Mobile oil refiners differ from by-pass filters in using pressure to filter smaller particles and heat to remove fuel.

*"Under engine pressure oil enters the refiner where the compaction of the filtering medium filters out the smaller particles and some liquids. It then enters the transfer chamber and moves in a thin film into the evaporation chamber where the pressure brings the liquids which. are vented out through their own pressure. Furthermore, because the oil remains free* ***of*** *contaminant and can be used indefinitely, it undergoes a further refining process resulting in a "super slick" oil with increased film strength.*[4]

TF Purifiner is the largest company selling mobile oil refiners. TF Purifiner claims its mobile oil refiner cleans oil continuously and is the only evaporation and oil filtration system that attaches to any internal combustion engine or hydraulic system where oil passes through the long stand cotton filter at a low flow rate. This removes contaminant particles down to one micron in size and absorbs acids and sulfur. TF Purifiner states that this refiner takes 1-2 hours to install and cleans the oil at a rate of 3-24 gallons per hour (depending on the size of the mobile oil refiner). Most major

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[3] **Hegberg, Hallenbeck & Brenniman, "Used Oil in Illinois," July 1991, p. 67-68.**
[4] **Ferrell, Gary, Purolater Products, by facsimile, September 1992.**

manufacturers, such as General Motors, Ford, Mack Trucks and Caterpillar, say that the installation and use of a non-factory accessories such as the TF Purifiner does not void the manufacturer's warranty.

Pricing of these filter units and replacement filters are based on the quart capacity of the engine, and ranges from several hundred dollars per unit to over a thousand dollars (240 quart units) with a ten year warranty. It is important to evaluate whether these filters are cost-effective compared to regular oil changes and if the oil does not degrade after numerous miles of vehicle use.

### *3.3.2 Oil Filter Recycling*

Every year unknown numbers of used oil filters are lost in the environment. Over 400 million oil filters are used every year in the U.S., in cars, trucks, buses and numerous other vehicles and industrial sources. Used oil filters and their contents impact landfills and water sources when they are improperly disposed of.

A study at the University of Northern Iowa estimated that over 6.2 million oil filters were discarded annually in that state. This translates into 660,000 gallons of used oil improperly entering the environment each year in Iowa alone.[5] It is estimated that in Illinois, 17.5 million filters are generated each year accounting for 878,000 gallons of used oil, or an additional 2% of the used oil generated in Illinois.[6] Depending on the size of a used oil filter it can contain on average of one-half quart (according to Purolator Products) to 10-12 ounces of oil (EPA estimates).

According to Purolator Products, in a drained filter only about 30% of the oil drains from the oil filter if the anti-drainback valve functions as designed (and if the filter has one). The drained filters will still contain over a third of a quart of used oil.[7]

The Environmental Protection Agency's "Toxicity Characteristic" rule issued in March 1990 makes it necessary for all generators, if their filters are to be disposed of, to test them to assure that they are non hazardous unless they are "completely" recycled. There is no statutory definition of a "recycled" used oil filter. It is assumed that the definition filters are crushed or shredded and taken to a scrap metal recycler, while the used oil is taken to an oil recycler.

[5] **Iowa Dept. of Natural Resources, "Summary of Oil Filter Recycling Demonstration Project."**
[6] **Hegberg, Hallenbeck & Brenniman, "Used Oil in Illinois," July 1991, p. 67-68.**
[7] **Ferrill, Gary, Purolater Products, by facsimile, September 1992.**

EPA has exempted all used oil filters from the TCLP requirement as long as they do not contain terne plate steel. Almost all light duty filter manufacturers, and the Filter Manufacturers Council member companies, have committed to eliminating terne-plate steel from their product line by the end of 1992.[8]

There are three primary methods of proper used oil filter disposal/recycling:

1. Draining the filter: a) remove it hot from the vehicle/engine; b) place it in a drain pan gasket side down; c) puncture the "dome end" of the filter with a punch or a sharp tool such as a screwdriver to defeat the anti-drawback valve function, and d) allow it to drain for 12-24 hours because merely draining the filter with an anti-drainback valve will not remove more than about 30% of the used oil in the filter housing, unless the anti-drainback valve is not presented or defeated; [9]

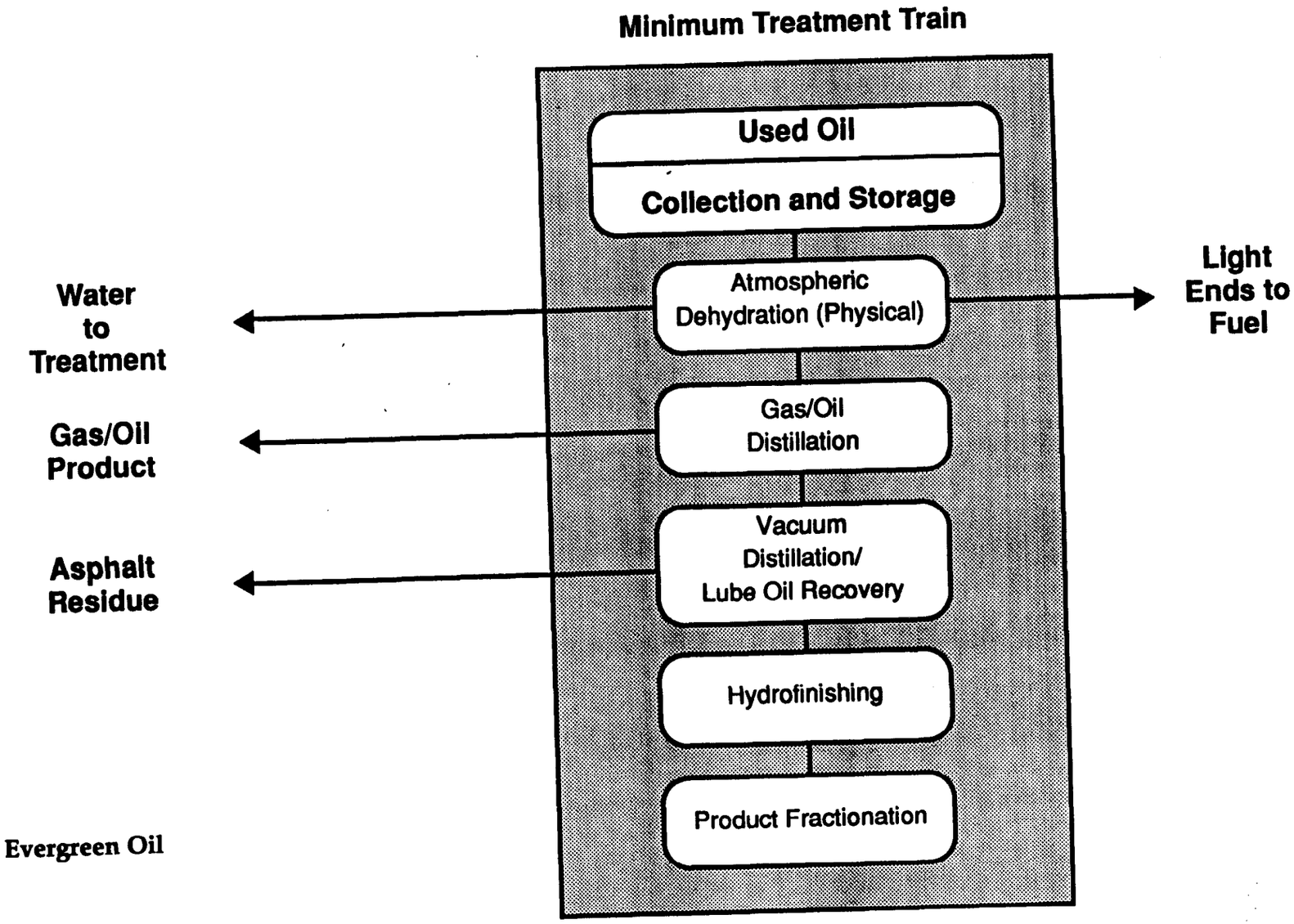
2. Draining the filter and crushing (mechanical compaction) the filter through numerous types of filter crushers and either recycling or disposing the filter biscuit or metal portion, and

3. Drain, disassemble (e.g., shred the filter) and send it to a scrap metal recycler.

Several states have taken active positions on used oil filter disposal. Rhode Island accepts used oil filters at several of its drop-off centers (called igloos), and used oil and used oil filters that are not destined for recycling are regulated as hazardous waste. In addition, Rhode Island mandates that used oil filters may not be disposed of by discarding them into the trash. The State of Texas has a law banning used oil filters from landfills as of 1994 (under Senate Bill 1340).

[8] Ibid.
[9] Ibid.

# RE-REFINING FOR USE AS LUBRICANT BASE STOCK




Source: Evergreen Oil

### 3.4 Re-refining Making Used Oil Into a Lubricant Again

Re-refining, once one of the most significant areas of used oil recycling, is making a comeback. In the last 30 years this technology has had significant set backs with acid clay processing. Both improved quality controls and technological advancements in vacuum distillation/hydra-treating has allowed this industry to compete with virgin lubricating oil market. Re-refiners transform used oil back into a lubricating basestock, exact in quality to virgin lubricant basestock. The present re-refining technology is based on vacuum distillation followed by hydro-treatment. These modern advancements provide the same high quality control, protection and performance as virgin (non-recycled) basestocks.

There are only four x-refiners in the U.S. that are recycling used oil into high performance automotive basestock. It is difficult to determine how much used oil is m-refined. Some estimate that 50-100 million gallons of used oil goes into the x-refining industry, although it is unknown how much is made into a lubricant rather than a fuel because of low oil prices.

For every gallon of used oil that is x-refined, 65 percent is made into two types of lube oils, 10-15 percent is light ends or fuels, 10 percent is waste water and 10 percent is bottoms or asphalt flux. The lube oil produced is sold to lube oil blenders and compounders who provide additives and then package the product for industrial and retail marketing. Some of the fuel is burned to help run the facility while some of it may be sold to fuel companies. The asphalt flux may be sold to roofing manufacturers or steel mills as a fuel. Finally, the water is treated and discharged.

