POLLUTION PREVENTION

AND

WASTE MINIMIZATION

OPPORTUNITIES

FOR THE

MINING INDUSTRY

Prepared for:

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HAZARDOUS WASTE MANAGEMENT DIVISION
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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This guide is based in part on pollution prevention and waste minimization assessments conducted by the Front Range Community College's Hazardous Materials Management Program (HAZMAT) at mining operations in Wyoming and large fleet maintenance operations in Colorado. Contributors to these assessments included: Richard Barth, David Boon, Kim Lewis, and Robin Wright.

Marie B. Zanowick, Manager of the Hazardous Waste Minimization Program, Hazardous Waste Management Division, U.S. EPA Region VIII served as the project manager and pollution prevention technical expert for the **P2 and Waste Minimization Opportunities for the Mining Industry** project.

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NOTE:

State regulations may preclude the use of some of the recommendations listed in this guidance document. For instance, used oil is considered a hazardous waste in some states and needs to be handled according to hazardous waste regulations.

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1.0 INTRODUCTION

1.1 BACKGROUND

Each year mining operations use thousands of gallons of solvents and generate millions of gallons of used oil, greases, and lubricants during routine maintenance and repair of heavy equipment. There are opportunities to reduce the amount of waste generated through source reduction, product substitution, equipment and/or process modifications, better management, inventory/purchasing control practices and recycling.

This guide is designed to provide the surface mining operations with pollution prevention (P2) and waste minimization options appropriate for their industry. It also provides worksheets designed to be used for a waste minimization assessment of a surface mining operation, to develop an understanding of the waste generation processes and to suggest ways that the waste may be reduced.

This guide is designed primarily for use by operators of surface mines with vehicle maintenance shops. Others who may find this document useful are operators of vehicle fleets, regulatory agency representatives and consultants. The guide is conveniently divided into the following sections:

- Overview of Waste Minimization (Section 2.0);
- Waste Generation from Surface Mines (Section 3.0);
- Waste Minimization Options for the Surface Mining Industry (Section 4.0);
- Summary and Conclusions (Section 5.0);
- Waste Minimization Assessment Worksheets (Section 6.0).

1.2 OBJECTIVES

This guide, which includes worksheets and a list of P2 and waste minimization options, was developed through assessments of surface coal mines in Wyoming and selected fleet maintenance facilities located throughout Colorado. The firms' operations, waste generation, and management practices were surveyed. In addition, their existing and potential waste minimization options were characterized. Additional information was developed from a nationwide literature search and review.

The long term objective in producing this guide is to utilize this information in assisting the mines in protecting the environment by reducing their hazardous waste generator status.

2.0 OVERVIEW OF WASTE MINIMIZATION

2.1 BACKGROUND

Waste minimization means the reduction, to the extent feasible, of waste that is generated prior to treatment, storage and/or disposal.

In 1984, Congress passed the Hazardous and Solid Waste Amendments (HSWA) to the Resource Conservation and Recovery Act (RCRA) which specifically states:

> *The Congress hereby declares it to be the national policy of the United States, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored, or disposed of as to minimize the present and future threat to human health and the environment.*

In addition, the HSWA of 1984 requires every hazardous waste generator to certify that he or she has a program in place to minimize waste generation. The certification statement is found on the Uniform Hazardous Waste Manifest. The certification statement is:

> *If I am a large-quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment, or, if I am a small-quantity generator, I have made a good-faith effort to minimize my waste generation and select the best waste management.*

Waste minimization requires a dedicated commitment, careful planning, creative problem solving, changed attitudes and sometimes capital investments. However, the payoffs for this commitment can be significant and include: reduced liability; more efficient use of natural resources; reduced treatment and disposal costs; lower environmental impacts; reduced regulatory involvement including reduced fines and penalties; monetary savings; a safer work environment and increased public relations.

2.2 WASTE MINIMIZATION TECHNIQUES

Pollution prevention and waste minimization techniques, as defined by the EPA can be broken down into two major categories: Source reduction and recycling. It should be pointed out that waste minimization does not include such processes as incineration, treatment, storage or disposal. Source reduction and recycling should always be considered before treatment and/or disposal.

Source Reduction includes inventory control, improved housekeeping, production/process modifications, product substitution or reformulation, waste segregation and new uses.

Recycling includes the use or reuse of the material as an effective substitute for a commercial product or as an ingredient or feedstock in a process. It includes the reclamation of useful constituents fractions within a waste materials or the removal of contaminants from a waste to allow it to be reused.

2.2.1 Inventory Controls

In the past, the basic purchasing consideration for chemicals was cost with little or no attention given to the expenses and liability incurred during disposal. As a result, chemicals were often purchased in large quantities. In addition, various brands were purchased to take advantage of sales. This created hazardous waste disposal problems that may be solved by some of the following suggestions.

- Require supervisor approval prior to purchasing hazardous chemicals. This forces workers to think twice before requesting that a hazardous chemical be purchased and it makes management aware of when and the volume of chemicals being added to the inventory.

- Keep the inventory of hazardous chemicals to a minimum. This will assist in container rotation and reduced shelf-life problems. In addition, when less product is available, workers generally use less.

- Reduce the number of brands or products used for the same purpose. While everyone has a favorite brand, numerous brands of the same product increase shelf-life problems.

- Purchase only what will be used within a short period of time. Manufacturing facilities call this "just-in-time" (JIT) purchasing.

- Use of a simple labeling code, such as an orange sticker, to identify chemicals that contain hazardous constituents. Train individuals who are using these chemicals to recognize the code and the proper handling and disposal techniques.

A strict purchasing and inventory control program will prevent the generation of hazardous waste due to poor product management. Examples from mines include: Restricting the purchase of terne plated filters, screening materials that contain trichloroethylene (TCE) prior to purchase, and restricting the access of employees to storage areas.

