INDEN 5350

INDUSTRIAL ENGINEERING PROBLEMS

(CREATIVE COMPONENT)

MANAGEMENT OF WASTE OIL

Submitted by:

ANILKUMAR URS

Submitted to:

DR. WAYNE C. TURNER

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SCHOOL OF INDUSTRIAL ENGINEERING AND MANAGEMENT

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ABSTRACT

Today's environment is being polluted by various sources. Used oil is one of the substantial contributors to the pollution and serious efforts are being made to prevent any damage to the environment. Hence a comprehensive study has been undertaken to investigate the factors responsible for such damage.

The characteristics of waste oil, have been studied which make the oil hazardous. Also, various sources, based on which waste oil is classified are also discussed.

Over the years, a large number of physical and chemical processes have been developed, which are used for recycle and recovery of waste oil. Some of the common processes which are in use are described.

Improper handling and disposal of used oil can result in unlimited liability. Hence a brief overview of regulations has been given to provide a basic understanding and enable the related persons/facilities to ensure complete compliance.

One aspect of the control of used oil is various in-plant measures. Keeping this in mind some case studies have been given, which have yielded positive results.

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CHAPTER - 1

INTRODUCTION

The rapid development of science in the past three decades has not been without damage to the environment. A stage has been reached wherein every industry needs to be carefully aware of the impact on the environment. Since the disposal of waste generated is not an easy task, all possible means have to be explored to minimize waste.

Increased public awareness and realization of the potential disaster, has prompted a comprehensive review and evaluation of chemical waste management.

This report provides an overall picture of management of waste oil. It provides information on characteristics of used oil, some recovery and recycling processes, disposal options and regulations governing used oil. Also, it gives an idea for the generator as to what steps should be taken for efficient management of waste oil.

However, it does not say which is the best possible option or process to follow, because the quantity, content, and economics involved vary from one generator to another.

Any waste management practice should be based on the hierarchy given in fig.1.1 [10]. There are 3 basic options: minimization, or reuse of hazardous waste, conversion of hazardous waste to non-hazardous or less hazardous material and perpetual storage. These general options differ based

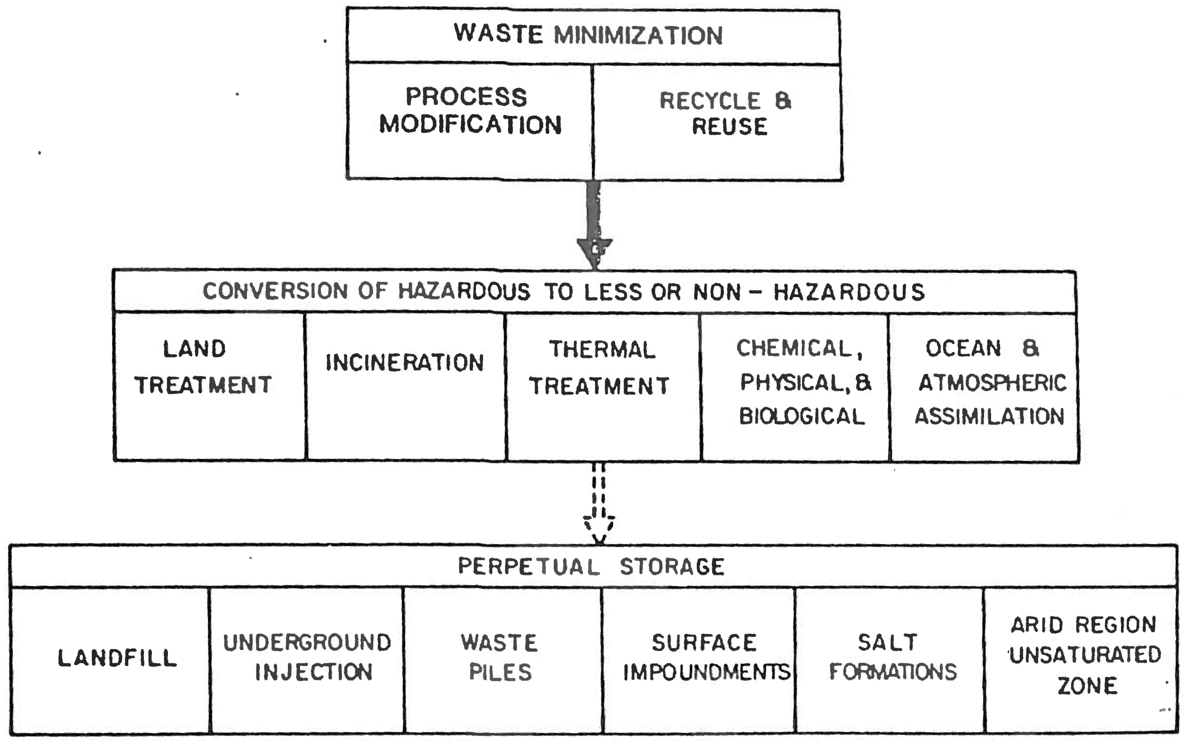

Fig. 1.1 Hierarchy of Hazardous Waste Management [10, pp. 3]

on philosophy, time frame, technique, and economics.

The major deviation from the old practice is that the perpetual storage option shown in fig.1.1 is almost ruled out due to stringent regulations and also the liability associated with it. Further, more emphasis is laid on the process modification option because it aims at elimination of waste which is the foremost goal of the modern waste management practice.

Oil has widespread use in various industrial and non-industrial applications. Used oil has a variety of metals and chemicals which were harmful to human health and environment. Hence in 1985 EPA came up with regulations governing used oil. It classified all used oil which was not recycled and which failed tests as hazardous waste. This meant that waste oil could no longer be handled as ordinary solid waste. Since then many changes have been made in the regulations and the details are given.

In most manufacturing industries oil is recycled until it can no longer be used. But eventually it has to be disposed. The common practice is to give away the oil to handlers who collect the oil, and depending on the condition they recover as much oil as possible. Also, sometimes energy is recovered by fuels burning.

The last alternative would be to dispose the oil. This is the most crucial step because of the liability concerns. In the past, road oiling was common practice, but now it has been banned by almost all states. Other standard methods are incineration and using waste oil as an auxiliary fuel in municipal incinerators. Another method which is seldom used is land spreading with decomposition by microorganisms found in the soil [8].

Due to the high cost of compliance and liability, industries have been constantly trying to come up with improvements to conserve oil, thereby reducing wastes. Some such instances which have yielded positive results are given.

The development of technology may have changed some of the recovery processes mentioned in the report. The material presented regarding the regulations is as per the latest amendments made by EPA in September 92 [19]. However there may be some other changes which may have taken place at the time of reading this report.

It is important to note that waste elimination is much more a thought process or problem solving sequence which attempts to go further back into the source of waste and employ engineering principles which reduce hazardous waste or recover useful material from such wastes [10].

CHAPTER - 2

SOURCES AND CHARACTERISTICS OF WASTE OIL

Non polluting disposal of waste oils is a problem of enormous complexity because it not only involves thousands of establishments using fuel as lubricant but also a large number of service stations, garages and auto dealers which service these vehicles.

It is estimated that about half the losses to the environment have come from production, refining, transportation and use of oil- as spills; wastewater discharges; land, ocean and deep well disposal of wastewater treatment sludges. Out of this less than 10% of the total potential lubricating oils are recovered [8].

The classification of waste oil has been done on the basis of point of generation, which somewhat reflects the data on oil sale.

2.1. Automotive Service Centers

This classification includes service stations, garages, car dealers and other retail establishments where used oil is drained from crankcases of automobiles. The oil primarily consists of crankcase and transmission fluids, gear lubricants, hydraulic oils and other solvents used in the service areas. Some oil is disposed as solid waste along with filters. The disposal problems are due to flash point, water, sediment, ash, nitrogen and oxygen contents. Many of the impurities are emulsified and are difficult to remove.

A part of the metallic materials in used motor oils is introduced during use. Typically, the metals introduced by means of wear or corrosion are aluminium, copper, iron, lead silicon and tin. Sodium, barium, calcium, zinc and magnesium are frequently from additives.