Re-refiners are more individualistic than reprocessors. Roughly 100 million gallons are produced by the m-refiners while 700 million gallons of used oil is burned in the fuel market. Evergreen Oil produces 15 million gallons a year of x-refined, or lubricating oil ($1 dollar per gallon of annual capacity). Safety Kleen just built a 70 million gallon-a-year re-refinery (at a cost of $70 million dollars to convert an old Chicago oil plant).

The remaining two re-refiners are DeMenno/Kerdoon and Ecoguard. It is unknown however the amount of lubricants that they presently re-refine into hydraulic fluids and engine lubricating oils.

First Recovery is a part of Ecoguard, both of which are subsidiaries of Valvoline, Inc. First Recovery maintains a state-of-the-art used oil recycling program with a network of 1000 used oil collection customers and retailers in 22 states collecting over 15 million gallons in 1991. Valvoline is aiming to collect almost 100 million gallons of used oil over the next four years.

Safety Kleen uses all petroleum-based oils for their East Chicago Re-refinery. They also have another re-refinery in Canada called Breslube. Collection comes from all over the United States.

Safety Kleen, which collects 70 million gallons of used oil a year in the United States, does extensive testing to make sure there are no PCBs, chlorinated solvents and/or other contaminants in the used oil. The used oil must have a flash point over 100 degrees F to be accepted.

Transportation costs, regulatory compliance, paperwork, testing costs and end product profitability are the critical elements determining whether Safety Kleen will pay or charge its customers. Purchasing agents expect a discount for re-refined oil.

Certain members of the re-refining industry have lobbied to have used oil listed as a hazardous waste. By limiting the amount of used oil burned, the industry would be better able to compete in the marketplace. Another important factor in the growth of this industry is government procurement of re-refined lubricating oil.

The attitudes of motor vehicle manufacturers regarding the viability of re-refined oil is the most critical factor affecting its marketability and re-refining operations. API, ASTM, SAE and the Motor Vehicles Manufacturers Association are close to finalizing a certification and measurement program evaluating m-refined lube stocks.

### *3.4.2 Re-Refined Consumer Products and Brand Names*

Past problems with m-refined lubricants created the myth that re-refined oils are inferior to virgin oils. Presently; re-refined oils must meet the same stringent standards set by the American Petroleum Institute that virgin oil products do.

In the past some re-refined oils have exhibited inferior performance characteristics compared to virgin oils. Presently if the re-refined oils has the American Petroleum Institute's SC/CD quality rating (API "donut" symbol) it establishes that the oil is of the same quality as virgin oil and meets or exceeds all vehicle warranty requirements for automobile manufacturers.

Various independent lubricant companies take advantage of re-refined basestocks and hydraulic fluids. Some are sold to repackagers/distributors where they are combined with an additive package and sold as a high-performance premium quality lubricant. There are numerous rumors that several major oil companies also use re-refined basestocks.

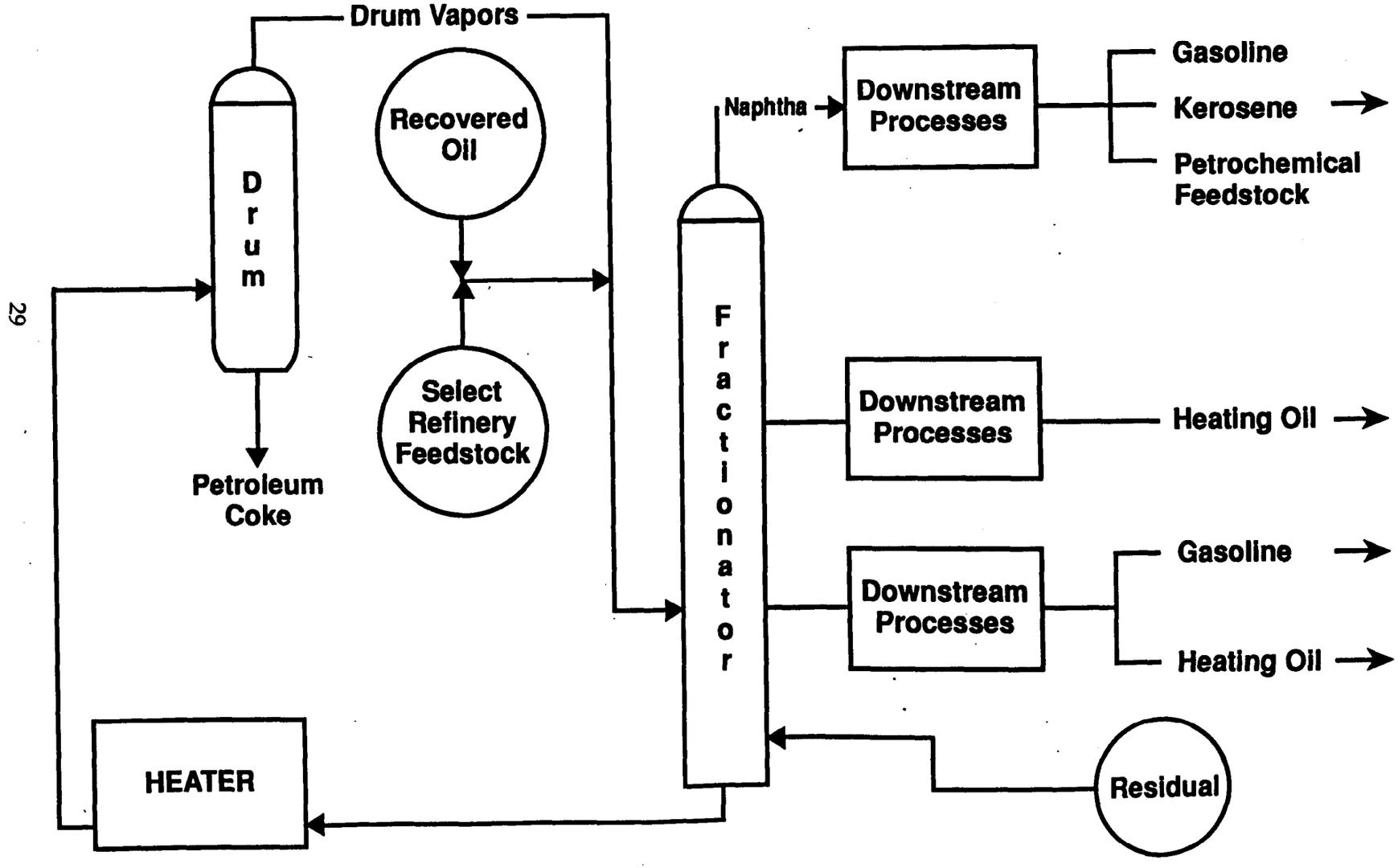
There are various brand names of re-refined lubricants sold in the U.S. For example, “America’s Choice” is sold in Wal-Marts all over the U.S. and is a Safety Kleen product. Ecoguard, a subsidiary of Valvoline, is re-refining hydraulic fluids and is exploring the market for their engine lubricating oils, in addition to examining the future availability of producing 10W-30, 10W-40 and SAE 30 in bottles and packages using recycled materials.

Lyondell Petrochemical Company has introduced Enviroil re-refined motor oil, the first premium recycled motor oil to be marketed in the United States under the brand name of a major petroleum refining company. Enviroil is a premium 10W-30 motor oil produced with high quality re-refined basestocks and additives providing a performance equal to virgin oil-based lubricants. Lyondell purchases its re-refined basestocks from Safety Kleen and Evergreen. Enviroil is formulated by Lyondell, a Houston-based refined products and petrochemical manufacturer and a top supplier of a wide variety of engine oils and lubricants. Lyondell certifies that Enviroil fully meets or exceeds the warranty requirements of automobile and light truck engines. Enviroil lOW-30 meets the performance standards of the Society of Automotive Engineers (SAE), the American Society for Testing and Materials (ASTM) and American Petroleum Institute (API), and is rated SG/CD, Energy Conserving II, the highest level awarded for gasoline engines.

Lyondell is the licensee of the ARCO lubricants trademark. Additionally, Lyondell has introduced a heavy-duty fleet service premium re-refined motor oil, Enviroil-T- 15W-40 (API 4/CD-II/SG). A line of premium anti-wear hydraulic oils are also available under the Enviroil trademark. Re-refined lubricants and virgin oil-based lubricants are produced using similar refining technologies. They differ in that virgin oil is processed from crude oil while m-refined oil is processed from carefully selected used oils. Laboratory and field studies of re-refined oil by the National Bureau of Standards concluded that high quality refined oils can perform as well as virgin oil-based lubricants.

Two years ago Morrison Oil Company introduced SOAR (Save Our American Resources), a full line of re-refined lubricants (15W-40, multigrade crankcase lubricant, 10W-30 multigrade viscosity motor oil, and a hydraulic oil anti-wear general purpose hydraulic oil). Recently Morrison Oil has switched its market strategy to the government and commercial buyers from the retail market. In August 1991, the city of Olympia, Washington used re-refined motor oil and re-refined hydraulic fuel in its vehicle fleets.

# SLIP STREAMING




Source: Lyondell Petrochemical Company

*3.4.2 EPA Guidelines for Purchasing Re-refined Lubricating Oils*

On June 30, 1988, the EPA issued procurement guidelines for x-refined oil. All federal agencies and all state and local government agencies and contractors that use federal funds to purchase such products are required to implement a preference program favoring the purchase of re-refined oil to the maximum extent practicable. The EPA guidelines recommend that engine lubricating oils, hydraulic fluids, and gear oils contain a minimum of 25 percent re-refined oil in the basestock.

The U.S. Post Office has used rerefined oil in over 14,000 vehicles with no reported problems. After numerous vehicle miles, chemical analysis of two samples of re-refined oil taken from Post Office vehicles showed that using re-refined oil was no different than using virgin lubricants.

As part of the pilot program, five of the 73 postal divisions bought re-refined motor oil: Buffalo, New York; Detroit and Grand Rapids, Michigan; Indianapolis, Indiana; and Minneapolis, Minnesota. A total of 14,511 vehicles were supplied in the pilot program. The contractor was Safety Kleen.