2.2.2 Improved Housekeeping

Good housekeeping can solve a variety of hazardous waste generation problems. In addition, housekeeping changes can be implemented quickly and with little cost. Sloppy housekeeping, which includes leaks from tanks, pumps and valves and release of product onto the floor, can dramatically increase the volume of hazardous waste. Other practices such as tank overfills, lack of drip boards, and chronic spills and leaks add to the hazardous waste stream. Not only is valuable product lost but the volume of waste generated increases due to the materials (rags, floor dry and water) used during cleanup. Other housekeeping problems involve improper storage practices, inefficient production startup and shutdown, scheduling problems and poorly calibrated control devices.

Examples from mines include: Utilizing drip pans, improving liquid transfer techniques, and reducing water usage during floor cleaning by using spot washing.

2.2.3 Production/Process Modifications

Outdated equipment and traditional production methods can generate large volumes of hazardous waste. Although the capital investment to purchase new equipment or modify existing equipment can be high, the investment payback is usually significant when compared to disposal and liability costs.

Examples from mines include: Filtering solvents for extended reuse, switching to industrial parts washers, and utilizing predictive maintenance programs.

2.2.4 Product Substitution/Reformulation

Substituting a non-hazardous chemical for a hazardous one has obvious benefits for waste minimization, environmental protection and worker health and safety. Many products are being reformulated by chemical manufacturers due to increased pressure being placed on them by industry.

Examples from mines include: Switching to water based parts cleaners and using reformulated greases which contain no TCE for shovel/dragline lubricants.

2.2.5 Waste Segregation

Many wastes are actually mixtures of hazardous and nonhazardous waste, such as chlorinated solvents and used oil. When this happens, regulatory definitions may place the entire waste stream in the hazardous waste category. By segregating key constituents, generators can save substantial amounts of money on waste disposal. *Waste segregation can also assist in recycling. An unsegregated* waste stream may be too costly to recycle because of the large component of nonrecyclable waste.

Examples from mines include: Segregating hazardous waste solvent coated rags from nonsolvent rags, segregating different types of paint waste, and segregating recyclable solid waste materials.

2.2.6 New Uses

When a waste material can be reused as in recycling or when a "new use" can be found for the materials several advantages occur. Disposal costs are reduced or eliminated and raw material purchase costs are also reduced. Operations are encouraged to seek out new and environmentally sound uses for waste materials which were previously treated and/or disposed. Some assistance can be found with the expanding waste exchange programs being established across the United States.

Examples from mines include: utilizing used oil for energy recovery on-site with used oil furnaces, using used oil as a crude lubricant for dragline ropes, and possibly using used oil as a mixture with fuel oil for a blasting agent.

2.3 WASTE MINIMIZATION ASSESSMENTS

The EPA has developed a general manual for waste minimization for industry. The Waste Minimization Opportunity Assessment Manual (USEPA 1988) and the revised Pollution Prevention Facility Manual (USEPA 1992) tell how to conduct a P2 and waste minimization assessment and develop options for reducing hazardous waste generation. It explains the management strategies needed to incorporate waste minimization into company policies and structure, how to establish a company-wide P2 and waste minimization program, conduct assessments, implementation options, and make the program an on-going component of the facility operation.

The Waste Minimization Opportunity Assessment (WMOA) is a systematic procedure for identifying ways to reduce or eliminate waste. The four phases of a waste minimization assessment are: (1) planning and organization, (2) assessment, (3) feasibility analysis, and (4) implementation. The steps involved in conducting a waste minimization assessment are illustrated in Figure 1.

Briefly the assessment consists of a careful review of a plant's operations and waste streams and the selection of specific areas to assess. After a particular waste stream or area is established as the WMOA focus, a number of options with the potential to minimize waste are developed and screened. The technical and economic feasibility of the selected options are then evaluated. Finally, the most promising options are selected for implementation.

2.3.1 Planning and Organization

Essential elements of planning and organization for waste minimization are: getting top level management commitment; setting waste minimization goals; and organizing an assessment task force.

2.3.2 Assessment Phase

The assessment phase involves a number of steps:

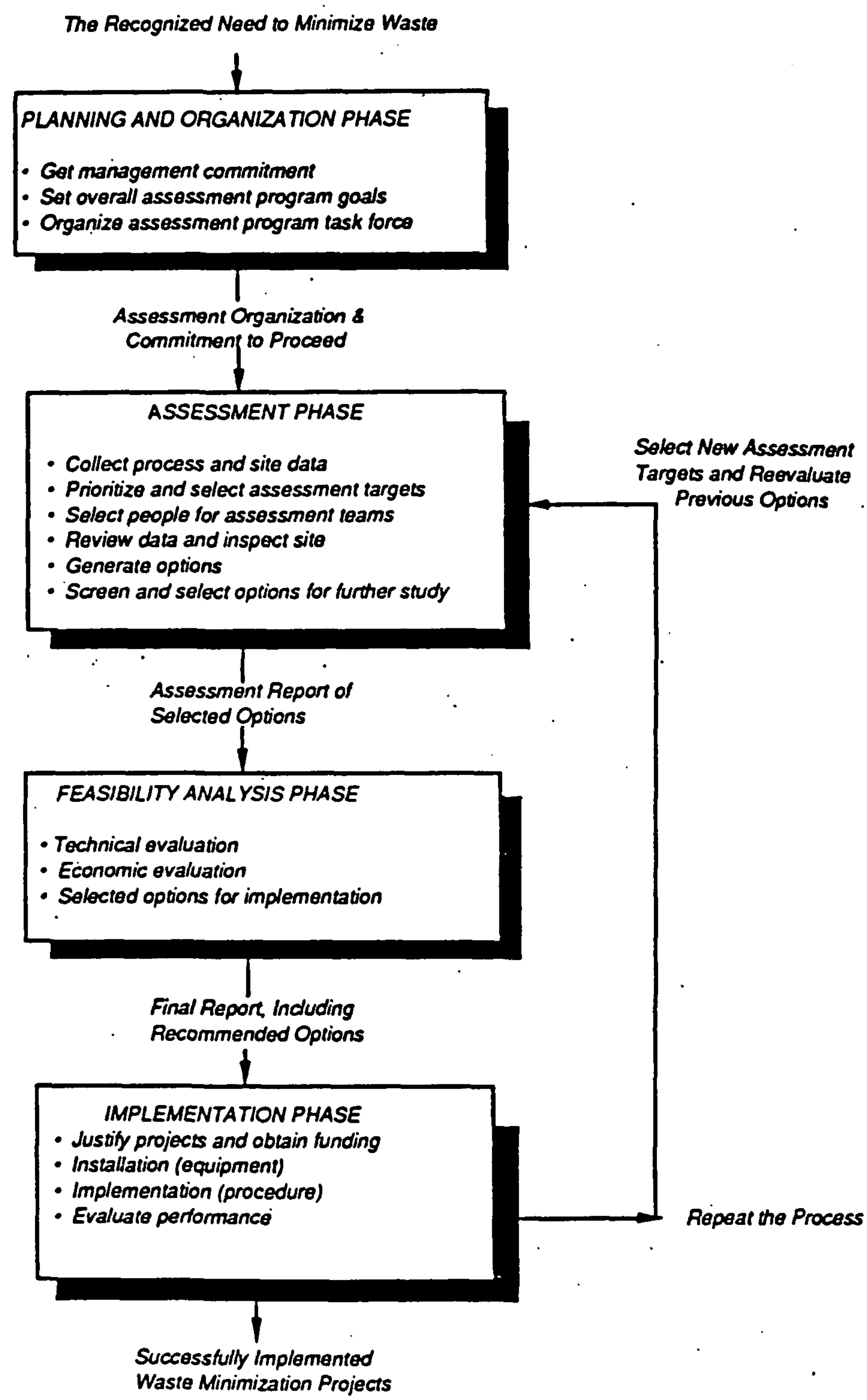
- Collect process and facility data;
- Prioritize and select assessment targets;
- Select assessment teams;
- Review data and inspect the site;
- Generate options;
- Screen and select options for feasibility study.