Most of the oil from automotive service centers is collected by independent collectors and waste oil processors with collection systems.

2.2. Railroad Service Centers

Railroad diesel engine lubes are usually isolated from other oils when drained. Much of this oil is shipped to re-refining centers for processing and returned as usable diesel engine lubricating oil. Little information is available on the composition of railroad diesel drain oils. However, compositions are expected to be same as automotive oil except that lead content will be negligible.

2.3. The Metal Industry

Typical operations in which oil is used in metal working are rolling, drawing, extrusion and machining. While in use, the lubricant is subjected to deterioration and degradation by heat, metal particles, oxidation, and introduction of grease. Thus, these metal working lubricants and coolants must be replenished and replaced periodically to maintain their quality. In many cases, the metalworking fluids are recirculated, settled, filtered and purified enabling their use in the plant [2].

Recovery of oil from the soluble oil emulsion is much more difficult than the recovery of ordinary lubricating oils. This is true because soluble oils often contain ingredients such as fatty oils and other compounds formed by chlorination and sulfurization.

In large metal fabricating plants, even where extensive recycling is practiced, relatively large quantities of waste oil are generated.

2.4. Industrial Process Waste Oils

The waste oils considered here are those which emanate from industrial processes like petroleum refining, petrochemicals, meat processing, and coke manufacture. Unlike many of the waste oils discussed earlier, the quantities of process waste oil are not readily estimated from sales, since they represent waste products generated during the process.

Refining crude oil and producing petrochemicals may result in losses from 0.1% to 2% of the total quantity processed [8]. However, the modern well operated refineries are expected to keep the losses within 0.5% [8]. Also, in addition to the losses in the refinery itself, considerable losses may occur during production on land and off shore, during overland and inland transportation, during transfer and storage at terminals and bulk plants, during storage and use by the ultimate fuel users.

Spills of volatile hydrocarbons such as gasoline fractions, discharge of wastewaters and disposal of oil containing sludge results in almost complete unavailability for recycling. However, tank cleaning, recovery from wastewater in oil/water separators and other loss modes do result in major portion of the loss being available for recycle.

2.5 Oil and Fat Industry

Fats and oils may be classified as vegetable oils, animal fats and fish oils. The major uses are in food, soap, paint and resins.

Almost all of the fats and oils produced are consumed, finally appearing in the environment as human waste, soaps in water and coatings on solid waste. Oily products do produce oily wastes, usually as a low concentration contamination in waste waters. A part of the fats and oils recovered is sold for non-critical applications.

2.6 Synthetic Oils

Synthetic oil industry is relatively small compared to others but increased amounts are being produced for special lubrication purposes. Some of the applications are at very low and very high temperatures, jet aircraft etc,.

Waste synthetic oils should be segregated and recycled where ever possible, because of their high cost and also to avoid contamination of other recyclable oils.

2.7 Marine Transportation Waste Oils

Enormous quantities of crude petroleum and refined products are transported by tanker and pipelines into and out of the refineries. This transportation results in waste oil generation from spills, ballast water and tanker washing.

The composition of the waste oil depends on nature of the product. The lighter fractions when spilled cannot be recovered since they evaporate quickly. Composition of the waste oil recovered also depends on the type of the recovery process used, the materials added to aid in recovery and dispersion.

Analysis of composition of any waste oil is extremely important before selecting any option, whether it is disposal or recovery.

CHAPTER - 3

RECOVERY PROCESSES

There are a large number of physical and chemical processes which have been developed for reclamation, re-refining and processing of industrial and automotive lubricants. Some of these processes are directed towards upgrading the oil for use in the same machines. Many industrial operations using significant quantities of lubricating oils maintain their own purification and renovation systems.

The performance of any technique depends on the condition of oil-water mixture. Hence the nature of a particular oily waste stream must be determined before proper treatment is selected.

Principal factors are [1]

- Amount of oil present
- Oil droplet size distribution
- Presence of chemical emulsifiers
- Specific gravity of oil
- Concentration of suspended solids

The following are some of the most commonly used physical and chemical methods used in the waste oil recovery.

3.1. Gravity Differential Separation

This process uses a method of separation which removes water and other settled solids and thereby recovering oil.

The principle used is based on the fact that the velocity of a rising droplet is proportional to the specific gravity difference between oil and water. Once oil reaches the surface, it is removed by slotted pipes, dip tubes, parallel plates or belt drum or rope skimmers [2].

The standards for the design of oil water separators are developed by API (American Petroleum Institute) based on experiments and plant operating data. Advantages of this process include potential for treatment of suspended solids, and effective removal of free and dispersed oil.

Disadvantages are limited efficiency for removal of emulsified oil, incapablity of removing soluble oil, and handling of chemical sludge.

3.2. Vacuum Filtration

Precoat Vacuum filtration incorporates a layer of filter aid on a vacuum rotary pump. This is a proven method for treatment of petroleum refining cuff.

A rotary vacuum filter consists of cylindrical drum rotating submerged in the waste oil. The drum is radially divided into number of sections. As the drum rotates each section is connected to the appropriate service. Various operating zones are encountered during a complete revolution of the drum. In the pickup or form section vacuum is applied to draw the oil through the filter [12].

A variation of the conventional drum filter is the top feed drum filter. The potential advantages are reduction in capital cost since the feed hopper is smaller and no agitator and related drive equipment are required.

This method can be conveniently used where space is limited. A major disadvantage is that very high operating skill is required to run the process which will increase the labor costs.

3.3. Flocculation and Sedimentation

Chemical flocculation can break emulsions and a recent study indicates that the addition of finely divided solids will greatly enhance separation. Materials such as clay, fly-ash, and even wastewater treatment sludges used in conjunction with a coagulant effectively result in separation of emulsions.

Sometimes flocculation is used to improve filtration rate. Since flocculation can be complicated at times, pre-treatment with acid and a polyelectrolyte may be desired. Flocculant requirements also vary from one industry to other but, it is somewhat the same within a particular industry.

3.4. Dissolved Gas Flotation

When used along with chemical flocculating agents, flotation is found to effectively remove oil and finely divided solids as emulsions.

This process is used where simple gravity separation is not sufficient. Air is introduced to provide air bubbles which attach the oil droplets and then float the oil quickly to the surface. More rapid oil removal can be achieved by gravity alone, resulting in smaller units [1].

Advantages are effective removal of dispersed and emulsified oil with chemical addition, and reliability of the process. The main disadvantage is sludge handling when coagulants are used.

3.5. Chemical Treatment

Chemical methods of breaking emulsion are widely used and these include the reaction with salts of polyvalent metals, salting out of the soap and destruction of the emulsifying agents.

One of the early chemical methods involving adsorptive purification is clay treatment. Frequently this is carried out at elevated temperatures and in state of agitation to cause intimate contact between the oil to be purified and the absorbent clay [5].

The treatment of chemical emulsions can be extremely difficult due to the characteristics of waste. The methods commonly used involve use of coagulants, pH adjustment and acid cracking. Sulfuric acid or hydrochloric acid is added to a pH solution along with a coagulant and heated 100 to 150°F for emulsion. This results in the oil being free from the water and therefore better than any the other means. Emulsion breaking is highly specific to the waste water and should be carefully tested in the laboratory before choosing the process.

3.6. Electrostatic Cleaning

Electrostatic separators remove brine and sediments from crude oil. Based on this a new technique has been developed for application of this principle to recover waste oil.

3.7. Extraction

Certain compounds can be separated by selective extraction. Many times though, the properties of the extracted oil are altered. For example pentane may precipitate materials which are dissolved in oil rather than suspended while benzene may hold in solution, materials which are actually insoluble in oil itself.

3.8 Acid Treatment

Sulfuric acid treatment can break emulsions and separate the saturated naphthenic and paraffinic molecules. Sulfuric acid also acts as an extraction medium for removing dirt, additives, color bodies and other materials from the waste oil. The spent acid consists of organic sulfuric acids of various types, all of which must be disposed off as process waste.

Apart from the processes described above, other processes like agitation in which emulsions may be broken down by vigorous agitation, and centrifugation with some improvements can also be used as effective methods for separating materials and there by recovering oil. Also the possibility of subjecting emulsions to ultrasonic vibration has been investigated, but data is not available to assess the effectiveness of this technique.