Using re-refined oil resulted in a substantial savings. Total oil purchases for fiscal year 1991 equaled $1.637 million, averaging 67 cents per quart. In contrast, the cost of re-refined oil for the five divisions was $28,000, with an average cost per quart of 62 cents-a savings of 5 cents per quart.

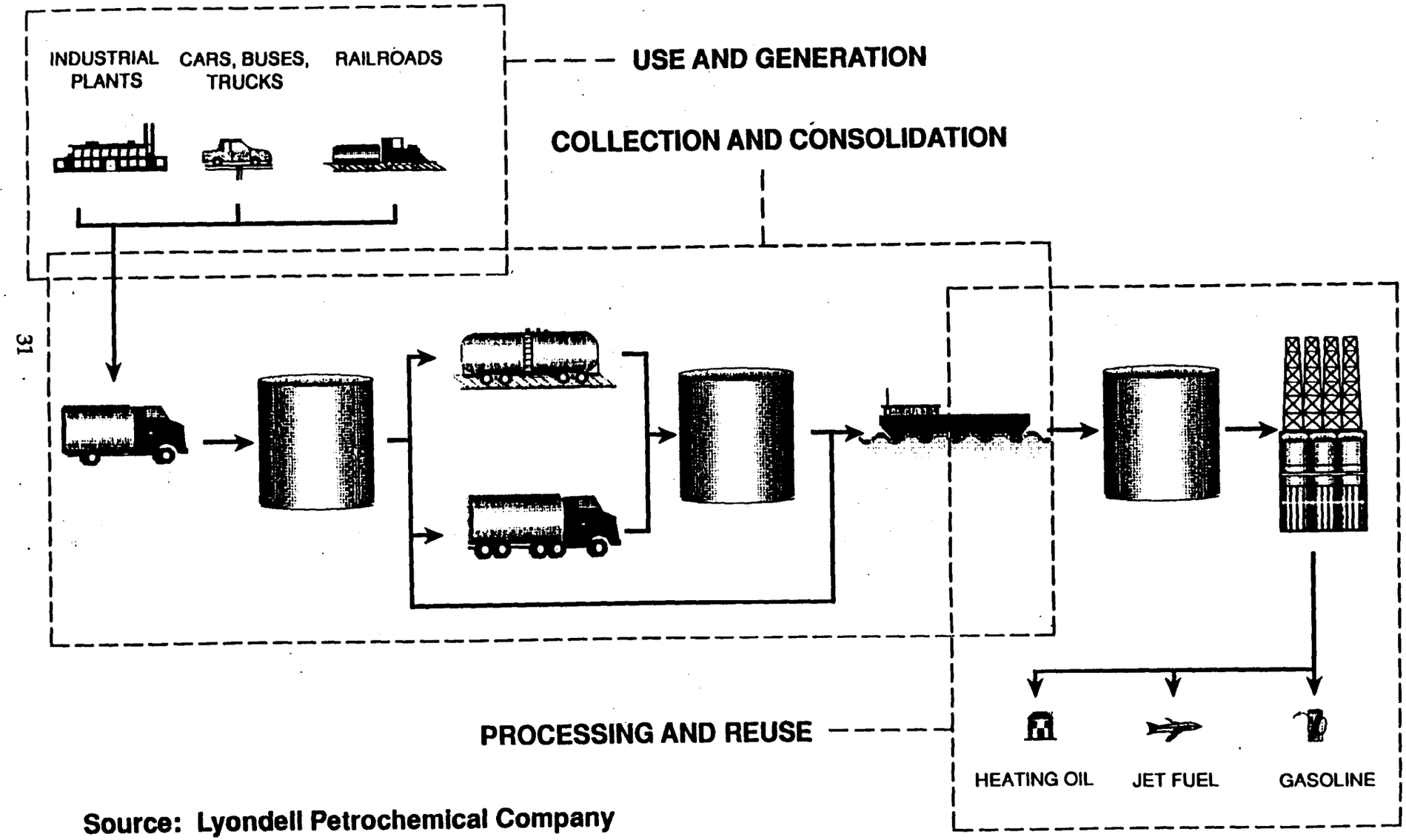
Various states (including Colorado, Connecticut, New York, New Jersey, Nebraska, Michigan, Illinois, Missouri, Kentucky and Vermont) are also purchasing m-refined oil. In 1991 Kentucky purchased 50,000 quarts of engine lubricating re-refined oil for $41,435; 4,000 gallons of hydraulic fluids for $10,748; and 1,000 pounds of general-purpose gear oils for $600. Vermont estimated that it has spent $22,148 to date on those three categories. [10] Some states, such as Illinois, have re-refined oil use provisions that instruct state motor vehicle operators to use re-refined oil whenever economically feasible (Public Act 87-0485). Florida has formulated an economic development program for the collection and recycling of oil and oil filters, antifreeze and automotive batteries, and procurement of re-refined motor oil through their Department of Management Services.

## 3.5 Slipstream Used Oil

Lyondell Refinery is the first major U.S. refinery to produce gasoline and other petroleum products from used oil on a commercial basis. Lyondell Lubricants, the ninth largest refinery in the United States, has begun

[10] **Meade, Kathleen, Recycling Times, September 1992, p. 6.**

# SELECT REFINERY FEEDSTOCK USED OIL MANAGEMENT SYSTEM




Source: Lyondell Petrochemical Company

slipstreaming used oil into its 265,000 barrels-a-day capacity refinery. Roughly 420,000 gallons of used oil a month are accepted into this Houston Refinery which is known as the Select Refinery Feedstock (SRF) program. The SRF process converts the used oil into gasoline, heating oil, and petrochemical feedstocks.

Lyondell slipstreams used lubricating oil in a very small amount (500 barrels of 6,300-8,400 gallons a day or 1% of used oil as feed) to a delayed coking unit. No special pretreatment is required. This coker thermally breaks down (cracks) the hydrocarbon molecules into gasoline, naphtha, heating oil, and petroleum coke (a solid hydrocarbon similar to coal). The coke is sold as a fuel. Small amounts of metal contaminants in the used oil are captured in the coke, although company tests have not found a significant increase in heavy metals caused by slipstreaming.

Lyondell has so far recycled 1.5 million gallons of used oil with the goal of slipstreaming 30 million gallons of used lubricants per year. As a result of used oil utilization as a feedstock, the plant's consumption of crude oil will proportionally decrease.

Lyondell is concentrating on purchasing used oil from large lubricant users such as railroads, commercial transportation fleets and large industrial plants. Lyondell is also working with some major used oil recyclers to collect other sources of used automotive oils.

Lyondell Petrochemical Company is an integrated manufacturer of refined petroleum and petrochemical products with manufacturing facilities in Houston, Channelview and Pasadena, Texas, and corporate headquarters in downtown Houston. Ranked 72nd in 1990 on the Fortune 500, Lyondell was rated the nation's most productive industrial company, according to Fortune data, ranking both sales and profits per employee for 1989 and 1990.

# 4.0 ENVIRONMENTAL ECONOMICS OF USED OIL

This section explores both the cost of the various recycling technologies and their environmental impacts. Environmental economics explores the efficiency of competitive markets by identifying both the social and private costs. Economics suggests ways of achieving efficient states while the environmental perspective measures the cost and benefits of pollution abatement even if nonpecuniary costs are factored into this equation (for example, the beauty lost in a stream from a used oil slick).

Used oil enters the environment in **various** ways. It is important to identify the cost of disposal versus recycling. Preventing clean up costs should be factored in as an avoided cost. It has been estimated that 450 million gallons of oil were leaked or lost in 1988. This represents approximately 33 percent of all used oil available for recycling in that year in the United States. Leakage may be the single largest source of used motor oil contamination of the environment. Some of that oil evaporates, but most of it, is eventually washed away by snow and rain and is added to rivers, lakes, and wastewater treatment systems.

## 4.1 Water Contamination

Hazardous contaminants, which can be concentrated in used oil, may enter surface water, ground water, and soil from leaking storage tanks, sewer drains, spills, and impoundments, as well as from disposal or treatment in landfills or lagoons. This oil can contain hazardous chemicals such as lead, zinc, and arsenic, and is a contaminant of groundwater. Intentional dumping and road oiling are other possible sources of contamination. The dumping of oil into sewers may ultimately result in water contamination.

## 4.2 Air Emission

The disposal of used oil on land results in air emissions via evaporation of organic compounds from draining, dumping, and landfilling and from contamination of surface and ground waters by infiltration, migration, and leaching of used oil contaminants following draining, dumping, and landfilling. Hazardous constituents are released to the air by incineration or burning of used oil (or blended fuel containing used oil) in nonpermitted burners, utility and industrial boilers, kilns, and space heaters. Constituents may also be released into the air by evaporation from land-based management practices.

### 4.3 Soil Contamination

Used oil dumped on the soil can contaminate water due to the process of infiltration, seepage, and percolation. Unlined municipal sanitary landfills have a high degree of potential for the release of contaminants into soil and with subsequent migration into water bodies.

### 4.4 Environmental Economic Factors of Recycling

It is important to recognize that no matter which recycling technology is employed, how its specific operators maintain pollution controls and good housekeeping practices is crucial. For example, a used oil reprocessor that has all its wastes utilized at an asphalt plant may result in having better environmental economics than a big re-refiner because the transportation costs are much less. Evaluating the market for fuel over lubricants is another consideration.

Numerous other important factors must also be examined, including the quality of the used oil collected, the distance to a recycling facility, the amount of investment for environmental controls, the market acceptance of end products, the capital cost of the operation, and other important investment questions, such as when a company turns a profit.

The process of handling used oils can result in adverse environmental impacts in many ways; from direct dumping, spills as **a** result of mishandling used oil, wastes from processing, releases into the air from burning without emissions controls, using used oil as a dust suppressant (road oiling), and improper discharge of oily wastewaters.

It is important to understand all the management issues and potential adverse environment impacts of used oil recycling:

- collection (possibility of spills);
- transportation (possibility of spills);
- storage/processing (possibility of spills, air emissions, liquid and solid wastes disposal); and
- end use (possibility of spills, air emissions, liquid and solid wastes disposal).