Collect process and facility data - The waste streams at a facility should be identified and characterized. Information about the waste streams may be available on hazardous waste manifests, National Pollution discharge elimination system (NPDES) reports, routine sampling programs and other sources.

Developing a basic understanding of the processes that generate waste at a facility is essential to the WMOA process. Block diagrams can prepared to identify the quantity, types and rates of waste generating processes. Also, preparing overall material balances for the facility can be useful in tracking various waste streams components and identifying losses or emissions that may have been unaccounted for previously.

Prioritize and select assessment targets - Ideally, all waste streams in a facility should be evaluated for potential waste minimization opportunities. With limited resources, however, a plant manager may need to concentrate waste minimization efforts in a specific area. Such considerations as quantity of waste, hazardous properties of the waste, regulations, safety of employees, economics, and other characteristics need to be evaluated in selecting a target waste stream.

FIGURE 1


The Recognized Need to Minimize Waste
PLANNING AND ORGANIZATION PHASE
• Get management commitment
• Set overall assessment program goals
• Organize assessment program task force
Assessment Organization & Commitment to Proceed
ASSESSMENT PHASE
• Collect process and site data
• Prioritize and select assessment targets
• Select people for assessment teams
• Review data and inspect site
• Generate options
• Screen and select options for further study
Select New Assessment Targets and Reevaluate Previous Options
Assessment Report of Selected Options
FEASIBILITY ANALYSIS PHASE
• Technical evaluation
• Economic evaluation
• Selected options for implementation
Final Report, Including Recommended Options
IMPLEMENTATION PHASE
• Justify projects and obtain funding
• Installation (equipment)
• Implementation (procedure)
• Evaluate performance
Repeat the Process
Successfully Implemented Waste Minimization Projects

Select assessment team - The assessment team should include people with direct responsibility and knowledge of the particular waste stream or area of the facility.

Review data and inspect the site - The assessment team evaluates process data in advance of the inspection. The inspection should follow the target process from the point where raw materials enter the facility to the points where products and waste leave. The team should identify the suspected sources of waste. This may include the maintenance operations and areas for storage of raw materials and finished product and for work in progress. The inspection may result in the formation of preliminary conclusions about waste minimization opportunities. Full confirmation of these conclusions may require additional data collection, analysis, and/or site visits.

Generate options - The objective of this step is to generate a comprehensive set of waste minimization options for further consideration. Since technical and economic concerns will be considered in the later feasibility stage, no options are ruled out at this time. Information from the site inspection, as well as trade associations, government agencies, technical and trade reports, equipment vendors, consultants, plant engineers and operators may serve as sources of ideas for waste minimization options.

Source reduction and recycling options should be considered first. Source reduction may be accomplished through good operating practices, technology changes, and input material changes. Recycling includes the use and reuse of the waste stream and reclamation.

Screen and select options for feasibility study - The screening process is intended to select the most promising options for full technical and economic feasibility analysis. Through either an informal review or a quantitative decision making process, options that appear marginal, impractical or inferior are eliminated from consideration.

2.3.3 Feasibility Analysis

A waste minimization option must be shown to be both technically and economically feasible in order to merit serious consideration for implementation. A technical evaluation determines whether a proposed option will work in a specific application. Typical technical evaluation criteria include worker health and safety, maintenance of product quality, space availability, compatibility with existing operations, labor requirements, installation procedures and system maintenance. In addition, both process and equipment changes need to be assessed for their overall effects on waste generation and product quality.

An economic evaluation is carried out using standard measures of profitability, such as payback period, return on investment, and net present value. Capital investment criteria include such costs as site development, permitting costs, contractors' fees, start-up time, and training. Operating costs and savings must also be analyzed and may include reduction in waste management and disposal costs, material cost savings, insurance and liability savings, changes in utility costs, and changes in operation and maintenance.

While profitability is important in deciding whether or not to implement an option, compliance with existing and future environmental regulations may be even more important. A company operating in violation of environmental regulations can face fines, lawsuits, civil and criminal penalties and even closure. Therefore, decisions should not be based on short-term profitability alone.

2.3.4 Implementation

An option that passes both technical and economic feasibility analyses should then be implemented. It is then up to the assessment team, with management support, to continue the process of tracking waste streams and identifying additional opportunities for waste minimization throughout a facility.