3.9 Acid Clay Process [8]

The acid/clay process has dominated the re-refining industry. This process is mainly used for recovering automotive oils. A schematic diagram is shown in fig.3.1 and

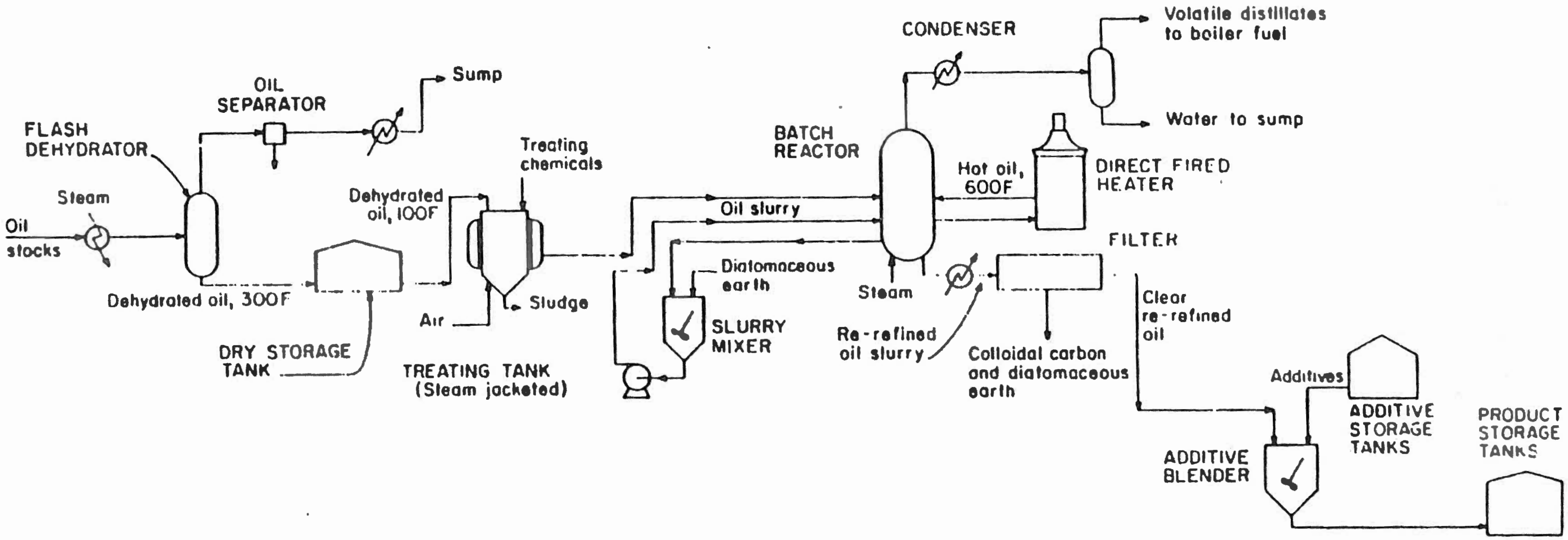

Fig. 3.1 Acid - Clay Process [8, pp. 18]

a brief description of the process is given below.

The incoming materials are unloaded into a receiving tank. The oil is then decanted and transferred to feed storage tanks and the water layer is pumped to a skimmer and then to waste water disposal.

The feed is pumped through a steam heat exchanger to the flash dehydrator which operates at 300°F and atmospheric pressure. The steam/oil overhead is condensed and separated The dehydrated oil is usually pumped directly to dry oil tanks, where it is stored and cooled. After 48 hours of storage the oil temperature will drop to 100°F. Dry oil is pumped into one of the several acid treating units, which will have 93% sulfuric acid and are maintained at 100°F. The oxidized products in the oil are removed by the acid within 24 hours. The acid sludge produced is one of the most critical problems in this process.

The acid-treated dehydrated oil is then transferred to the stream stripping clay treating operations. The purpose of this operation is to remove the remaining light fuel fractions and other compounds which may be present. The seam stripped materials are condensed and the oil is separated from the water. The water fraction is treated through the wastewater system and the oil fraction is used as plant fuel. The hot oil is filtered through a series of filters containing additives. The residue left is uneconomical to separate and recover. It must therefore be discarded usually by landfill, after making sure that it conforms to all the standards applicable to the disposal of the residue.

Odors can be a problem in acid-clay process. They can be controlled by sealing open tanks and also by good house keeping practices. Some plants employ caustic scrubbers to treat gases vented from the treating steps.

The oil produced by acid/clay process is equivalent to an SAE 20 oil. The viscosity index of the re-refined oil normally exceeds 90. For high performance specifications and high index requirements conventional additive packages are used.

3.10 NORCO Distillation Process [8]

The NORCO distillation process uses settling and distillation techniques. The schematic diagram is as shown in fig.3.2. In this process, waste crankcase oil is settled to remove heavy solids and water and then it is charged to a flash heater and tower combination where residual water and low boiling naphtha are removed. The bottoms of the flash tower are subjected to fractional distillation at relatively low vacuum. In the vacuum distillation tower the feed is separated into a bottoms product, a light overhead product and a middle-heavy cut.

This process uses condensers to maintain vacuum and thus requires decanting to separate the overhead light naphthas from the cooling water. This light naphtha may be used as fuel for the plant and the heavy products may be used for lubricants, rubber oil, fuels and similar applications.
The soaking operation performed in this process attempts to

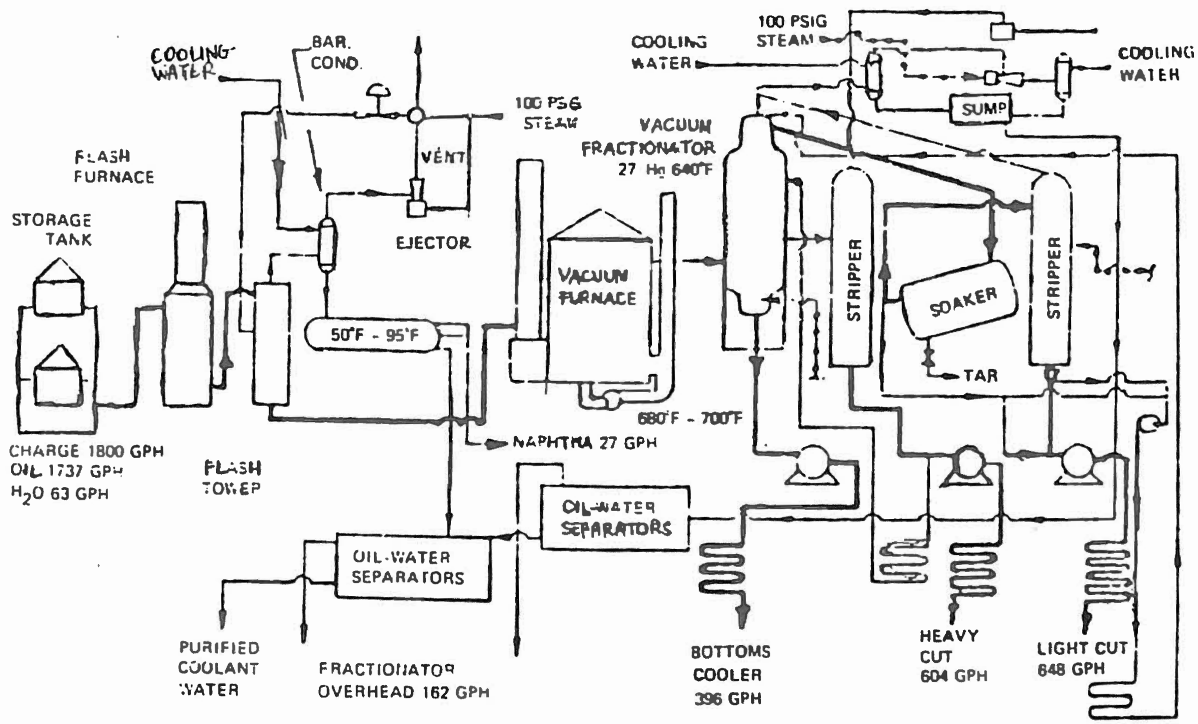

Fig. 3.2 NORCO Distillation Process[8, pp. 20]

stabilize the precipitation of tarry bodies and other insoluble materials from the oil.