There are arguments that on-site burning lessens the chance of spillage or that long distance re-refining/slipstreaming is better since the oil isn't being burned, rather it is turned back into a new lubricant or petroleum product. Many factors have to be weighed from a risk standpoint and geographic location (rural versus urban).

No single generalization can be made on oil recycling techniques, for example, that all burning is bad and all re-refining is good. Certain criteria can better help in the evaluation of the environmental economics of used oil recycling.

The following evaluation should be made:

- quality and quantities of the oil that is being generated;
- management practices of the used oil recycler;
- what pollution controls are in place and what is the rate of residual build-up;
- insurance coverage and environmental compliance record, and
- ability to identify and test for contaminants and the ability to deal with the other materials such as solvents, and anti-freeze.

Later in this paper the section, “Evaluate Your Recycler,” offers a more detailed checklist of assessing individual used oil recyclers.

### 4.5 An Innovative Graduate Thesis Evaluates Used Oil End Uses

In 1989, a team of graduate students specializing in Hazardous Materials Management at Tufts University evaluated the potential health and environmental risks associated with the re-use, recycling, and disposal alternatives for used automotive oil.[11] Research into used oil management practices produced a list of currently employed end uses which was narrowed to 14 based on process similarities and potential releases. A qualitative human health risk assessment identified 14 contaminants of concern, evaluated the potential effects of each practice for each contaminant of concern, and resulted in a ranking of end uses according to their relative potential for posing risks. **A** qualitative environmental assessment was also conducted. The report format was tailored to meet the needs of their client, the Massachusetts Department of Environmental Protection.

A comprehensive risk rating table was developed to sum the risk ratings for each end use from each exposure route. This rating was used to compare end uses and rate relative risk potentials. Alternative end uses with the lowest numbers represent the least potential for adverse effects on human health. The relative ranking of end use alternatives is indicated below.

[11] **The Environmental Challenge of the 1990s, Proceeding of the International Conference on Pollution Prevention, USEPA/600/9-90/039, September 1990, p. 643-651.**

Used Oil End Use Alternatives

| Classification/Alternative | Relative Risk Ranking |
|---|---|
| **Re-refining and Reprocessing Technologies** | |
| • Vacuum Distillation with Hydrotreating | 8 |
| **Burning with Controlled Emissions** | |
| • Incineration (hazardous waste and municipal) | 1 |
| • Asphalt Batching Plants and Cement Kilns | **4** |
| • Large Utility Boilers | **3** |
| **Burning with Uncontrolled Emissions** | |
| • Space Heaters (vaporizing and atomizing) | 12/14 |
| • Small Residential Boilers | 13 |
| • Industrial Boilers (without emission controls) | **6** |
| Other **End Uses** | |
| • Landfilling | **2** |
| • Landfarming | **5** |
| • Disposal in Storm and Sanitary Sewers | **9** |
| • Uncontrolled Dumping and Road Oiling | 11 |

The group concentrated their risk analysis on contaminants of concern (COC) in air, water, and soils. This understanding was particularly important for evaluating the availability of COC for human exposure. This approach was based strictly on human health risks. Several team members with ecological and biological backgrounds convinced the group that environmental risk is a critical factor in determining the overall risks of end uses, thereby protecting public health, welfare, and the environment.

Implementation of three of the preferred end uses (hazardous waste incineration, landfarming, and landfilling) was judged to be inapplicable in Massachusetts due to regulatory restrictions, capacity limitations, and/or public opposition. The feasibility of utility boilers, asphalt batching plants, and municipal incinerators was further evaluated based on economic and practical advantages and disadvantages of recycling used oil in these respective capacities.

The group recommended that:

1) More efficient permitting processes be established to expedite the review of utilizing asphalt plants and utility boilers.

2) Study the feasibility of using used oil as an auxiliary fuel in municipal incinerators.

3) Institute a source reduction program to decrease the amount of used oil entering the management system and upgrade the quality of the used oil that does enter the management system.

### 4.6 Conclusions

It is important that in evaluating your options in recycling used oil that you do not take the most economic or least costly path until you explore the full ramifications of that choice. Many times generators have had their used oil picked up by transporters who have undercut their competitors and then improperly disposed of the oil. This opens up to the possibility of having generators pay countless dollars as a Potentially Responsible Partly (PRP) in a subsequent Superfund clean up. It is impossible to generalize that one technology is better than another because used oil is regulated differently depending on where it is being generated. However, one point remains constant and that is the better the environmental controls and good housekeeping practices, the less liable and better off the generator will be.

# 5.0 BEST MANAGEMENT PRACTICES

The history of used oil mismanagement practices at processing facilities has resulted in numerous cases of environmental damage (25 Superfund sites on the National Priority List) where used oil was the major constituent of concern. Whether the cause of damage was from leaking tanks/containers, spills, surface impoundments, or sludge waste piles, EPA has concluded that used oil processing/re-refining facilities pose the greatest problem primarily as a result of used oil mismanagement. Even though the generator may not directly deal with these operations, he/she may be made liable (Potentially Responsible Party (PRP)) if a collector takes the used oil to a future Superfund site. Moreover, to lessen liability and prevent or prepare for any possible accident, the generator, on a small scale, should observe some simple good housekeeping procedures.

## 5.1 Good Housekeeping Practices

The proper handling, transferring, storing and transporting of used oil requires specific safety procedures to ensure worker protection, accident prevention, and protection against other harmful factors so as to reduce liability insurance costs. These can range from providing a trash container that is regularly serviced at a public used oil drop off, to establishing a solvent recovery program to ensure used oil is not being mixed with hazardous materials.

### *5.1.1 Handling*

As in all recycling, the less that materials are handled, the better. Anytime that used oil transfer occurs there is the possibility of a spill. Preventive measures in handling are important to lessen spills and insure human error is minimized. Experienced oil recyclers have very low instances of spillage.

### *51.2 Separating Different Types of Used Oils*

It is critical that contaminants be kept out of used oil; oils should be separated by their different types, such as metalworking oils from crankcase drainings and from CFC used oils. The next section is a generic specification for automotive used oil that is to be reprocessed as a fuel.

***Used Oil Specifications****

These materials are ACCEPTABLE:

Automotive Industry
Motor Oil, Automatic Transmission Oil, Power Steering Fluid, Diesel Fuel, Gear Oil, Kerosene, Mineral Spirits or Varsol

Aviation Industry
Turbine Engine Oil, Jet Fuel

General Industry
Hydraulic Oil, Gear Oil, Fuel Oil (No. 2,4,6)

These materials are CONDITIONALLY ACCEPTABLE:

A sample of these wastes must first be submitted for approval. These products may be subject to an additional processing charge.

Oily Waste Water, Slurry or Emulsion, Synthetic Heat Transfer Oil, Synthetic Hydraulic Oil, Higher 'Sediment Oils Derived from Tank Cleaner, Coal Tar and Asphalt-Based Products, Animal or Vegetable Oils

These materials are NOT ACCEPTABLE (if the flash point is less then 140 degrees F and Total Organic Halogens is greater than 1000 ppm):

Chlorinated Solvents
Metalworking Fluids, Degreasing Solvents, Dry Cleaning Solvents, Freon-Contaminated Refrigeration Oils

Flammable Liquids
Gasoline, Naphtha, Paint Thinner, Fiberglass Resin

Other
Transformer Oil, Ammonia-Contaminated Refrigeration Oil, Brake Fluid, Bromine Contaminated Refrigeration Oil, Engine Coolant (anti-freeze)

It is important to see if there are some disposal/recycling options for materials not accepted since in many cases these may become mixed with used oil. In addition, depending on what specific used oil is generated, segregating it separately may open some waste minimization recycling opportunities (e.g., metalworking oils).

***Eastern Oil Company, Used Oil Specifications, January 30, 1992.**

## 5.2 Evaluating Your Used Oil Recycler - A Checklist

### 5.2.1 Introduction

This checklist is intended to help one decide whether or not a used oil recycler is running an environmentally sound operation. The checklist provides methods for evaluating and comparing the positive and negative factors associated with each operation. A positive evaluation does not guarantee or certify that EPA believes the operation is sound; it only serves as the basis for making a wise choice.

### 5.2.2 Approach

Each section relates to a specific function of a typical used oil recycling facility. Review the questions, answer them, and then identify any liabilities observed in the normal, day-to-day operations. This means that the consumer must take time to examine the operation and see how it relates to the question being asked.

### 5.2.3 Used Oil Acceptance

The basis of every operation is how the materials are being processed. Thus, it is critical that quality controls be in place before used oils are received. The questions in this section concern where the materials come from, how the facility checks the materials to determine whether they can be accepted by its processing system, and how the materials are stored prior to processing.

| Question | Desirable | Undesirable |
|---|---|---|
| 1. Is there a documented procedure for accepting the waste? | Yes | No |
| 2. Does the facility require specific laboratory tests prior to accepting the waste? | Yes | No |
| 3. Does the facility segregate the waste received from each client until after laboratory testing? | Yes | No |
| 4. Is there a standard group of clients? | Yes | No |
| 5. Is the initial receiving and storage area neat and clean? | Yes | No |
| 6. Is there any evidence of spillage or regular loss of materials in the storage area? | No | No |
| 7. Do containment measures surround the storage area? For example, are there walls or berms surrounding the tanks to keep spilled materials from leaving the area? | No | Yes |

*5.2.4 Processing*

A number of different processes may be used to reclaim used oil. Depending upon the final use of the recycled oil (whether it is to be used as a fuel, a cutting oil, or as a high quality reclaimed oil product), the processing steps usually fall into two categories: filtration or separation. In either case, the oil must be brought from the storage area into the processing area, usually by direct piping. It must then go through the processing system, where the oil is separated from the wastes that contaminate it. The basic concern is that no uncontrolled losses occur as a result of haphazard processing or a lack of maintenance.

| Question | Desirable | Undesirable |
|---|---|---|
| 1. Are the processing areas contained to prevent loss of spills (i.e., does a wall *or berm* surround the processing area)? | *Yes* | *No* |
| 2. Is this a closed process system with no vapor loss and no strong odors? | *Yes* | *No* |
| 3. Is the wastewater from the process discharged to a sanitary sewer or a permitted treatment unit? | *Yes* | *No* |
| 4. Are problems encountered when the type of oil being processed is changed? | *No* | *Yes* |
| 5 Is the residual portion (sludge, bottoms or sediment) being properly disposed of (e.g., asphalt plant or an approved landfill)? | *Yes* | *No* |