3.0 SURFACE MINING WASTE PROFILE

The major waste streams generated by the mining industry are in conjunction with their heavy equipment use and maintenance operations. Primary consideration was given to waste streams that met the following criteria:

- Hazardous waste;
- Waste which poses a significant risk to human health and/or the environment;
- Waste generated and/or released in high volumes;
- Waste that has a high cost associated with treatment, storage and/or disposal;

The most common waste streams generated by mines during heavy equipment operations that meet the above criteria include:

- Waste Water - This waste is generated by the washing of vehicles prior to maintenance, washing shop floors, and water-based parts washers.
- Spent Parts Cleaning Solvents - These typically include chlorinated or hazardous substances containing solvents from equipment and parts cleaning, and aerosol sprays.
- Lubrication Greases - Two broad categories of lubricants are used: grease for mobile vehicles and those for the relatively stationary shovels and draglines.
- Spent Vehicle Fluids and Accessories - These waste streams include anti-freeze, engine oil and lubricants, transmission fluids, hydraulic fluids, refrigerants, filters and batteries.
- Shop and Vehicle Clean-up Waste - These include waste such as aqueous floor and vehicle cleaning solutions, oil adsorbents, floor dry type materials for minor spills and dirty rags.
- Solid Waste - These include rejected metal parts, old tires, broken hoses and belts, empty containers, filters and paper waste.

3.1 WASTE WATER

3.1.1 Waste Water Generation

Washing vehicles prior to maintenance, washing the shop floor, and water-based parts washers are the dominant generators of waste water.

Vehicles are washed prior to maintenance in a separate wash bay and light vehicles are washed as needed for appearance. The vehicle washing waste stream consists of hot water, detergents, grease, oil, and solids, especially road dirt. Most facilities use a high pressure water spray to facilitate the cleaning process.

Floors are washed with cold water and usually a cleaner. A variety of floor cleaners are used, usually a non-hazardous high pH liquid. Water is often applied via a high pressure unit.

Water-based parts washers are used at many facilities. Parts washers use water, detergent (usually a biodegradable type), and sometimes a surfactant. Most washers have an oil skimmer and a sediment trap.

Total amount of waste water from vehicle maintenance areas is unknown, but solids generated from washing may exceed several hundred yards per year at some mining operations. Both solids and liquids are usually analyzed on an annual basis for hazardous constituents. The waste water and associated solids are typically non-hazardous. However, samples should be taken on a point source basis so a particular waste stream that might generate a hazardous waste is identified prior to mixing with a non-hazardous waste, which may result in the entire waste stream becoming a hazardous waste.

3.1.2 Waste Water Treatment

Pretreatment of waste water varies but usually includes traps that catch solids. The traps are cleaned out on a periodic basis either through a contracted vacuum service that disposes of the waste off site or through mining personnel where the solids are scooped out and landfilled on site. A method that is less common is to treat the waste water solids by land farming prior to landfilling.

Some facilities have an oil skimmer as part of the waste water sump system. The skimmed oil may be recovered for fuel blending. A variety of oil skimming systems are used. A pneumatic system allows sediments to settle out before it turns on, and this may decrease the need for pump maintenance. All waste water is eventually retained in some type of pond where it evaporates or is reused as discussed in Section 4.1.2 (Waste Minimization Options).

3.2 SOLVENTS AND SPENT PARTS CLEANING

A variety of solvents (or degreasers) are used throughout the vehicle maintenance program. The largest volume of solvent is used for parts cleaning. The waste solvents from parts cleaning often represent the largest source of hazardous waste from a mining operation. Relatively small quantities of solvents are used for cleaning electrical contacts, small engine parts, and related uses. A third solvent waste stream is generated when these chemicals are used for general purpose surface cleaning (wipe down or field solvents), especially on draglines. Solvents associated with painting are addressed in Section 3.7 (Paints/Strippers and Thinners).

3.2.1 Parts Cleaning with Solvents

Parts cleaners are dominated by a sink type device that dispenses solvent from a faucet and collects the spent solvent in a drum beneath the sink. Parts cleaners may have filtering units that remove grease and solids and allows for product reuse. When the filters are spent they must be tested to determine if they are hazardous waste even if the solvent was a non-hazardous material. In some cases the solvents supplier picks up the filters for proper disposal. The solvents used in parts cleaners ranges from the typical hazardous chlorinated solvents to non-hazardous solvents with a citric base. Mining operations can easily generate from 10,000 to 30,000 pounds of hazardous waste from solvent parts washers each year.

Various types of "dip" tanks are used for cleaning large components, such as engine blocks. The tank solvent is usually methylene chloride or sodium hydroxide. Both products are considered hazardous waste. Tanks may contain as much as 600 gallons of solvent which requires replacement every few years, depending on use.

3.2.2 Contact Solvents

Numerous contact cleaners, usually in aerosol form, are used for cleaning electrical components, small parts, carburetors, etc. Some of these contain chlorinated hydrocarbons, especially when the cleaned surface must be product or residue free. Standard procedures call for the aerosol solvents to be completely used, the container depressurized, and the carcass thrown into the trash. Mining operations can use over 20,000 cans of non-chlorinated aerosol solvents per year.

3.2.3 Wipe Down (Field) Solvents

Wipe down solvents are used for general purpose cleaning of surfaces that are dirty due to grease and other lubricating fluids.

A variety of products are used, such as a non-chlorinated petroleum naphtha which contains ethyl benzene, xylene, aromatic, and mineral spirits. Hazardous solvents are often used as wipe down because the solvent quickly volatilizes and the only waste product is the contaminated rag. However, concerns about worker safety are forcing mining operations to look at less toxic alternatives. Large mines use over 10,000 gallons of field solvents per year.

3.3 LUBRICATION GREASES

A variety of lubricating greases are used throughout the vehicle maintenance operations. In some cases it is difficult to distinguish between grease and oil. Although oils are viewed as low viscosity and greases as high viscosity, there are no definitive lines separating the two types of lubricants. Therefore, some of the lubricants discussed below, especially for draglines and shovels, may be closer to oils than greases.

Waste disposal problems for greases are not related to the basic hydrocarbon nature of the lubricants but to the additives that distinguish one product from another. Thousands of additives are used, and some of them are classified as hazardous under RCRA.