It is found that burning with untreated crankcase oils can cause serious maintenance problem with burners and also can cause health problems due to the discharge of heavy metals in the exhaust gas. Efforts were made to find suitable method to remove suspended solids. Processes like filtration and centrifugation were found to yield good results in this regard.

CHAPTER - 4

INDUSTRIAL RECYCLING PROCESS

Many industrial establishments practice in-house purification of lubricating oils for various types of operations like transformer oil and metal working lubricant applications. Recycling should be one of the top priorities of any industry because it can change be cost effective.

In this chapter some of the popular processes for recycling are described.

4.1 Filtration

Filtration using diatomaceous earth and tubular filters has been used for purification and recirculation of oil resulting from the manufacture of rolled aluminum products.

First, the oil to be purified is mixed with a small amount of filter aid as it is pumped into the filter for purification. A number of oil re-refining operators have used diatomaceous earth filtration either on a rotary precoat filter or fixed media tubular or plate filters.

Waste turbine oils also refined by clay bleaching can be purified further by the use of diatomaceous earth filtration. In this operation, the filter is used to precoat plate and frame filter presses or tubular filters after which the clay bearing used turbine oil is filtered to remove any suspended organic contaminants and the bleaching clay.

In a cutting oil reclaiming process the oil is separated from the metal chips, allowed to settle at room temperature and then is mixed with filter aid and filtered on a horizontal plate filter equipped with filter paper. The reclaimed lubricating oil is used either directly for lubricating purposes or by blending with disinfectants and oil additives for cutting purposes.

4.2 Vacuum Distillation

Straight cutting oil frequently contains volatile ingredients including solvents and moisture. These impurities can be removed by vacuum distillation which effectively purifies the oil and renders it suitable for reuse or further processing. The vacuum still is operated at a pressure just low enough to remove volatile materials. Once these are removed, the liquid in the evaporator sump is pumped either to another purification system, like clay treatment or is sent to storage.

4.3 Dalton's Process [8]

Dalton and Co.Ltd., England has been reclaiming various grades of synthetic lubricants and hydraulic fluids. A simplified diagram of Dalton process for reclaiming turbine lubricant is given in figure 4.1.

The adsorbent is removed in a pressure leaf-filter and the purified turbine lube is further filtered through a fine medium to remove very small residual insoluble matter. Depending on the results of oxidation stability tests, chemical and chromatography tests, specific additives are replaced in the final step.

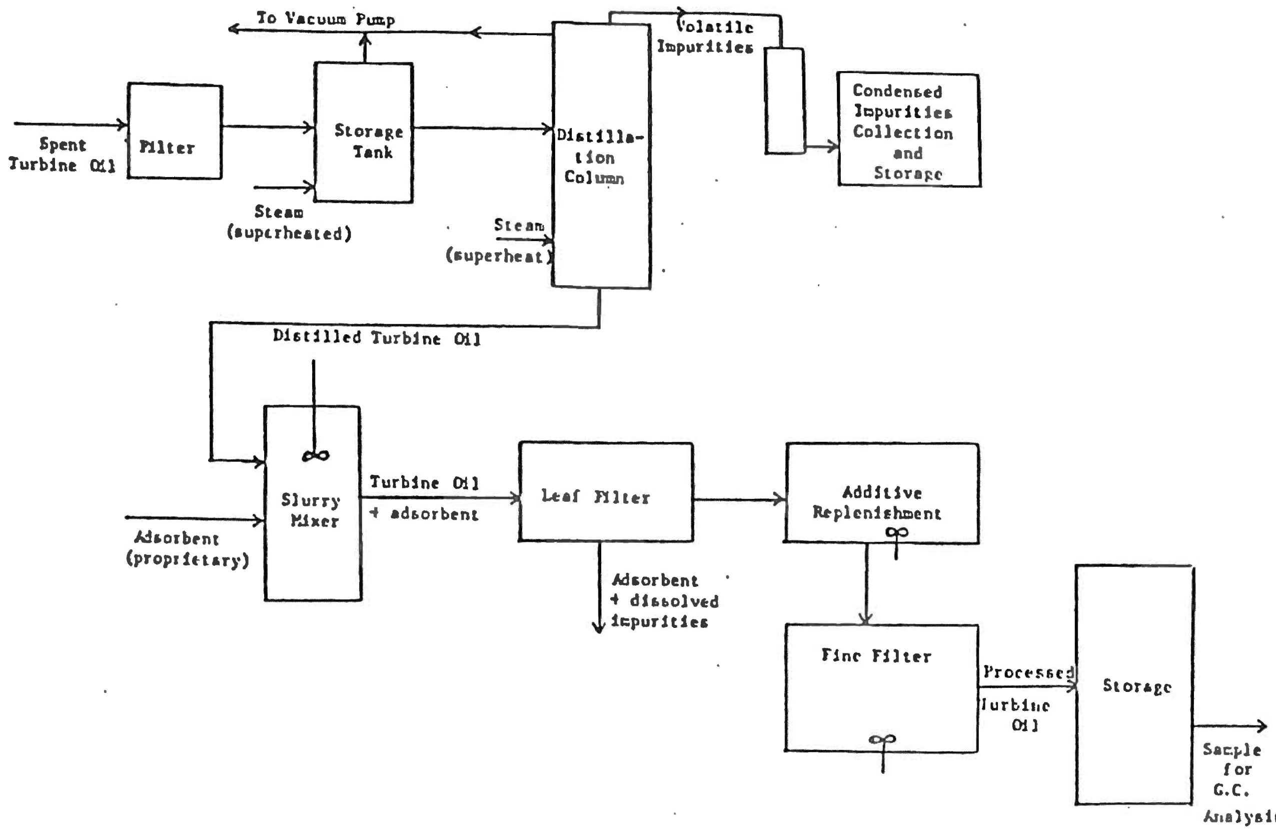

Fig. 4.1 Dalton's Process [8, pp. 52]

4.4 Settling

Cutting oils for machining operations have been reclaimed industrially for a long time. In a typical operation, the cutting oils are separated from all the chips by means of a chip extractor and then made to settle in a vertical storage tank. After that, oil without heavy solids is heated to about 180°F and maintained at that temperature for several hours to permit settling of finer particles and purified on a centrifugal separator. The clarified oil is then cooled and can be used as desired [8].

Whenever large quantities of lubricants are required for operation (for eg.,steel mill) waste oils are recovered by settling followed by skimming. The treated waste oil can be used as fuel in mill operation [5].

CHAPTER - 5

DISPOSAL OF WASTE OIL

In recent years disposal of any hazardous waste is a problem because of the stringent regulations. Before disposing of using a particular method, one should make sure that all regulations have been satisfied. Agencies are constantly monitoring for any possible violations and if there are any they can be costly.

In this chapter, some of the factors affecting the disposal, and possible options for used oil are discussed briefly.

5.1 Factors Affecting the Selection of Method of Disposal[8]

There are number of factors which affect the selection of disposal, depending upon the type of waste and also on the location of the facility. The most important are economics and degree of contamination.

5.1.1 Economics

Economic consideration is one of the prime important factors in selecting the disposal option. The most economical method selected may sometimes violate the regulations. The following are the points which contribute towards the cost:

- Transportation
- Capital equipment if any, to implement the system
- Cost of collecting the Waste oil

There are instances where just the cost of transportation has affected the actual economic advantage offered by a specific technique.

5.1.2. Degree of Contamination

The degree of contamination and mixing with other wastes will greatly affect the disposal of any waste product. Most damaging contaminants are lead and halogen compounds. Each disposal facility/equipment will have certain composition requirements/limitations which may prohibit the presence of specific contaminants. In this connection it is usually very important not to mix wastes.

5.1.3. Other Factors

Other factors affecting the selection of disposal/recycle include, availability of entrepreneurs, quantity of waste oil to be handled, and regulations.