*5.2.5 Products*

This section covers product storage and use. It provides an indication as to the efficiency of the overall facility. Most processing operations discharge the finished product to a holding tank where it is held to settle, drain additional water, and wait until a client is ready to pick it up.

| Question | Desirable | Undesirable |
|---|---|---|
| 1. Is the product storage area clean and neat, showing no evidence of spills? | Yes | No |
| 2. If the product is transferred to drums for shipment to clients, is it stored in a contained area to prevent spillage? | Yes | No |

*5.2.6 Compliance*

This section is used to determine whether or not the facility is operating properly under federal or state requirements and whether it is able to meet the requirements of these regulatory agencies. After talking to the facility operator you can verify your findings by calling the appropriate agencies and speaking with the local inspector.

| Question | Desirable | Undesirable |
|---|---|---|
| 1. Does the facility have a federal EPA operating permit, usually known as a RCRA permit? | *Yes* | *No* |
| 2. Has the facility been visited by any state or federal environmental inspectors? | *Yes* | *No* |
| 3. Are copies of those inspection reports available from the facility? | *Yes* | *No* |
| 4. Did these inspections uncover any violations or non-compliance issues? | *No* | *Yes* |
| 5. Has the facility been inspected by local fire marshals or fire departments? | *Yes* | *No* |
| 6. Have there been any instances of environmental release or contamination resulting from the facility's operations? | *No* | *Yes* |
| 7. Have any environmental lawsuits been brought against the facility? | *No* | *Yes* |

# USED OIL FUEL CLASSIFICATION UNDER RCRA




Note: The Toxic Substances Control Act (TSCA) allows the burning of used oil fuels containing less than 50 ppm of PCBs in those industrial furnaces and boilers that are authorized to "non-specification" fuel and have notified EPA of their "waste as fuel activities" under EPA's PCB rule. "Used oil fuel is presumed to contain PCBs above 2 ppm unless the marketer obtains analyses through testing or has special knowledge of the used oil certifying that the used oil does not contain PCBs above 2 ppm.

Source: Rajani Joglekar, USEPA, 9/92

### *5.2.7 Assessment*

The preceding questions allow one to compare the negative versus the positive aspects of an operating facility. The first column indicates a positive response and the second a negative response. Compare the number of answers in the first column with the number in the second. If the number of answers in the first column is greater than the number in the second column, then the facility has more positive than negative factors or has fewer environmental liability indicators. When comparing multiple facilities, the facility with the most answers in the first column would be one's best choice in terms of being the most environmentally sound. As the number of answers in the second column increases, the facility may have less control over its operations and thus may be less environmentally sound. Generally, a facility that has more than half of its answers in the second column should be avoided since it may have too much potential for environmental impairment.[12]

## 5.3 Recommended Guidelines for Used Oil Collection Centers Operating Procedures

1. The owner or operator of the collection facility should ensure that all containment devices, including tank pipes and containers used for collection or storage, are inspected (at least once a week, month, etc.). The tank should also be inspected (weekly, monthly) to avoid malfunctions, operation error and/or leaks.

2. Each designated collection facility should have the accumulated oil picked up by a registered used oil transporter on a regular basis. A list of registered transporters should be available from your state regulatory officials.

3. Any accumulation of water in the tank should occasionally be drained off and properly disposed of. Inquire with the local environmental regulatory agency about proper disposal.

4. The collection facility operator should inspect the tank gauge and record the oil level daily.

5. The facility should be attended at all times, or provided with after hours security to minimize the possibility of unauthorized access, vandalism, or any unplanned sudden release of used oil into the environment.

6. Each designated facility should post and maintain a durable and legible sign readily visible in an appropriate place which indicates that the facility is a used oil collection facility site and also indicates the hours that the facility will be open.

[12] **Alford, Michael; Versar Inc., 1988.**

7. The collection facility should not charge a fee to persons making deposits.

8. All tanks must be locked except during filling and emptying.

9. Road access to the collection area should be convenient. Access should be limited to those times that an attendant is on duty.

10. A recordkeeping system should be set up and maintained to keep account of the dates, volume of used oil received and transported off site, the transporter's name, and the oil's final destination.

11. Routine cleanup and replacement of absorbent material under the tank should be performed monthly.

12. Trash cans should be available for the disposal of empty containers.

13. A plan containing emergency procedures should be prepared and retained on site which describes the actions facility personnel should take in response to vandalism, theft, fires, explosions or any unplanned release of used oil on the ground which would threaten human health and the environment. The plan must contain the names, addresses and phone numbers of the local police, fire departments and local emergency response teams to coordinate emergency services in a time of need. The plan containing emergency procedures should be located within the office of each of these groups.

14. Finally, one may want to consider periodic testing of the used oil with a chlorine/halogen detection kit for used oil to monitor whether the oil is being contaminated by household hazardous waste. Also check with the used oil transporter who may have some sort of halogen detection device.

(Guidelines adapted from Florida's Department of Environmental Regulations Guidelines for Collection Centers.)

## 5.4 Local Used Oil Recycling Coordinator Suggestions

1. Determine the number of retailers.

2. Determine the number of service stations.

3. Determine the volume of used oil which is generated, collected and recycled by all program participants within the community.

4. Determine the volume of new oil purchased by public agencies in the community, the volume of used oil generated, and the volume recovered. From these figures, estimate the revenues brought into the area through used oil recycling.

5. Send letters to retailers encouraging them to post a point of purchase sticker or sign urging recycling of used oil.

6. Send letters to service stations or auto repair centers requesting them to act as used oil collection centers; find out which stations are full service; include a return postcard and specific date to respond by. Also indicate that all employees should be aware of the program.

7. Develop a list of Used Oil Collection Centers and participating service stations.

8. Ask Used Oil Collection Centers for current volume of oil generated at the station and percent donated by do-it-yourself oil changers; ask them to keep a record of volumes of oil brought in after signing up as a collection center.

9. Develop a system to monitor each Used Oil Collection Center's data; conduct follow-ups after a given period of time to record program successes and failures.

10. Generate a press release announcing the used oil program and the number and location of collection centers; this can be arranged through your local press centers.

11. Conduct a press event featuring a popular individual in the community and use visual aids to attract media attention (e.g., oil change by mayor; baseball mascot featured in event, etc.).

12. Arrange for a week-long public awareness week, which can be launched by the press event; arrange for all profits from oil sales to go to local charities; advertise this fact.

13. Seek cooperation between local used oil industry members, service station associations located within the community and local service groups.

14. Distribute television/radio public service announcements to local stations after initial on-site visits with participating managers.

15. Investigate and research the possibility of the curbside collection of used oil. Your local hauler/recycler may be willing to participate if you can provide good background information and show how this has worked in other communities (such as Sunnyvale, California).

## GENERATION OF USED AUTOMOTIVE OILS BY STATE

The following table was prepared by the National Oil Recyclers. Association. Direct figures for used oil generation were not available on a state-by-state basis: however, state figures for gasoline consumption are available (based on tax reports). It was assumed that states generated used automotive. oil in approximately the same proportion as they consumed gasoline. The base figure used for the total amount of used automotive oils generated in the United States was 847 million gallons, the figure given for 1988 by Temple, Barker, and Sloane in a 1989 report prepared for the Environmental Protection Agency.

| STATE | GALLONS (MILLIONS) | STATE | GALLONS (MILLIONS) |
|---|---|---|---|
| Alabama | 17.0 | Montana | 3.4 |
| Alaska | 1.7 | Nebraska | 8.5 |
| Arizona | 8.5 | Nevada | 4.2 |
| Arkansas | 8.5 | New Hampshire | 4.2 |
| California | 101.6 | New Jersey | 25.4 |
| Colorada | 12.7 | New Mexico | 5.9 |
| Connecticut | 12.7 | New York | 42.4 |
| Delaware | 2.5 | North Carolina | 25.4 |
| Florida | 46.6 | North Dakota | 2.5 |
| Georgia | 25.4 | Ohio | 33.9 |
| Hawaii | 2.5 | Oklahoma | 12.7 |
| Idaho | 3.4 | Oregon | 9.3 |
| Illinois | 33.9 | Pennsylvania | 33.9 |
| Indiana | 21.2 | Rhode Island | 2.5 |
| Iowa | 10.1 | South Carolina | 11.0 |
| Kansas | 8.5 | South Dakota | 2.5 |
| Kentucky | 12.7 | Tennessee | 18.6 |
| Louisiana | 17.0 | Texas | 64.4 |
| Maine | 5.1 | Utah | 4.2 |
| Maryland | 17.0 | Vermont | 1.7 |
| Massachusetts | 17.8 | Virginia | 22.0 |
| Michigan | 33.9 | Washington | 17.0 |
| Minnesota | 17.0 | West Virginia | 5.9 |
| Mississippi | 8.5 | Wisconsin | 17.0 |
| Missouri | 21.2 | Wyoming | 1.7 |