Two broad categories of such lubricants can be distinguished: grease lubricants for mobile vehicles ranging from light duty vans to 240 ton haul trucks, and grease lubricants for the relatively immobile shovels and draglines.

3.3.1 Mobile Vehicles

Relatively large quantities of grease are used during routine vehicle maintenance, especially for haul trucks. Haul trucks range in size from 100 to 240 tons, with the latter size being the most common. It is estimated that the average haul truck requires from 350 to 400 pounds of grease per year. Greases for these vehicles generally are dominated by extreme pressure formulas and are classified as non-hazardous when it arrives as a virgin product.

No waste streams were identified specific to mobile vehicle greases. Small quantities of waste grease enter the shop's waste water when vehicles are washed prior to maintenance. Minor amounts of waste grease are also generated when lubricated parts are removed for repair or replacement. The grease associated with these parts is scraped, wiped, or washed off with solvents or hot water. Additional grease is lost during normal vehicle use due to evaporation of the more volatile compounds in the lubricant, although evaporation accounts for less than 5 % of the grease loss. It appears that most (over 90%) of the vehicle grease is lost through normal leakage while the vehicle is in motion. Some of this leakage is due to shear stress that changes the molecular weight of the grease and allows it to run out of the bearings and other contact surfaces.

3.3.2 Shovels and Draglines

Shovel and dragline lubricants can be classified into four loose and somewhat overlapping categories:

- Open gear compounds;
- Extreme pressure (sometimes called general purpose) greases;
- Wire rope lubricants; and
- Cam and slide lubricants.

<u>Open Gear Compounds</u>

Open gear compounds are used on any kind of flat surface contact between two components where the motion is relatively slow. This type of lubricant is most commonly used on the large open gear and pinion sets. Swing rack, rollers, cam frame, propel bushings, open gear sets, and the center pin also use open gear compounds. A given machine uses from less than 4,000 to over 60,000 pounds of open gear compounds per year, depending on the size of the machine.

The areas in which open gear compounds are used consist of high stress contacts that require a viscous, additive-laden, petroleum based lubricant. Therefore, most open gear compounds are asphaltic (heavy black oils with a high viscosity) in nature and required a fast drying solvent, such as trichlorethylene (TCE) as a "carrier" which makes the grease more pumpable. In addition, the TCE additive allows the grease to form a thin, uniform, and fast drying coat on the wear surfaces. Recently, paste type lubricants were manufactured that had less tendency to run under high temperatures but still required a chlorinated solvent to make them pumpable, especially in cold weather. These types of open gear compounds are commonly used at surface mining operations.

Some dragline operations use lubricants where the hazardous solvents have been replaced by biodegradable solvents that pass current TCLP tests. Such lubricants supposedly provide improved water resistance and equipment protection over a wide range of operating temperatures. Petroleum resins and oils dominate these lubricants with minor constituents that include lubricating solids, additives, and biodegradable components. Although such greases are not classified as hazardous waste, they tend to cost more, they are runnier because of slower evaporation of the biodegradable solvent, and they tend to be messy and require more cleanup time.

As the above-mentioned greases degrade with use, they may ball up, form a paste, or for the less viscose types accumulate on the side and bottom of cases. Routine maintenance removes this grease. Approximately 50% of the open gear compounds are recovered for disposal as either a hazardous or non-hazardous waste, depending on the constituents.

Extreme Pressure Greases

Extreme pressure (EP) lubricants are used in all anti-friction bearings and higher speed applications. It consists of an oil base compound, a thickener system (often lithium or calcium soaps), and additives that were dominated by lead (up to 35% of the lubricant by weight). The lead is now being replaced with antimony, bismuth, boron, and other products. These lubricants can withstand normal operating temperatures, and are pumpable, water resistant, and mechanically stable.

Following application, the EP lubricants weep out of the bearings and other lubricating points. Therefore, less than 5% of EP greases are recovered, usually during cleaning operations that utilize rags to remove released lubricants. Annual use of EP lubricants ranges from less than 2000 to approximately 3000 pounds per machine.

Wire Rope Lubricants

Both hazardous and non-hazardous wire rope lubricants are used at surface mining operations. These products lubricate the running wire ropes connected to the bucket. For the most part, these lubricants are dispersed throughout the length of the rope and cannot be recovered. Some lubricants are designed to have good penetrating qualities that lubricate the inner strands to minimize corrosion and wear. Other lubricants are of high viscosity and are formulated to stay on the outside of the rope to minimize dirt entry. Both products consist of petroleum hydrocarbons and extreme pressure additives.

Wire rope lubricants are applied manually by the operator. Hoist and drag ropes require more lubricant, often about 55 gallons per day, than the dump ropes that may only require a few gallons of lubricant per day. Use varies considerably and can range from approximately 5000 to over 30,000 pounds per year per machine. Some operators are of the philosophy that liberal use of wire rope lubricants cleans off the rope and increases rope life. Other operators contend that liberal oiling encourages dust collection by the rope.

Essentially all of the wire rope lubricant is lost during normal dragline or shovel operation. Recovery of spent lubricant would be limited to inside the machine and would account for less than 5% of the wire rope lubricant.

Cam and Slide Lubricants

Cam and slide units require grease with every movement. The previous described non-hazardous open gear compounds with EP additives are commonly used, with some important exceptions.

Some draglines use a propel system known as a Monigham cam. This has a large metal cage in which an eccentric cam rolls around and lifts the machine when walking. This cam is extremely difficult to lubricate and usually requires a lubricant heavily fortified with heavy metals such as copper flakes, zinc, graphite, and others. These lubricants are semi-solid with retention characteristics that allow the lubricant to remain intact on surfaces to protect against metal to metal contact under the combined rolling and sliding friction dynamics of the cam mechanism. At the present time all Monigham Cam lubricants contain from 5 to 25% chlorinated solvents as a diluent. Several lubricant manufacturers are in the process of developing non-hazardous cam lubes, however none have been thoroughly tested. Other additives may include lithium, nitrogen, sulfur, and phosphorus. This lubricant tends to harden and sluff off in solid chunks and must be disposed of as a hazardous waste. Annual use of cam and slide lubricants ranges from 800 to over 6,000 pounds per machine, with approximately 80% of this grease being recovered for disposal.