The problem of the availability of entrepreneurs is also interlinked with economics. This is due to the fact that even though there are entrepreneurs, they may not be located close to a facility, in which case the cost of transportation becomes extremely high. Also, the factor of mixing wastes may limit the capabilities of a particular entrepreneur to handle that waste.

The quantity of used oil generated contributes significantly to the determination of the method of disposal. If the quantity generated is too low, then the cost involved may not justify the disposal option. In such cases the facility might accumulate the waste as allowed and then try to dispose thereby justifying the cost.

Lastly, environmental factor is a very important factor, influencing the waste disposal, particularly for surface disposal methods. This factor is largely taken care of by federal regulations, but some states may have more stringent regulations which need to be carefully examined.

5.2 Disposal Methods

In the past, various indirect methods of disposal like application of crankcase oil to livestock to prevent pests, road oiling, and using as a fuel were practiced. Almost all of them have been eliminated now.

The methods in practice today are incineration and fuels burning. Although the emissions due to incineration are of concern, the EPA has tough standards. Fuels burning is popular because of the fact that they involve recovery of energy. Also, the waste oil if suitable can be used for lubrication purposes.

Another common method is use of waste oil as fuel. Some times the waste oil can easily be used as fuel depending on the content of lead. Waste oils are generally used as primary fuel in commercial boilers and space heaters and as supplementary fuel in larger industrial boilers. But, these boilers may emit toxic constituents to the atmosphere. The concentration of these contaminants may be significant to classify the residual ash as hazardous waste [5].

Various commercial methods are available for disposal of used oil. These can be considered after making a cost analysis regarding the pay-back and the effectiveness of the equipment to a particular type of used oil. The names of the vendors and some equipments are given in Table 4.1 for reference. The addresses of the vendors are given in appendix A9.

Equipment	Mode of operation	Vendor
Hotsy oil water separator	Gravity separation	The Hotsy Corp.,
Clean Burn Furnace	Oil burning	Clean Burn Waste Oil furnaces
Cook's disposal System	Squeezing soak pads	Cook's Industrial Lubricants, Inc.

Table 5.1 Equipments and vendors for waste oil disposal.

The above systems may not be suitable for all types of waste oils. It is recommended to refer to the literature of the equipments available with the vendor for a detailed understanding.

CHAPTER - 6

AN OVERVIEW OF REGULATIONS

In this chapter the regulatory aspects of used oil management are discussed. A brief history of the regulations is provided to give an understanding of the background in which the regulations were promulgated. Recent changes in the regulations due to which some standards were moved from 40 CFR 266 to 40 CFR 279 have also been mentioned. If more information is needed the references given in the parentheses can be consulted.

6.1. A Brief History

On December 18, 1978 EPA initially proposed guidelines and regulations for the management of hazardous waste as well as specific rules for the identification and listing of hazardous waste under section 3001 of RCRA (43 FR 58946). At that time EPA also proposed to list waste lubricating oil, waste hydraulic and cutting oil as hazardous waste on the basis of toxicity.

In addition, the agency proposed recycling regulations to regulate: [19]

1. The incineration or burning of used, lubricating, hydraulic, transformer, transmission or cutting oils that were hazardous.
2. Use of waste oil in a manner that constituted disposal.

On November 29, 1985 EPA proposed to list all used oil as hazardous waste including petroleum derived and synthetic oils, based on presence of toxic constituents at levels of concern from contamination during use and adulteration after use.

Currently there are several regulatory programs in place to control the storage and transportation of used oil, to protect against releases to ground, ground water and surface water to protect against improper disposal of used oil. EPA also decided that these are not enough to protect human health and environment from potential mismanagement of recycled used oils. Therefore apart from the existing regulations, used oil handlers will have to comply with additional management standards.

But the new standards promulgated on September 10, 1992 [19] protect human health and environment from mismanagement of recycled used oil without imposing undue regulatory and financial burden on recycling systems.

The primary groups affected by the new used oil management standards are the transporters and processors of used oil destined for recycling. However, many of these businesses have already fulfilled the requirements for notifying EPA, obtaining an EPA ID number, and instituting effective management practice and spill control plans.

A summary of the issues addressed by each subpart of 40 CFR 279 and responsibilities created for various groups associated is given later.

Subpart A gives the definition of the terms used in the regulations. Subpart B defines the applicability of the standards to various waste oil producing/handling facilities.

USED OIL NOT EXCEEDING ANY SPECIFICATION LEVEL IS NOT SUBJECT TO THIS PART WHEN BURNED FOR ENERGY RECOVERY [1]

Constituent/property	Allowable level
Arsenic	5 ppm maximum.
Cadmium	2 ppm maximum.
Chromium	10 ppm maximum.
Lead	100 ppm maximum.
Flash point	100 °F minimum.
Total halogens	4,000 ppm maximum.[2]

[1] The specification does not apply to mixtures of used oil and hazardous waste that continue to be regulated as hazardous waste (see § 279.10(b)).

[2] Used oil containing more than 1,000 ppm total halogens is presumed to be a hazardous waste under the rebuttable presumption provided under § 279.10(b)(1). Such used oil is subject to subpart H of part 266 of this chapter rather than this part when burned for energy recovery unless the presumption of mixing can be successfully rebutted.

Table 6.1 Used Oil Specification Levels [19, pp. 41615]

The following are some of the terms defined in 40 CFR 279.1 [19].

Container means any portable device in which a material is stored, transported, treated, disposed of or otherwise handled.

Do-it-yourself used oil collection center means any site or facility that accepts/aggregates and stores used oil collected only from household do-it-yourselfers.

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

Tanks means any stationary device, designed to contain an accumulation of used oil which is constructed primarily of non-earthen materials.

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

Used oil burner means a facility where used oil not meeting specification requirements in section 279.11 is burned for energy recovery in devices identified in section 279.61(a).

Used oil burned for energy recovery and any fuel produced from used oil by processing, blending, or other treatment is subject to regulation under section 279.11 if it is found to exceed any of the allowable levels given in the Table 1 of this section.

6.2. Subpart C - Standards for Used Oil Generators

A used oil generator is any person, by site, whose act or process produces used oil or whose act first causes used oil to become subject to regulations.

This subpart is applicable to all generators except

- Household do-it-yourselfers
- Vessels at sea or port
- Mixtures of used oil and diesel fuel mixed by generator for use in own vehicles
- Farmers who generate a total of 25 gallons/month or less

Used oil generator conducting following activities are subjected to this part. The applicable provisions are:

- Generator who transport oil - **subpart E**
- Generator who burn off-specification oil for energy recovery except site space heater - **subpart G**
- Generator disposing oil as a dust suppressant - **subpart I**

Section 279.21 provides provision for rebuttable presumption. Under this, used oil containing 1000 ppm total halogens is presumed to be a hazardous waste and thus it must be managed as a hazardous waste and not as used oil unless the presumption is rebutted. The rebuttable presumption is not applicable to certain metal working oils/fluids and certain used oils removed from refrigeration units.

Section 279.22 lists the standards for used oil storage. According to this generators are subject to all SPCC, UST standards even if they do not exhibit characteristics of hazardous waste, in addition to the requirements of this subpart. This part also specifies the requirements for storage units, its condition, labeling and responses to the release.

6.3 Subpart D - Standards For Collection Centers and Aggregation Points [19]

Subpart D has standards for used oil collection centers and aggregation points of various types like do-it - yourselfers, used oil collection centers, and aggregation points owned by the generator.

6.4 Subpart E - Standards for Transporters and Transfer Facilities [19]

Subpart E gives standards applicable for all oil transporters, and owners and operators of transfer facilities. In addition, there are requirements for

- Transporters who are not processors or refiners
- Deliveries, shipping and used oil discharges
- Used oil storage at transfer facilities

The following are exempted from this subpart

- On site transports
- Generators transporting 55 gallons or less
- Generator transporting 55 gallons or less from generator of an aggregate point owned or operated by generator.

6.5. Subpart - F Standards For Used Oil Processors and Re-Refiners [19]

Subpart F is applicable to owners and operators of facilities that process used oil. There are requirements for general facility standards like preparedness and prevention, arrangements with local authority, contingency plan and emergency procedures.