### 5.5 How Many Used Oil Collection Centers Should a Community Have

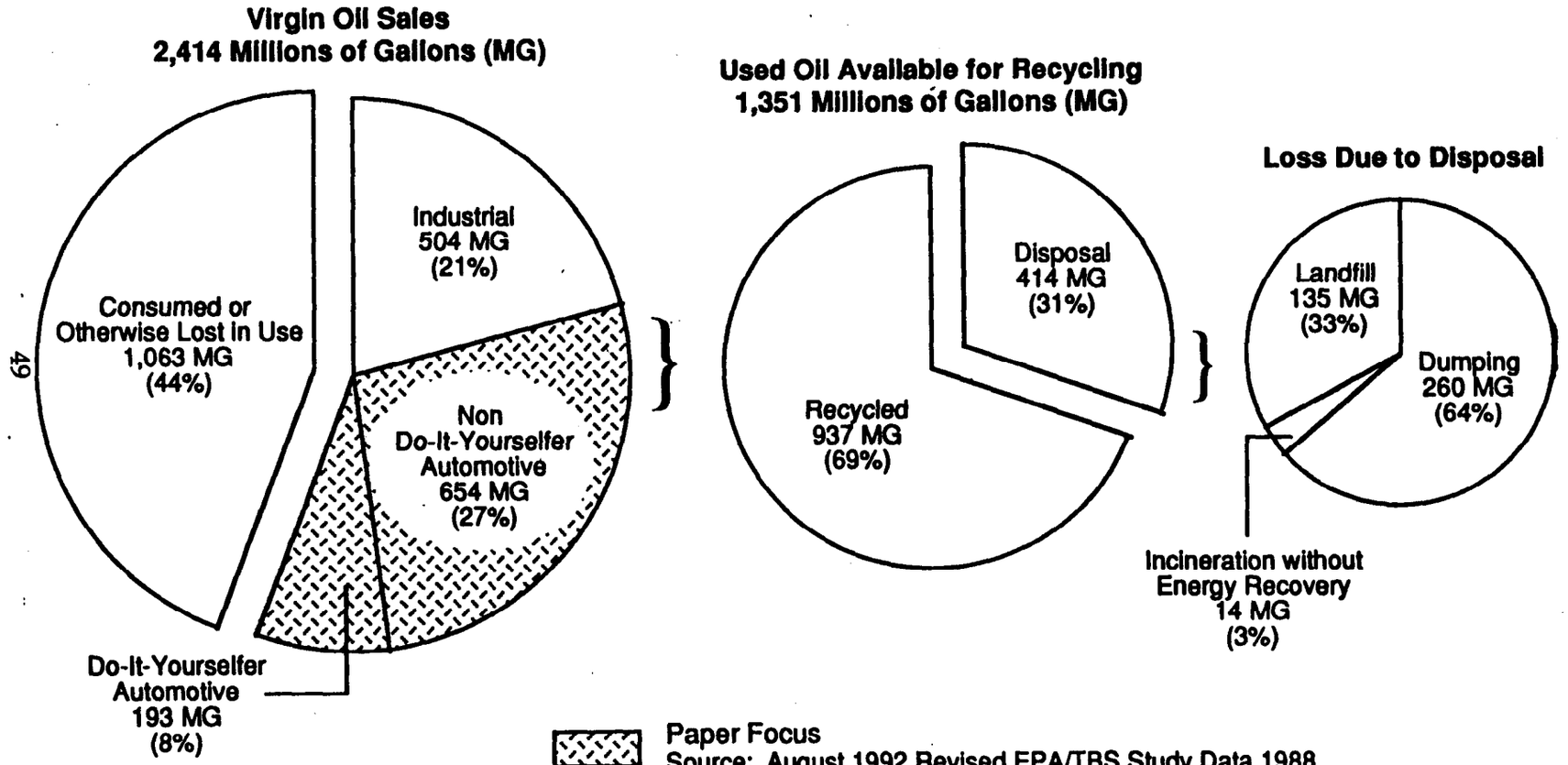
The number and capacity of the used oil collection centers in any given **area** is determined by the population size of the municipality they will serve so that they can efficiently handle the anticipated amount of used oil generated by do-it-yourself oil changers. A suggested minimum number of used oil collection facilities for a given community population is:

1. Zero, if the population is less than 3,500;
2. One, if the population is at least 3,500 but less than 25,000;
3. Two, if the population is at least 25,000 but less than 100,000; and
4. Three, if the population is at least 100,000 plus an additional facility for each additional 100,000 of population.

The American Petroleum Institute has published an excellent how-to manual, A Guidebook for Implementing Curbside and Drop-off Used Motor Oil Collection Programs (February 1992) which provides useful free information. Write to: American Petroleum Institute, 1220 L Street, NW, Washington, DC, 20005; or call 202-682-8000.

[13] **Wisconsin, Department of Natural Resources, Engine Waste Oil Collection Storage and Transportation, June 1982, p. 689.**

# DISPOSAL TRAIN FOR USED OIL



## 6.0 CONCLUSIONS

Of the 1.35 billion gallons of used oil Americans generate annually, an estimated 60 percent, or 850 million gallons, are reclaimed. Of this, 90 percent is recovered as a fuel supplement. A small percent is currently being re-refined. There is no question that both slipstreaming used oil or re-refining oil back into a lubricant should be encouraged as much as possible. These two recycling technologies presently have severe practical and economic constraints.

Slipstreaming a small amount of used oil into existing refineries is probably the most significant development in this industry. Utilizing existing equipment and pollution controls and thus piggy-backing on a refiner's ability to crack crude oil is an. innovative way to recycle used oil with virgin oil. The only drawback is the cost to transport used oil feedstock in sufficient quantities to justify the process for refiners.

Re-refining used oil back into a lubricant needs the support of government procurement to assist this technology in a time where the oil market has been depressed. This industry is quite active in all parts of the world except in the U.S. because of numerous factors, including the low cost we pay for oil. Any "buy recycled" campaign should include the purchasing of re-refined used oil.

The first two technologies - slipstreaming and re-refining - represent the best attempts to return used oil to its original state. The second two technologies - direct burning and reprocessing-transform used oil into an alternative fuel as its end market.

Reprocessing used oil or cleaning used oil to be used as industrial fuel plays a valuable role in marketing this petroleum by-product. Strong management standards are important to ensure that the necessary pollution controls are in place to test, and properly dispose of the waste materials, and to lessen toxic emissions to the air basin.

Burning used oil without reprocessing plays an important role for certain types of generators, primarily those who do not have access to other methods. Like reprocessing, this technology requires strict management standards in disposing of the ash and in ensuring proper emission controls. Also, other hazardous wastes associated with the specific generators' activities should be strictly manifested and accounted for. The burning of hazardous waste in this sector can cause serious health and safety problems.

The draining and recycling of used oil filters is another area which requires public and government support. Every motor vehicle administration in the U.S. could, at a minimum, promote that DIYs drain their oil filter before disposal. This could also be promoted on every oil filter sold.

The status of mobile oil refiners is not clear. The opportunities to develop on-site, closed-loop, recycling technologies can not be over-stressed. Reclaiming oil for reuse on site is a very attractive prospect since transportation costs and the possibility of increased spills are severely curtailed.

As discussed, there are many used oil technologies that differ in how they reclaim ‘used oil. No matter what technology is used, one important market must be changed. Roughly 20 percent of all the total used oil generated is generated by the DIY oil change market. Of this, nearly 80 percent does not become marketed and is “lost” in the environment. This represents half of all the used oil discarded. Public education is crucial to further create greater incentives and awareness of used oil recycling. Further, private/public cooperative efforts may prevent used oil from being disposed of improperly and maybe lessen further law suits and the sensational news coverages that have diverted proper attention to this issue. This offers numerous marketing opportunities to abate a serious environmental problem.

*The oil can is* mightier *than the sword.*

*- Everett Dirksen*

# APPENDIX 1

## USED OIL REFERENCES

The most important sources consulted during the preparation of this paper are listed below.


FEDERAL REGISTER NOTICE

Environmental Protection Agency Management System; Identification and Listing of Hazardous Waste; Recycled Used Oil Management Standards; Final Rule, September 10, 1992.

Environmental Protection Agency Management Standards Issued to Control Potential Risks from Recycled Used Oil - No Hazardous Waste Listing, August 13, 1992, EP/530-F-92-018.

Cost and Economic Impact Screening Analysis for the 1991 Used Oil Proposal, Regulatory Analysis Branch, Office of Solid Waste, U.S. Environmental. Protection Agency, August 14, 1991.

Environmental Protection Agency Proposed Rule, Hazardous Waste Management System; Identification and Listing of Hazardous Waste; Used Oil; Supplemental Notice of Proposed Rulemaking, 56 Federal Register 48000, September 23, 1991.

ENVIRONMENTAL PROTECTION AGENCY (EPA) REPORT

An Innovative Graduate Thesis Evaluates Used Oil End Uses, "The Environmental Challenge of 1990's," Proceeding of the International Conference on Pollution Prevention, USEPA/600/9-90/039, September 1990, p. 643-651).

"Preliminary Data Summary for the Used Oil Reclamation and Re-refining Industry," Office of Water Regulations and Standards, September 1989.

ENVIRONMENTAL PROTECTION AGENCY, (EPA) CONTRACTORS REPORTS

Franklin Associates, Inc., "Composition and Management of Used Oil Generated in the United States," Office of Solid Waste and Emergency Response, November 1984.

Development Planning Research Associates, Inc., "Selected Characteristics of the Waste Oil Space Heater Industry," Office of Solid Waste, July 1983.

Temple, Barker & Sloan, Inc., “Background Document: Regulatory Impact Analysis for the Management of Used Oil,” Office of Solid Waste, November 1985.

Temple, Barker & Sloan, Inc., “Generation and Flow of Used Oil in the United States in 1988,” Office of Solid Waste, November 30, 1989.

Versar, Inc., “Hazards of ‘Unsafe’ Used Oil Management Practices (Draft Report),” Office of Solid Waste, December 23, 1986.

Versar, Inc., “Health Risk Assessment: Review (Draft Report),” Office of Solid Waste, January 2, 1987.

Versar, Inc., ‘Waste Oil Characterization Volumes and Treatment Study (Final Draft Report),” Office of Solid Waste, March 9, 1987.

DEPARTMENT OF ENERGY REPORTS

Aerospace Corporation, Utilization of Used Oil, Division of Industrial Energy Conservation, August 1978.

Argone National Laboratory, Energy and Material Flow in Petroleum Refining, Office of Industrial Programs, February 1981.

Brinkman, D.W., et al., Environmental, Resource Conservation, and Economic Aspects of Used Oil Recycling, Bartlesville Energy Technology Center, April 1981.

Cotton, F.O., Waste Oil Lubricating Oil: An Annotated Review, Bartlesville Energy Technology Center, October 1982.

GCA Corporation, The Fate of Hazardous and Non Hazardous Wastes in Used Oil Disposal and Recycling, October 1983.

Market Facts, Inc., Analysis of Potential Used Oil Recovery from Individuals, Office of Industrial Conservation, July 1981.

Mueller Associates Inc., Waste Oil: Technology, Economics, Environmental, Health and Safety Concerns,” Office of Environmental Analysis, January 1987.