The second exception involves a different propel system that consists of a shoe hung from either side of the machine by a crank arm in which the sliding surfaces are immersed in a bath of semi-liquid lubricants that can be considered a thick oil or a runny grease. The lubricant is a petroleum hydrocarbon plus unspecified additives that may contain antimony, molybdenum, and phosphorus. This product does not contain solvents and is not a RCRA hazardous waste. Estimated annual use of this lubricating fluid ranges from less than 10,000 to 30,000 pounds per year per machine depending on how far the machine is walked and the operating grade. Approximately 80 to 90% of the lubricant is recoverable for waste disposal.

Other Lubricants

A variety of other contact surfaces on shovels and draglines are lubricated with some combination of the above compounds. For example, shovels that use a track system for movement require a variety of open gear compounds, closed gear oil, and EP lubricants, some of which may have hazardous constituents. Often this variety of lubricants is replaced by a single multi-purpose grease. Estimated use of track system lubricants is 3000 pounds per year per machine. Some of this can be recovered, especially the lubricants within the crawler gear case that contains from 100 to 200 gallons of lubricants. Other greases, such as those that accumulate within the crawler frame, are sloughed off in a soft or semi-solid form and can be scraped up and recovered for disposal.

3.4 SPENT VEHICLE FLUIDS AND ACCESSORIES

Spent vehicle fluids and accessory waste streams include greases, engine oil, filters, transmission and hydraulic fluids, refrigerants, and batteries. Waste greases were covered in Section 3.3 (Lubrication Greases).

3.4.1 Used Oil

Oil systems perform two important functions. They lubricate moving parts and aid in cooling of the engine by reducing friction and removing some heat from the cylinders. Used oils are by far the largest component of the spent vehicle fluid waste stream.

The amount of oil used depends on the vehicle type, size and the type of maintenance program. Used oil volumes typically range from approximately 20,000 gallons to over 70,000 gallons each year. The used oil is drained from the vehicles into satellite storage containers and then transferred into larger above or below ground storage tanks. Currently, the most common disposal practice at mining operations is off-site recycling through vendors for supplemental fuel programs.

3.4.2 Waste Filters

Filters are utilized to remove particulates (debris) from the fuel, lubrication, or control (transmission and hydraulic) systems of vehicles. To increase the life of many filters and to provide for corrosion resistance, some manufacturers plate filters with a lead and tin coating on the internal surface. These type of filters are termed terne plated filters. Filters without the internal plating are called nonterne plated filters.

Most operations are aware of the difference between terne plated and non-terne plated filters. Many of the vendors in the past marketed the terne plated filters with a life-time warranty. The problem associated with terne plated filters is the high levels of lead and tin. These constituents make the filters unsuitable for land disposal. The filters, if not recycled, must be tested and if failure of TCLP occurs they must be handled as hazardous waste. Most operations are discontinuing the purchase of terne plated filters or are insuring that filters are recycled as scrap metal.

A general breakdown of the types of filters utilized at a mining operation for a one year period is as follows:

- 60% diesel oil;
- 20% diesel fuel;
- 10% diesel transmission;
- 5% diesel hydraulic;
- 5% gas engine oil, fuel and transmission filters.

The actual number of filters used or the volume of waste filters generated on an annual basis is undetermined at most operations.

3.4.3 Transmission and Hydraulic Fluids

Vehicle preventative maintenance programs typically call for a change of oil, transmission and hydraulic fluids at predetermined periods (i.e., after 250 hours of operation). Most operations do not segregate out the transmission and hydraulic fluids. These vehicle fluids are mixed with the used oil that is generated on site. However, the volumes may be significant since the larger haul trucks can use over 150 gallons.

3.4.4 Antifreeze

Most vehicles contain a engine coolant which is most commonly an ethylene glycol antifreeze. The engine coolant may be regulated as a hazardous waste because it contains ethylene glycol and detectable concentrations of benzene, toluene, lead, zinc, arsenic, mercury and copper which accumulate from the cooling system.

Most operations estimate that they use between 2,000 and 8,000 gallons of antifreeze (ethylene glycol) each year. Some operations have switched to propylene glycol, which is less toxic than ethylene glycol.

3.4.5 Batteries

Spent batteries are generated by the light and heavy duty trucks at mining operations. Larger mines can generate in excess of 300 spent batteries per year. On a weight basis, spent lead batteries can be one of the larger categories of hazardous waste generated at a fleet maintenance operation. However, recyclers typically pay for battery recycling. Most operations return their vehicle batteries to the vendor for recycling. However, waste can be generated from broken batteries and from spilled battery acid which is added to batteries on an as needed basis.

3.4.6 Freon

The Clean Air Act Amendments of 1990 require that the freon from the vehicles' air conditioning system is captured and recycled. All operations currently utilize certified employees or vendors to perform this service.

3.5 SHOP AND VEHICLE CLEAN-UP WASTE

Most mining operations utilize a form of floor dry to absorb minor spills and leaks in the maintenance areas. The volumes of waste generated are unknown. Most mines take precautions to avoid any hazardous materials from being spilled, therefore most of the floor dry is not a hazardous waste.

Most mines use a clay type of absorbent material to clean up spilled fluids in the shop areas. The procedures for the spent floor dry varies between mines and ranges from disposal at on-site or off-site landfills. Any floor dry used to absorb a hazardous materials such as spilled solvents must be treated and disposed of as a hazardous waste.

There are three types of sorbents currently available: natural, mineral, and synthetic. Natural and mineral sorbents are considered absorbents because the liquid penetrates their fibers. Natural and mineral sorbents are typically disposed of in landfills, but some states have banned disposal of saturated sorbents in landfills due to the leaching problems associated with the material. Synthetic sorbents are considered adsorbents because the liquid does not penetrate into the fibers.

Natural sorbents includes materials such as cotton, peat, sawdust, and corncobs. These sorbents have widespread use due to their low cost and most are usually disposed of in a landfill. Certain types of natural sorbents also have the advantage of being able to be incinerated for energy recovery if they meet RCRA standards, including being lightweight, liquefiable and having a BTU content of at least 5000 BTU's per pound.