6.6 **Subpart G - Standards For Burners For Energy Recovery** [19]

The requirements of this part are applicable to all burners and facilities burning oil for energy recovery. However, the following are exempted.

- Used oil burned by generators in an on-site space heater
- The used oil burned by processor/re-refiner for the purpose of processing oil.

Subpart H gives standards for used oil fuel marketers, whereas **subpart I** has standards for use as dust suppressant and disposal of used oil.

The new standards, which were announced in September 92 will become effective on March 8, 1993 instates that are not RCRA authorized (Alaska, Hawaii, Iowa, and Wyoming).

In RCRA authorized states, the states must adopt the standards by: [20]

- July 1, 1994, in states with statutes that allow adoption of the standards
- July 1, 1995, in states without statutes in place for adoption of the standard. (These states must create the necessary statutes and then, in turn adopt the standards).

In this chapter, a brief description of the location, along with the highlights of regulations governing used oil was given to provide an insight. For details and better understanding, it is advisable to refer to the regulations itself. Tables which give listing of all the sections are given in the appendices A1 - A6.

CHAPTER - 7

WASTE OIL MANAGEMENT - A GENERATOR'S VIEW

In the preceding chapters information about used oil composition, recycling, recovery and the regulations governing them were given. However, as a generator one needs to be aware of the regulations applicable to them in detail and also the possible options to manage used oil. Keeping this in mind, an attempt has been made to provide information regarding management of waste oil from generator's point of interest.

7.1 Applicability of Regulations

According to the definition given in 40 CFR 279, a used oil generator is any person whose act or process produces used oil or whose act first causes the oil to become subject to the regulation [19].

The agency decided to regulate all used oil generators under one set of minimum management standards. The rule promulgated on 10 September 1992, does not exempt any class of generator based upon the generation rate. This approach minimizes complexity by placing all used oil generators under uniform regulatory requirements. It eliminates the need for measuring quantities of used oil collected and stored each month. Above all the approach eliminates the concern that the generators could be subjected to more stringent regulations if the quantity of waste oil generated exceeds a particular figure.

Therefore if a facility is classified as a generator, irrespective of the quantity they produce it will be subjected to the same set of regulations as others.

7.1.1 Used oil Generated On Ships [19]

In the case of used oils generated by ships or vessels (as defined in 40 CFR 260.10), these oils are not subjected to the used oil management standards until the used oils are transported ashore. When used oils are removed from a ship or vessel taken ashore, the owner or operator of the ship or vessel and the person removing or accepting the used oil from the vessel are co-generators of used oil and both parties are subjected to generator standards.

7.1.2 On-Site Management of Used Oil [19]

Generators who blend used oil with diesel fuel for use in their own vehicles need not manage the used oil/diesel fuel mixture in accordance with the generator requirements of part 279.

Used oil generators who dispose of used oil on-site must test the used oil or apply their knowledge to determine whether or not used oil exhibits a hazardous waste characteristic. When disposing used oil that cannot be recycled, the generator must comply with subpart I of part 279, relating to proper management and disposal of waste oil.

7.1.3 On-site Storage [19]

Used oil generators are required to store used oil in tanks or containers and must maintain all tanks and containers in good condition, making sure that they are free of leaks and spills. The tanks and containers stored above ground should be labelled "Used Oil". Generators covered under SPCC program will be subjected to the requirements of 40 CFR part 112.

7.1.4 Off-site Transport [19]

Generators should ensure that all shipments of used oil greater than 55 gallons are transported only by transporters who have EPA identification number. A used oil generator is not required to obtain an EPA identification number for off-site transportation activity.

7.1.5 Accumulation Limit [19]

Although EPA proposed, both in 1985 and in 1991, to restrict the accumulation of used oils stored by generators but now there is no limit for oil storage.

7.1.6 Tracking Requirements [19]

EPA has determined that information maintained by used oil transporters will provide sufficient records of shipping activities without burdening used oil generators with additional tracking requirements. Therefore the agency has eliminated the proposed tracking requirements for used oil generators.

7.1.7 Inspection Requirements [19]

In 1985 and 1991 EPA proposed daily inspection requirements for used oil generators to assure the discovery of used oil spills at used oil generator facilities. SPCC inspection and clean up requirements will be applicable.

7.1.8 Closure Requirements [19]

Since the agency has determined that the damage at oil generator site is not substantial to threaten the environment, it believes that closure requirements are not necessary at this point. However, EPA has deferred such requirements.

7.2 Cost of Compliance

One of the major impacts of the new regulations is on the cost of compliance. A historical comparison of compliance costs given in table 7.1 shows that the new regulations have brought down the cost.

[Millions of 1991 dollars per year]

Listing recycled used oil as hazardous waste without tailored 3014 standards (1985 proposal option updated to 1991) [1]	$500
Section 3014 management options (1985 proposal updated to 1991) [2]	$204
1991 supplemental notice [3]	$2–25
1992 final rule	$4–11

[1] Option assumed burning as used oil fuel under part 266, subpart E, rather than as hazardous waste under subparts D and H. Costs are updated to 1991 from the 1985 RIA to allow for inflation and certain intervening regulatory changes such as the underground storage tank (UST) rule. However, costs for this historical proposal do not include estimates for corrective action for prior releases or cost implications of the mixture and derived from rules. Costs are not revised to address comments on the 1985 proposed rule.

[2] Costs updated from the 1985 RIA to allow for inflation, but not to respond to comments.

[3] Costs are as presented in table X.D.1. (56 FR 48071, September 23, 1991). They are not revised to address comments. However, see subsection A.2 below for discussion of other cost estimates.

Table 7.1 Historical Comparison of Compliance Costs [19, pp. 41607]

Requirement	Generators	Independent collectors	Burners (off-spec)	Processors/ rerefiners/fuel oil dealers	Totals
Storage:					
Label tanks and drums	502	2	3	4–5	511–512
Drums and tanks in "good" condition	61–99	(*)	(*)	(*)	61–99
Secondary containment		15–179	11–138	59–964	65–1,201
Reporting, planning, recordkeeping:					
Identification numbers		1	(*)	(*)	1
Biennial report				118–155	118–155
Analysis plan				9–12	9–12
Contingency plan				86–118	86–116
Shipment and delivery records		(*)	(*)	(*)	
Operating record				435–590	435–590
Closure				813–2,038	813–2,038
Response to environmental releases	2,183–5,261	5	(*)	3–4	2,191–5,270
Totals	2,746–5863	23–187	14–141	1,327–4,784	4,110–10,975

*, Indicates the facility type is subject to the requirement, but no incremental cost is incurred, while a blank space indicates the facility type is not subject to the requirement.

Table 7.2 Nationwide Annual Compliance Costs for Used Oil Management Standards [19, pp. 41608]

Table 7.2 shows the annual cost of compliance for various handlers of used oil. Even though the cost seems to be high, when compared to penalties for non compliance this amount is worth spending to ensure full compliance.

These regulations are the basics which are applicable to all facilities. A list of all the sections applicable to generators is given in appendix A2 for reference. Apart from making sure that they are in full compliance with regulations the generators have to be on the look out for efficient methods of control and management of used oil.

In general control of oil wastes and its management can be classified into four categories: In-plant measures, pretreatment, effluent treatment, and ultimate disposal of oil[1].

In-plant Measures [1]

1. Proper design of oil emulsion coolant or lubricant recirculation system to reduce the quantity wasted.
2. Use of bactericides such as cresylic acid, dichlorophenol to extend the life of coolant or lubricant in the recirculation system.
3. Use of bags or vacuum filters or solid bowl centrifuges to separate solids from water.
4. Use of solvent extraction for recovery of oil or other organic compounds.
5. Chemical precipitation of selected process waste streams to remove metals at source.
6. Containment and segregation of spent caustic to avoid

formation of oil emulsion.

7. Segregation of highly emulsified oil, acid, alkaline or toxic waste, to facilitate pretreatment.

Pretreatment [1]

Pretreatment can be for discharging to municipal/industrial treatment system or further on-site effluent treatment.