DEPARTMENT OF COMMERCE, National Bureau of Standards (NBS)

National Bureau of Standards, “Recycled Oil Program Test Procedures for Recycled Oil Used as Burner Fuel,” August 1980.

National Bureau of Standards, “Measurements and Standards for Recycled Oil,” September 1979.

National Technical Information Services, Waste Oil Reclamation (January 1980 - August 1991), September 1991.

STATE USED OIL RECYCLING REPORTS

Energy and Environmental Research Corporation, Oil Waste Management Alternatives Symposia-Conference Proceedings, April 1988 (Sponsored by the California Department of Health Services and U.S. EPA).

Energy and Environmental Research Corporation, California Guide to Waste Management Alternatives for Used Oil, & Other Oily By-products, April 1988.

University of Illinois, Used Oil Management In Illinois, July 1991.

Franklin Associates, State-wide Market Study for Used Oil in Michigan, February 1987.

Shull, H. Eugene, Natural Resources Research Institute, University of Minnesota, Feasibility Study for Long-Term Management Options for Used Oil in Minnesota, October 1, 1987.

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North Carolina State University, Managing Used Oils, March 1987.

Versar, Inc., Franklin Associates, Jacobs Engineering, "Assessment of State Used Oil Management Practices and Regulations," Volume I, June 9, 1986.

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INDUSTRY STUDIES

The American Petroleum Institute, A Guidebook for Implementing Curbside and Drop-off Used Motor Oil Collection Programs by Washington Citizens for Recycling Foundation (February 1992).

American Petroleum Institute, Recycling Motor Oil: A Model Program (API Pub. 1591, Third Addition, December 1988).

Nolan, J., et al., Used Oil: Disposal Options, Management Practices and Potential Liability, Government Institutes, March 1990.

OTHER INFORMATION SOURCES

Carnegie-Mellon University, "Regulation and Disposal of Used Motor Oil," Engineering and Public Policy Department, December 15, 1990.

Wolfe, Paris, *Economics of Used Oil Recycling:* Still Slippery, Resource Recycling, September 1992, pg. 28-40.

## APPENDIX II

LIST OF VENDORS

*II.a.* Direct *Burning*

Waste Oil Heater Manufacturers Association
members and contact points:

Advanced MetalTech
194 Speedvale Ave., West
Guelph, Ontario
Canada N1H 1C3
Contact: Bill Jager
(519) 824-7653

Black Gold Corporation
240 Great Circle Road, #344
Nashville, Tennessee 37228
Contact: Wayne Robertson, Esq.
(615) 251-0680

Clean Burn, Inc.
83 S. Groffdale Rd.
Leola, PA 17540
Contact: David Wolf
(800) 331-4183

Lenan, Inc.
20 South Main Street
Janesville, WIS 53545
Contact: Bill Forbes
(608) 752-1601

F.L. Industries, Reznor Division
1555 Lynfield Road, Suite 250
Memphis, Tennessee 38119
Contact: Bill Powis
(800) 888-0211, ext. 278

Shenandoah Manufacturing Co.
P.O. Box 839
Harrisonburg, VA 22801
Contact: Richard Lantz
(703) 434-3838

*II.b. Reprocessors*

For the names and phone numbers of over 60 Transporters and Recyclers, contact:

National Oil Recyclers Association
Ms. Kitty McWilliams, Executive Director
2266 Bellefield Ave.
Cleveland, OH 44106
(216) 791-7316

*II.c. Bypass Oil Filtration System*

T.F. Purifiner
4300 South U.S. #l Suite 203-248
Jupiter, FL 33477
407-627-0629

*II.d. Used Oil Filter Recycling*

*Provided by the Convenient Automotive Services Institute (August, 1992)*

Almar Petroleum Co.
P.O. Box 269
Gloucester, MA 01930
Contact: David Dow
(508)283-3287

American Iron & Supply
2800 Pacific North
Minneapolis, MN 55411-9911
Contact: Doug Hall
(612) 529-9221

Bio Cycle
10029 Glen Street
Bakersfield, CA 93312
Contact: Ben McNeil
(805)589-7757

Calderia Brothers, Inc.
N. Main Shore Road
Waretown, NJ 08758
Contact: Joe Calderia
(609)971-0506

California Oil Recyclers Inc.
P.O. Box 248
Newark, CA 94560-0248

Connecticut Waste Oil Inc.
P.O. Box 179
Meriden, CT 06450
Contact: Joe Calvi
(203)235-8889

Crane's Waste Oil
6504 Juniper Road
Lake Isabella, CA 93204
(619) 379-4377

CRT
1300 Plymouth St.
Bridgewater, MA 02324
Contact: Jack Mooney
(800) 833-8278

Dow Smith Oil Filter Rec.
P.O. Box 269
Gloucester, MA 01930
Contact: David Dow
(508) 281-5969

Evergreen Oil Co.
6880 Smith Ave.
Newark, CA 94560
Contact: Kirk Hayward
(415) 795-4410

Express Oil Co.
8748 Remmet Avenue, Suite B
Canoga Park, CA 91304
(818)700-7996

Heritage Environmental
7901 West Morris
Indianapolis, IN 46231
Contact: Frank Fehsenfeld
(800) 544-0498

Industrial Pollution Con.
810 Poindexter St.
Jackson, MS 39204
Contact: Mark Case
(601) 355-2448

Industrial Service Corp.
1633 S. Marsh
Kansas City, MO 64126
Contact: Timothy J. Roche
(816) 833-1919

Industrial Pollution Control
P.O. Box 3569
Jackson, MS 39207
Contact: Jeff Summers
(601) 238-2448

International Petroleum Corp.
14890 Intracoastal Drive
New Orleans, LA 70129
Contact: Dwight Diagle
(504) 254-9021

Mesa Gil, Inc.
4701 Broadway, SE
Albuquerque, NM 87105
Contact: John F. Dempsey
(505) 877-8855

N. Hennepin Recycling
8550 Zachary Lane
Maple Grove, MN 55369
Contact: Timothy Klatke
(612) 943-2239

Oil Services, Inc.
19412 Country Rd., #81
Osseo, MN 55369-9229
Contact: Paul DeRosia
(612) 943-8198

Product Recovery & Recycling
P.O. Box 36
Ft. Calhoun, NE 68023
Contact: Mark Stephens
(402) 238-2518

Rollins Enterprises, Inc.
Route 1- Box 1488
King George, VA 22485
Contact: Bobby Dunnington
(703) 235-5907

Intersol of Florida
13902 N. Dale Mabry, #120
Tampa, FL 33618
(813) 963-1534

L.S. J. Communications
17 Bon Aire Circle
Suffern, NY 10901-7008
Contact: Susan Muller
(914) 357-7000

MetroPro
6186 Old Franconia Road
Alexandria, VA 22310
(703) 971-8300

Oil Filters Recyclers
P.O. Box 4193
Springfield, IL 62708
Contact: Jim Johnson
(217) 789-4970

ProCycle Oil, Inc.
P.O. Box 1540
Boyd, TX 76023-1540
(817) 433-2888

Refineries Service
P.O. Box 1167
Patterson, CA 95363

S&S Services
6573 Guthrie Road
Jacksonville, FL 32205
(904) 695-0992

Safety Kleen Corp.
777 Big Timber Road
Elgin, IL 60123
Contact: Mike Carney
(708) 697-8460

Scrap Metal Processors
150 N. Girard Ave.
Minneapolis, MN 55406
Contact: Mickey Minter
(612) 377-6633

Specialty Environmental Services
2740 Valley Drive
Shreveport, LA 71148
(800) 256-9900

Spencer Environmental
914 S. Molalla Avenue
Oregon City, OR 97045
Contact: Mike Gibson
(503) 655-0896

Sunwest Energy Corp.
2518 Brandt Ave.
Nampa, ID 83687
(208) 465-4800

Sunwest Energy Corp.
P.O. Box 17008
Portland, OR 97217-0008
(503) 223-4224

TAMCO
P.O. Box 325
Etiwanda, CA 91739
Contact: Leonard Robinson
(714) 987-2521

Tri-Star Environmental
267 West 2950 South
Salt Lake City, UT 84115
(801) 596-9414

United Recyclers, Inc.
105 East Drive
Melbourne, FL 32904-1026
Contact: John F. O'Connell
(407) 722-5757

U.S. Foundry
8351 N.W. 93rd Street
Meadley, FL 33165
Contact: Doug Linne

Wadhams Sales & Service
6 South 141 Park Meadow Drive
Naperville, IL 60540
Contact: Pat Wadhams
(708) 420-0123

Zunker Iron & Metal
Route 6 - Box 51
Alexandria, MN 56308
Contact: Dick Zunker
(612) -763-4673

*II.e. Re-refining*

Manufacturers and Distributors of Re-refined Lubricating Oils
May 1992

This list has been prepared by the Center for Earth Resource Management Applications, Inc. to facilitate implementation of the U.S. Environmental Protection Agency's guideline for purchasing lubricating oils containing re-refined oil.

Product information has not been verified either by EPA or by CERMA. To add or correct information, or for information on the EPA Guideline for Procurement of Lubricating Oils Containing Re-refined Oil, call the Recycled Products Information Clearinghouse at (703) 941-4452.