Mineral sorbents include vermiculites such as clay pellets and are also widely used due to their low initial cost and ease of disposal, usually in a landfill.

Synthetic sorbents made from polypropylene and polyurethane are becoming increasing popular because of their high absorbency and the fact that certain types can be wrung out and reused and the recovered fluids recycled or burned for energy recovery. This can cut down on the disposal costs, offsetting the higher cost of the synthetic sorbents. Synthetic fibers come in different types such as socks, rolls, and pads. Some can be wrung out and reused more than 15 times.

3.6 SOLID WASTES

3.6.1 Scrap Metal

Mines generate various types of scrap metal in unknown quantities. The scrap metal includes broken parts, cuttings from machine shops, and aluminum cans.

3.6.2 Tires

Mining operations generate light vehicle tires and large tires from haul and shovel trucks. Mines can generate over 300 light vehicle tires and over 80 large tires per year.

Disposing of tires is becoming increasingly difficult as some states enact bans on landfilling tires. Landfilled tires are also possible health hazards as they are breeding grounds for mosquitoes, which may carry diseases.

Most of the light vehicle tires are taken back by vendors for retreading. In some cases the mines landfill the light vehicle tires. Mines also use smaller tires for "cable trees" and survey markers.

The larger haul truck and scraper tires are typically given away to ranchers and farmers. The ranchers utilize them for water troughs, wind breaks, shelter breaks, salt troughs, etc. Most mines have no trouble getting rid of large tires. However, some mines will not give their tires away due to the potential liability from injuries. These mines landfill their tires.

3.6.3 Shovel and Dragline Cable

The draglines and shovels utilize a variety of ropes (steel cable) for hoisting, dragging and releasing the digging bucket. These "ropes" range in thickness of 2.5" for shovels to over 3.25" and weigh up to 40 pounds per linear foot of cable.

The amount of rope utilized in any given year varies among mines. The length varies from 10,000 to 25,000 yards of rope per year per machine. Mines typically backfill the "ropes" or landfill them on-site.

3.6.4 Rags

Rags are needed in maintenance facilities for parts cleaning and drying and for cleaning small drips or spills. Mining operations typically use disposable rags for minor cleaning. Mines typically segregate solvent rags from other types. Solvent rags are typically drummed, tested for TCLP, and handled accordingly. If utilized for general cleanup without solvents, they are placed in a dumpster for disposal at an off-site or on-site landfill.

3.6.5 Paper

Paper is either discarded in dumpsters or recycled from computer printer areas. However, most paper at mines is disposed of at either on-site or off-site landfills.

3.6.6 Wooden Spools

Wooden spools from cable and dragline/shovel ropes are typically broken down and have a variety of uses on site or are landfilled. Some mines have arranged with their wire or cable rope vendors for the vendor to take the wooden spools back.

3.7 PAINTS, STRIPPERS AND THINNERS

3.7.1 Paints

Paint is used for a variety of operations including the touch-up of trucks and mining equipment, parts coating, and facility maintenance. The painting of large equipment is typically contracted to off-site vendors.

Different types of paints are used depending on the required task. Acrylic lacquer, acrylic enamel, synthetic enamel, catalyzed acrylic enamel, color/clean polyurethane, and primers may be used to touch up trucks and mining equipment. Powder coatings and high temperature paints may be used to coat engine parts. Latex (water-based) paints, oil-based paints, lacquers and enamels may be used for facility maintenance.

Some paints are considered hazardous due to heavy metals they may contain including arsenic, lead, cadmium, chromium and zinc. Certain types of paints may contain hazardous solvents. Some paints, primers, lacquers and enamels may also be flammable.

Waste streams from painting operations include leftover paint, paint sludge, primer waste, paint containers, spent solvents/thinners due to paint removal and cleaning of painting equipment, and air emissions of volatile organic compounds (VOC's).

The most common methods for disposal of paint and paint associated waste steams at most mining operations include: off-site fuel blending for flammable hazardous waste materials, puncture (atmospheric pressure) of aerosol cans with collection of waste paint, segregation of water-based latex paints from solvent/oil based paints, land disposal and/or recycling of metal paint containers and aerosol cans.

3.7.2 Strippers and Thinners

Paint strippers are used to remove the paint and primer from trucks and mining equipment in preparation for repainting. Paint thinners are also used for washing painting equipment and thinning viscous paint.

Different types of paint strippers are used depending on the required task. Highly caustic paint strippers are commonly used for stripping the lacquers and enamels used on trucks and mining equipment. Paint strippers and thinners used for facility maintenance may vary from toxic to more "environmentally friendly" products.

Some paint strippers and thinners are considered hazardous due to their flammability and their chemical constituents (xylene, methylene chloride). Paint strippers used to strip enamels and lacquers from vehicles are often ammonia-based and highly caustic.

Waste streams from paint stripping operations may include paint sludge, primer waste, paint stripper/thinner containers, spent solvents/thinners due to paint removal and cleaning of paint equipment and air emission of VOC's.

The most common disposal method for these types of wastes include: disposal at licensed hazardous waste landfills, recycling off-site (through vendors) of the solvents, and fuel blending for the flammable wastes.

4.0 WASTE MINIMIZATION OPTIONS

Using the criteria outlined above in Section 2.1, the following waste stream prioritization is warranted:

- Chlorinated or hazardous waste solvents;
- Dragline and shovel greases;
- Used oils, hydraulic and transmission fluids;
- Solid waste.

Efforts should be targeted to reduce and/or eliminate these waste streams. Several excellent examples have been initiated at several mining operations. Waste minimization options for mining operations are outlined in the following section.

4.1 WASTE WATER

4.1.1 Waste Minimization During Floor Washing

Frequency of washing floors, the largest generator of waste water at some facilities, varies from daily to once a month and less. The need for regular washing of the shop floor is debatable. Floors are washed for the following purposes:

- Dirt, oil, and other fluids can create a slippery floor that is a safety hazard;

- Shop floors should be relatively clean to facilitate equipment use and to prevent any transfer of dirt from parts into the vehicle;

- A relatively clean floor promotes a good working environment and makes an indirect statement about quality.