1. Gravity separation to remove free flotable oil and settleable solids.
2. Treatment with steam, acid, alum, or iron salts to break oil emulsions.
3. Use of chemical coagulation to remove suspended solids and emulsified oil
4. Chemical precipitation of metals with lime or caustic.
5. Neutralization of excess acidity or alkalinity.

Effluent Treatment [1]

1. Biological treatment such as activated sludge, trickling filter, or aerated lagoon to reduce or remove biochemical oxygen demand (BOD), soluble oil and solids
2. Use of deep-bed filters
3. Use of activated carbon to adsorb biodegradable as well as non-biodegradable dissolved solids.

Ultimate Disposal [1]

1. Re-refining to recover oil for reuse
2. Incineration in furnaces to recover heat values
3. Incineration in multiple-hearth furnaces, fluidized beds, or special liquid waste incinerators (need scrubbers to

control air pollution).

4. Disposal of dewatered sludge or incinerated residues in approved sanitary landfills.

Each method/process will have its limitation. The selection of any option should be based on the factors explained in chapter 5. Treatment efficiency will vary depending upon the initial concentrations of raw wastes.

On the whole, the generator of used oil is required to understand the compliance requirements completely, be aware of any change in regulations, have updated information on the technology and explore efficient ways of control of used oil. All these measures will make the management of used oil less complicated and less risky.

CHAPTER - 8

CASE STUDIES

Any industry needs to constantly evaluate possible ways and methods of waste elimination, minimization and reuse because of ever increasing compliance costs and liability concerns. The increased public awareness has forced the industries to be extremely careful while handling waste.

At the same time the industry has to consider factors like feasibility and cost effectiveness while trying to change the systems. Often it may not be possible for the industry to go for sophisticated methods due to prohibitive costs. Therefore steps like consulting other companies, writing to journals regarding the problem, consulting specialists and attending conferences might yield results which are economical and at the same time effective.

Some of such problems and the solutions to them are given in the following studies.

8.1. Case Study 1

Centrifugal Reconditioning to Recycle Oil And Cut Waste [17]

Standard Lock and Washer Manufacturing Co. of Worcester, Massachussets makes fasteners, valve balls and a variety of nuts. The sulfur based cutting oil used during production, once dirty, loses its effectiveness and becomes difficult to dispose.

The oil extractor which was used recovered 99% of cutting oil. However, oil in this state contain microorganisms causing it to pollute the new oil. The contaminants affected the finish of the end products also. An outside service charged $300/barrel to dispose of the sludge.

The company installed centrifugal Centech 1000, a machine that is designed to recondition the reclaimed oil. There was a significant change in the quality of the oil reclaimed. Also, this measure eliminated the excess oil the company had to purchase.

Thus the company not only saved money on buying new oil but also on disposal costs. It reduced the compliance standards and the liability associated.

8.2 Case study 2

Gear Lube System Cuts Costs and Waste [18]

An enclosed gear lubrication system for cement kilns which was developed recently, which is expected to reduce the high cost of disposing of used lubricants, which in many states are considered hazardous.

Mobil Oil Corp.'s enclosed gear lubrication system was first installed at the Evansville plant. The company has reported that in the first six months the system has

- Eliminated the hazardous waste problem because the oil remains in service
- Reduced gear wear
- Lowered gear operating temperatures by 20°F

The major changes to be made in the open system are changing the lubricant to one which has a higher viscosity and developing a circulating system.

The Mobil system is expected to cost $60,000, including system components, cleaning gears of old open gear lube, installation and the initial charge of the lubricant. However, considering that using open-gear lubricant where disposal costs are as high as $250,000 a year in some states, this system has a fast payback.

8.3. Case Study 3

Dissolved Air Flotation cuts Oil/Grease in waste water [15]

Dayton's Oklahoma City manufacturing plant exceeded city's 1000 ppm limit for oil and grease discharged to publicly owned treatment works (POTW).

Roberts/Schornick and associates Inc., a consulting firm determined that majority of the oil and grease was coming from one line, which carried waste water from processing area as well as the cafeteria.

A dissolved air flotation system from Tenco Hydro Inc, Brookfield, IL was selected. The clari-float uses chemical coagulation and flocculation in combination with dissolved air flotation.

A portion of the effluent is recycled with air through pressurized solution column, mixed with additional wastewater and sent through a patented diffuser to the flotation tank. Air is released from the solution in the form of rapidly raising pinpoint bubbles that attach themselves to suspended solids. These solids float to the top of the tank and are removed by a rotating skimmer. Floated sludge is collected and sent for off-site disposal, conforming to the applicable regulations.

By adopting the new system the facility brought down the oil/grease content in the wastewater to well within the 1000 ppm limit prescribed. The Tenco Hydro company confirmed this fact by running some sample tests on the wastewater after the system was adopted.

The case studies have demonstrated that there are numerous ways of minimizing the waste which can result in substantial savings. The industries need to be on the look out for such opportunities. This will not only ensure the growth of the company but also will help keep the environment in a better condition without giving up the comforts we enjoy today.

SUMMARY

Increased public concern over the environment in the recent years has forced the government to bring out tougher regulations protecting the environment. The agency and the industries should work together and show the committment towards protecting the environment, which will alleviate the fears of the public.

The vast quantities of used oil generated on an annual basis in this country represent a great source if managed properly. The future of the technologies associated with the reuse of these materials are directly related to costs associated with environmental regulations. The industries have a greater burden to bear because they have to look out for new ways of cost reduction to make up for the compliance costs, and at the same time produce quality products.

Keeping the above factors in mind the current regulations reflecting the environmental concern, recycle, recovery and the disposal options described in this report will continue to play a major role in the management of used oils.

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17. "Fastener Firm Locks on Centrifugal Reconditioning to Recycle Oil and Cut Waste Oil", Modern Machine Shop, v64, pp124, June 1991.

18. "Gear Lube System Cuts Waste", Rock Products, v95, pp33, July, 1992.

19. "Rules and Regulations", Federal Register, vol. 57, No. 176, Thursday, September 10, 1992.

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Appendix

USED OIL

[General standards]

Requirement	New or existing	Regulatory citation
Recycling presumption	New	§ 279.10(a).
Mixtures of used oil with hazardous waste	Existing	§ 279.10(b).
Rebuttable presumption for used oil	Existing	§ 279.10(b)(1)(ii) and § 261.3(a)(2)(v).
Exceptions from rebuttable presumption for CFC and metalworking oils.	New	§ 279.10(b)(1)(ii) (A) and (B) and § 261.3(a)(2)(v) (A) and (B).
Mixtures of used oil with non-hazardous waste	Existing	§ 279.10(c).
Mixtures of used oil with products	New	§ 279.10(d).
Materials derived from used oil	New	§ 279.10(e).
Conditional exemption—wastewater	New	§ 279.10(f).
Used oil introduced into crude oil or natural gas pipelines	New	§ 279.10(g).
Used oil on vessels	New	§ 279.10(e)(3), § 279.10(h), and § 279.20(a)(2).
PCB contaminated used oils	New	§ 279.10(i).
Used oil specification	Existing	§ 279.11.
Surface impoundment/waste pile prohibition except for units operated under Part 264/265 requirements.	New	§ 279.12(a).
Prohibition on use as a dust suppressant	New	§ 279.12(b).
Prohibition on burning in other than certain units	Existing	279.12(c).

Appendix A1 General Standards [19, pp. 41580]

USED OIL

[Generator standards]

Requirement	New or existing	Regulatory citation
Used oil on vessels	New	§ 279.20(a)(2).
Mixtures of used oil and diesel fuel	New	§ 279.20(a)(3).
Farmers	New	§ 279.20(a)(4).
Generators who perform other management activities	New	§ 279.20(b).
Hazardous waste mixing	New	§ 279.21.
Type of storage units	New	§ 279.22(a).
Good condition above ground tanks and containers	New	§ 279.22(b).
Labelling of tanks and containers	New	§ 279.22(c).
Response to used oil releases from above ground storage units	New	§ 279.22(d).
On-site burning in space heaters	Existing	§ 279.23.
Off-site shipment	New	§ 279.24.
SPCC requirements, including spill prevention and control	Existing (applicable independently)	40 CFR part 112.
UST requirements, including corrective action and financial responsibility.	Existing (applicable independently)	40 CFR part 280.
Accumulation limit	NA	None.
Inspection requirements	NA	None.
Closure	NA	None.
Collection Centers:		
Do-it-yourselfer collection centers	New	§ 279.30.
Used oil collection centers	New	§ 279.31.
Used oil aggregation points	New	§ 279.32.