## Manufacturers

BresLube USA, Inc.
Oil
7001 West 62nd Street
Chicago, IL 60638
Contact: Jim Hoffman
Phone: (312) 229-1500 Fax: (312) 229-0666

| | |
|---|---|
| Product A: | Engine Lubricating |
| Viscosity: | 5W30, 10W30, 1OW40, 15W40, 1OWSAE, 20WSAE, 20WSAE, 40WSAE 5OWSAE, 2OW50 |
| API Service: | Full range SG/CC/ CD/CE |
| Packaging | Quarts, pails, and drums (and gallons for 15W40 and 30WSAE) |
| Product B: | Hydraulic Fluid |
| Packaging | Pails and drums |
| Product C: | Gear Oil |
| Packaging | Pails, kegs, and drums (80W90/GL5 also available in gallons) |
| Plants: | Breslau, Canada<br>East Chicago, IL |
| Owned by: | Safety Kleen |
| Distribution: | U.S. and Canada |

DeMenno/Kerdoon
2000 N. Alameda St.
Compton, CA 90222
Contact: David Valencia
Phone: (213) 537-7100 Fax: (213) 639-2946

| | |
|---|---|
| Product A: | Engine Lube. Oil |
| Viscosity: | 10W30 & 10Wa˜0 |
| API Service: | SF/CC |
| Packaging | Bulk |
| Product B: | Paraffinic Base Oil |
| Distribution: | Sold and labelled by re-packagers Western U.S. |

Ecoguard, Inc.
Promax Division
301 East Main Street
P.O. Box 14047
Lexington, KY 40512
Contact: Cleve Huston
Phone: (606) 264-7389 Fax: (606) 264-7012

| | |
|---|---|
| Product A: | Engine Lubricating Oil (Future availability) |
| Product B: | Hydraulic fluids |
| Brands: | Ecoguard |
| Distribution: | United States |
| Owned by: | A subsidiary of Valvoline |

Evergreen Oil
5000 Birch Street
Suite 500
Newport Beach, CA 92660
Contact: Lori Klein
Phone: (714) 757-7770 Fax: (714) 474-9149

Product A: Basestock
Product B: Packaged motor oil
Product C: Hydraulic fluids
Packaging: Bulk, sold to repackagers
Motor oil: Sold to distributors
Distribution: U.S. and Canada
Plant: Newark, California

Mohawk Lubricants, Ltd.
130 Forester Street
N. Vancouver, BC V7112M9
Canada
Contact: Terry Wilson
Technical Manager
Phone: (604) 929-1285 Fax: (604) 929-8371

Product A: Engine Lube. Oil
Viscosity: Full range
API service: SF/SC/CC/ CD/DC-IVCE
Packaging Drum, bulk, 1 liter, 4 liter, 20 liter pail
Product B: Hydraulic Fluids
Product C: Gear Oil
Product D: Industrial Lubricants
Brands: Mohawk Oil, Spartan Oil, Canadian Pride
Distribution: Canada and Northwestern U.S.
Plant: North Vancouver, British Columbia

## Vendors/Distributors

Enviroil
P.O. Box 3646
Houston, TX 77253-3646

Distribution: United States
Plants: Various U.S. compounding locations

Lyondell Petrochemical Company
12000 Lawndale Avenue
P.O. Box 2451
Houston, TX 77252
Contact: Andy Wnek
Phone: (708) 344-9444 or 344-9446

Product A: Engine Lube. Oil
Viscosity: 10W30
API Service: SG/CD Energy Conserving II
Packaging Quarts, drums, and bulk
Product B: Anti-Wear Hydraulic Oil
Viscosity: ISO 32,46 and 68 grades
Packaging Drums and bulk
Product C: Diesel Engine Lube. Oil
Viscosity: 15W40
API Service: CF-/CD IVSG
Packaging Quarts, drums, bulk

Prime Lube, Inc.
800 Roosevelt Avenue
P.O. Box 539
Carteret, NJ 07008
Contact: Donald A. Di Vite
Phone: (800) 634-4615 Fax: (201) 541-7999

Product A: Engine Lube. Oil
Viscosity: 10W30
API Service: SC/CD
Energy Conserving II
Packaging: Quarts and drums
Product B: Anti-Wear
Hydraulic Oil
Viscosity: ISO 32, 46, 68 grades
Packaging Drums
Product C: Diesel Engine Lube. Oil
Viscosity: 15W40
API Service: CF-4/CD IVSC
Packaging: Quarts and drums
Brand: Enviroil
Distribution: CT, NJ, NY

*II.f. Slipstreaming*

Lyondell Petrochemical Company
P.O. Box 3646
1221 McKinney, Suite 1600
Houston, TX 77253-3646

Contact: Manager, Special Lubricant Projects
Phone: (713) 752-7303 or
Customer Connection: (800) 447-4572

## Table 1 — Used oil recycling operations

| Company | Plant location(s) | Annual capacity (1) | Cost (2) | Year operational | Pay/charge to collect | Trans-portation | End products | End markets |
|---|---|---|---|---|---|---|---|---|
| Evergreen Group<br>Newport Beach, CA | Newark, CA | 14 | $10 million | 1986 | Charges 20-25 cents per gallon | Own fleet to pick up | Lube oil (65%)<br>Asphalt flux (15%)<br>Fuel oils (10%) | Blenders/com-pounders<br>Wholesale market<br>Roofing tiles |
| | T.B.A. | 38 | $30 million | 1994 | | | | |
| Safety-Kleen Inc.<br>Elgin, IL | Breslau, ON | 35 | N.A. | 1978 | Charges $50 for up to 250 gallons | Own fleet to pick up | Lube oil (65%)<br>Asphalt extender (7%)<br>Fuel oils & other | Blenders/com-pounders<br>Retail<br>Asphalt |
| | East Chicago, IN | 75 | $50 million | 1991 | | | | |
| Lyondell Petrochemical Co.<br>Houston, TX | Houston, TX | 7.5 | (3) | 1992 | Payment varies | Distributors collect | Gasoline (40%)<br>Diesel oil (40%)<br>Fuel products | Distributors return to their customers |
| | Houston, TX | Increase to 30 | (3) | T.B.A. | | | Buys recycled lube oil for retail market | |
| International Recovery Corp.<br>Miami Springs, FL | Plant City, FL | 30-35 | $2-3 million | 1986 | Charges or pays | Own fleet | On-specification fuel products | Fuel customers |
| | Wilmington, DE | 30-35 | $4-5 million | 1992 | | Independent haulers | | |
| Cibro Petroleum Products<br>Bronx, NY | Albany, NY | 20-30 | Part of $100 million refin-ery expan-sion | T.B.A. | Pays 20 cents per gallon | Independent haulers/ truckers | Lube oil<br>Fuel oil | Undetermined |
| Shannon Environmental Services<br>Toronto, Ontario | Toronto, ON | 7.8 | $27-30 mil-lion | 1992 | Charges | Independent haulers/ truckers | Light to heavy lube oils with four viscosi-ties | Blenders/com-pounders<br>Specialty blenders |
| Environmental Services and Recycling<br>River Rouge, MI | River Rouge, MI | 35 | $15 million | Cancelled | | | | |

T.B.A. = To be announced.
N.A. = Not available.

(1) In million gallons.
(2) All costs are reported in U.S. dollars.
(3) There was no increase in capital costs, because the feedstock was simply changed from virgin oil to used oil.

Source: PW Communications, 1992.

Source: Wolfe, Paris, *Economics of Used Oil Recycling: Still Slippery*, Resource Recycling, September 1992.

## APPENDIX III. ORGANIZATIONS AND ASSOCIATIONS USED OIL RECYCLING

Asphalt Institute
PO Box 14052
Lexington, KY 40512-4052
606-288-4999

American Petroleum Institute
1220 L street, NW
Washington, DC 20005
202-682-8000

American Society for
Testing and Materials
1916 Race Street
Philadelphia, PA 19103
215-299-5400

Association of Petroleum Refiners
PO Box 605
Ellicott Station
Buffalo, NY 14205-0650
716-855-2757

Automotive Parts and
Accessories Association
4600 East-West Highway, 3rd Floor
Bethesda, MD 20814
301-654-6664

Center for Earth Resources
Management
5528 Hempstead Way
Springfield, VA 22151
703-941-4452

Convenient Automotive
Services Institute
PO Box 34595
Bethesda, MD 20817
301-897-3191

Community Coalition For
Oil Recycling
PO Box 141255
Dallas, TX 75214-1255
214-821-3000

Greenpeace, USA
1436 U Street, NW
Washington, DC 20009
202-462-1177

Green Seal
1875 Connecticut Ave, NW
#300-A
Washington, DC 20009-5818
202-986-0520

Hazardous Waste
Treatment Council
1440 New York Avenue, NW
Washington, DC 20005
202-783-0870

Independent Lubricant
Manufacturers Association
651 S. Washington Street
Alexandria, VA 22314
703-684 -5574

Izaak Walton League
1401 Wilson Blvd., Level B
Arlington, VA 22209
703-528-1818

Motor Vehicles Manufactures
Assn. of the United States, Inc.
7430 2nd Street, Suite 300
Detroit, MI 48202
313-872-4311

National Asphalt
Pavement Association
5100 Forbes Blvd.
Lanham, MD 20706-4413
301-731-4748

National Automotive
Dealers Association
8400 West Park Drive
McLean, VA 22102
703-821-7040

National Institute for
Petroleum & Energy Research
PO Box 2128
Bartlesville, OK 74005
918-336-2400

National Institute of
Governmental Purchasing
115 Hillwood Avenue
Falls Church, VA 22046
703-533-7715

National Oil Recyclers Association
277 Broadway Avenue
Cleveland, OH 44115
216-791-7316

National Petroleum
Refiners Association
1899 L Street, NW, Suite 1000
Washington, DC 20036
202-457-0480

Natural Resources Defense Council
40 w. 20th street
New York, NY 10011
212-727-2700

Petroleum Marketers
Association of America
1120 Vermont Ave, NW
Suite 1130
Washington, DC 20005
202-331-1198

Service Station Dealers
Association of America, Inc.
499 S. Capitol Street, SW
Suite 407
Washington, DC 200034013
202-479-0196

Sierra Club
408 C Street, NE
Washington, DC 20002
202-547-1141

Society of Automotive Engineers
400 Comonwealth Drive
Warrendale, PA 15096
412-776-4841

Society of Independent Gasoline
Marketers of America
11911 Freedom Drive
Suite 509
Reston, VA 22090-5602
703-709-7000

United States Department
of Energy
Office of Industrial Programs
1000 Independence Ave. SW
Washington, DC 20585
202-586-2369

United States -Environmental
Protection Agency
401 M Street, SW
Washington DC, 20460
1-800-424-9346 (RCRA Hotline)

Waste Oil Heating
Manufacturers Association
c/o Patton, Boggs & Blow
2550 M Street, NW
Washington, DC 20037
202-457-6420

The Waste Watch Center
16 Haverhill Street
Andover, MA 01810
508-470-3044