Appendix A2 Generator Standards [19, pp. 41584]

Requirement	New or existing	Regulatory citation
Processors who perform other management activities	New	§ 279.50(a).
Notification and EPA identification number	Existing for processors/re-refiners who are marketers; new for others.	§ 279.51.
Preparedness and prevention	New	§ 279.52(a).
Contingency plan and emergency procedures	New	§ 279.52(b).
Rebuttable presumption for used oil	Existing for processors/re-refiners managing used oil fuel	§ 279.53 (a), (b), and (c).
Exceptions from rebuttable presumption for CFC and metal-working oils.	New	§ 279.53(c) (1) and (2).
Type of management units	New	§ 279.54(a).
Good condition above ground tanks and containers	New	§ 279.54(b).
Secondary containment for containers and existing and new above ground tanks.	New	§ 279.54 (c), (d), and (e).
Labelling of containers and tanks	New	§ 279.54(f)
Response to releases	New	§ 279.54(g).
Closure for containers and above ground tanks	New	§ 279.54(h).
Analysis plan	New	§ 279.55.
Indicator parameters	N.A.	None.
Tracking—acceptance, deliveries, and recordkeeping	Existing for processors/re-refiners who are marketers (invoices); new for others.	§ 279.56.
Operating record	New	§ 279.57(a).
Biennial reporting	New	§ 279.57(b).
Off-site shipment	New	§ 279.58.
Management of residues	New	§ 279.59.
SPCC requirements, including spill prevention and control	Existing (applicable independently)	40 CFR Part 112.
UST requirements, including corrective action and financial responsibility.	Existing (applicable independently)	40 CFR Part 280.
Inspections	N.A.	None.

Appendix A3 Standards for Used Oil Processors and Re-refiners [19, pp. 41593]

STANDARDS FOR MARKETERS OF USED OIL FUEL

Requirement	New or existing	Regulatory citation
Prohibitions	Existing	§ 279.71.
On-specification used oil-analysis	Existing	§ 279.72.
Notification and EPA identification number	Existing	§ 279.73.
Tracking—off-specification fuel	Existing (invoices)	§ 279.74(a).
Tracking—on-specification fuel	Existing	§ 279.74(b).
Recordkeeping	Existing	§ 279.74(c).
Certification	Existing	§ 279.75.

Appendix A4 Standards for Marketers of Used Oil Fuel [19, pp. 41601]

Requirement	New or existing	Regulatory citation
General requirements	New	§ 279.40(a) through (c).
Transporters who perform other management activities	New	§ 279.40(d).
Restriction on processing used oil	New	§ 279.41.
Notification and EPA identification number	Existing for transporters who are marketers; new for others	§ 279.42.
Used oil deliveries	New	§ 279.43(a).
DOT requirements	Existing (applicable independently)	§ 279.43(b).
Used oil discharges	New	§ 279.43(c).
Rebuttable presumption for used oil	Existing for transporters managing used oil fuel; new for others	§ 279.44(a), (b), and (c).
Exceptions from rebuttable presumption for CFC and metal-working oils.	New	§ 279.44(c)(1) and (2).
Record retention for rebuttable presumption	New	§ 279.44(d).
Recordkeeping	New	§ 279.44(d).
Storage limit	New	§ 279.45(a).
Type of storage units	New	§ 279.45(b).
Good condition above ground tanks and containers	New	§ 279.45(c).
Secondary containment for containers and existing and new above ground tanks.	New	§ 279.45(d), (e) and (f).
Labelling of containers and tanks	New	§ 279.45(g).
Response to releases	New	§ 279.45(h).
Tracking—acceptance, deliveries, export, and recordkeeping	Existing for transporters who are marketers (invoices); new for others.	§ 279.46(a), (b), and (c).
Tracking—exports	New	§ 279.46(d).
Management of residues	New	§ 279.47.
SPCC requirements, including spill prevention and control	Existing (applicable independently)	40 CFR part 112.
UST requirements, including corrective action and financial responsibility.	Existing (applicable independently)	40 CFR part 280.
Inspections	None	None.
Closure	None	None.

Appendix A5 Standards for Transporter and Transfer Facilities [19, pp. 41602]

Requirement	New or Existing	Regulatory citation
Burners who perform other management activities.	New	§ 279.60(b)
Restrictions on burning.	Existing	§ 279.61
Notification and EPA identification number.	Existing	§ 279.62
Rebuttable presumption for used oil.	Existing	§ 279.63(a), (b), and (c)
Exceptions from rebuttable presumption for CFC and metalworking oils.	New	§ 279.63(c)(1) and (2)
Record retention for rebuttable presumption.	New	§ 279.63(d)
Type of storage units.	New	§ 279.64(a)
Condition of tanks and containers.	New	§ 279.64(b)
Secondary containment for containers and existing and new above ground tanks.	New	§ 279.64(c), (d) and (e)
Labelling of containers and tanks.	New	§ 279.64(f)
Responses to releases.	New	§ 279.64(g)
Tracking—acceptance and recordkeeping.	Existing	§ 279.65
Certification	Existing	§ 279.66
Management of residues.	New	§ 279.67
SPCC requirements, including spill prevention and control.	Existing (applicable independently).	40 CFR Part 112
UST requirements, including corrective action and financial responsibility.	Existing (applicable independently).	40 CFR Part 280
Inspections	N.A	None
Closure	N.A	None

Appendix A6 Standards for Burners of Off-Specification Used Oil [19, pp. 41599]

Facility type	Total number of facilities	Facility cost per gallon (cents)	National average cost per gallon (cents)
Independent collector	383	0.00–0.66	0.02–0.16
Minor processors	70	0.43–2.24	0.46–1.20
Major processors	112	0.14–0.88	0.16–0.50
Rerefiners	4	0.05–0.32	0.05–0.16
Fuel oil dealers:			
Low estimate	25	0.43–2.24	[1] 0.17–0.45
High estimate	100	0.43–2.24	[1] 0.69–1.82
Total handlers:			
Low estimate	594	0.00–2.24	0.16–0.20
High estimate	669	0.00–2.24	0.48–0.58
Burners	1,155	0.00–0.22	[1] 0.00–0.03

[1] Includes both on-spec and off-spec oil, for a total of 66 million gallons for fuel oil dealers and 55.1 million gallons for burners. If considered separately, off-spec oil will be a fraction of this total, which would make the cost-per-gallon higher.

Appendix A7 National Average and Individual Facility-Level Compliance Cost per Gallon[19, pp. 41609]

ANNUAL FACILITY-LEVEL COMPLIANCE COSTS: COMMERCIAL USED OIL HANDLERS AND BURNERS

Facility type	Total number of facilities [1]	Cost range for affected facilities (dollars per year)
Independent collector	383	$6-$1,976
Minor processors	70	4,280-22,389
Major processors	112	6,909-44,155
Re-refiners	4	9,246-64,671
Fuel oil dealers:		
Low estimate	25	4,280-22,389
High estimate	100	4,280-22,389
Total handlers:		
Low estimate	594	6-64,671
High estimate	669	6-64,671
Burners	1,155	2-335

[1] The number of facilities affected by individual requirements varies by requirement, from zero cost (unaffected) up to all facilities affected.

Appendix A8 National Facility-Level Compliance Costs [19, pp. 41609]

Vendor	Address	Telephone #
Hotsy Corporation	21,Inverness Way East Englewood, Colarado 80112-5796	(303)792-5200
Clean Burn Inc.	83,South Groffadale Leola, PA 17540	(800)331-0183
Cook's Industrial Lubricants, Inc.	5,North Stiles Street Liden, New Jersey 07036	(800)526-4127
Industrial Oil Services	Oklhoma City, Oklahoma	(405)789-1098
Oil Recovery	Tulsa,Oklahoma	(405)943-8969

Appendix A9 Addresses of Vendors for Disposal of Used Oil.