Cleaning a floor with water may not be necessary to accomplish the above objectives. Waterless floor cleaning will likely achieve the objectives if the following steps are followed:

- Thorough washing of vehicles prior to maintenance and/or repair;

- Use of portable containers to catch fluids as they are drained from vehicles or as they drip from components under repair;

- Use of absorbents to catch any inadvertent fluid spills; and

- Thorough sweeping of the floor immediately after a vehicle leaves the shop.

Most of these steps are currently implemented on a routine basis. However, after sweeping the floor many facilities then wash the floor. This step is rarely necessary and simply increases the volume of waste generated. Conscientious implementation of waterless cleaning should almost eliminate the need for washing a floor with water.

Spot washing with a mop may accomplish the same objectives and will generate a minimal amount of liquid waste as compared to washing the entire floor. The shop area floor drains can also be covered with rubber mats to discourage unnecessary washing and to prevent unauthorized dumping into the drains. Another option is a mobile floor washer that recycles the fluids as it washes the floor.

Some facilities do not scrub their shop floor with water. Floor dry is used to absorb spills and the area is swept on a daily basis. Other operations mop the floor about twice a month with very little waste water generated.

4.1.2 Waste Water Reuse

Prior to reuse, waste streams must be separated from the waste water. Solids are allowed to settle out in traps of some type. Used oil is skimmed from the water surface. One effective technique uses a sump to pump the oil from a collection point. The pump does not turn on until the used oil depth reaches 18 inches, then the pump kicks in and pumps down to 9 inches of oil. This eliminates any water in the used oil. The used oil can then be burned on site for heat recovery or transported off-site for fuel blending.

The impounded waste water can be used effectively for dust suppression. Most mining operations have had no problems in reusing the water in this manner.

4.2 SPENT PARTS CLEANING SOLVENTS

4.2.1 Product Substitution

Product substitution is the most promising method to reduce the large contribution of solvents to the hazardous waste stream. Numerous substitute products exist and surface coal mine vehicle maintenance facilities are quickly changing to non-hazardous solvents. However, product substitution is not without problems. Some of these problems are summarized as follows:

- Some substitute products leave a residue on the cleaned part. The requirement for complete and rapid volatilization of a solvent has prevented some mines from using non-hazardous solvents for cleaning sensitive parts, such as electrical contacts. For example, solvent residue on electrical components can cause flashover that may result in a fire. Solvent residue within a dragline means that a cleaned surface will remain slippery for longer than normal.

- Some non-hazardous solvents have a strong odor, usually a citrus smell, that is offensive to some workers.

- Some users of non-chlorinated solvents claim that it takes twice as much solvent to clean a part as compared to chlorinated solvents.

- Suppliers that recycle solvents have a difficult time preventing hazardous solvents from being mixed with the recycled waste stream. For example, one major company supplies a "non-hazardous" recycled solvent to mines, yet this product contains approximately 0.5 percent TCE. This chlorinated solvent is not part of the original formulation and appears to come from users dumping TCE into the recycling container.

Some mines have experimental programs to evaluate solvents. Only one solvent is used at a time and those using the solvents keep notes on the results. This allows systematic evaluation of solvents one at a time.

4.2.2 Technology Substitution

Industrial parts washers provide a promising alternative to solvent cleaners. These washers clean parts using hot water and a surfactant and/or detergent. Most units have an oil-water separator, filters, and sludge collectors. Washers come in various sizes, with the large size capable of handling most parts typically cleaned during vehicle maintenance. The water from the hot water parts washers is recycled within the unit. Many mining operations are using these washers on an experimental basis. At this time, all mines contacted during this study were satisfied with the results and plan on buying more units.

Large oven-type devices are available that bake off greases and other residues on vehicle parts, especially the large parts such as engine blocks. Although limited to components that will not be damaged by heat, thermal treatment has potential, especially since no waste is generated.

4.2.3 Recycling and Reuse

Fitting parts washers with recycling pumps and filters can reduce solvent waste generation by 50% or more. The spent filters are considered hazardous waste and need to be managed accordingly.

Newer parts washers that use citrus based solvents do not require solvent removal. A system of filters keeps the solvent usable, regardless of its age. Additional solvent is added to replace product lost through evaporation and dragout.

4.2.4 Staged Cleaning

Cleaning can be done in stages to minimize the use of hazardous solvents. For example, a non-hazardous solvent can be used for basic cleaning and the chlorinated solvent used only to remove the residue from the non-hazardous solvent left on the part. This works well when it is important that no residue remains on the part.

4.2.5 Quality Standards

Quality standards for cleaning non-electrical parts are generally lacking, except for the philosophy that most parts require precision cleaning. Over-cleaning is not necessary and simply increases the use of solvents and the generation of waste products. Cleaning standards should be set for all parts, and the part cleaned to meet that standard.

4.2.6 On-Site Distillation

Small distillation units are commercially available and offer the possibility of on-site recycling of spent solvents.

4.2.7 Product Consolidation

Minimizing the different types of solvents used at a facility will promote recycling by maintaining waste stream integrity. As previously mentioned, TCE is a contaminant in a recycled solvent that is not formulated with TCE. By minimizing solvent types such contamination can be prevented.

4.2.8 Work Practices

Certain work practices can minimize solvent use. Examples are as follows:

- If solvent is first sprayed on a rag and then the rag used to clean a part, less solvent is used than if applied directly to the part;

- Cleaning operations can be consolidated to minimize vapor loss, additionally, all solvents should be covered when not in use;
- For dip tanks, increasing the drain time for parts reduces drag-out loss;
- Do not cross contaminate solvents;
- Use dirty solvents for initial cleaning and clean solvent for the final cleaning;

4.3 LUBRICATION GREASES

4.3.1 Mobile Vehicles

Lubricating greases for mobile vehicles at mining operations are not usually an identifiable and quantifiable waste stream. It appears that the best opportunities for waste minimization focus on good maintenance and sealed units that minimize the loss of greases during vehicle operation. High performance synthetic oils that have longer molecular chains and retain their molecular structure under wear may also minimize loss.

4.3.2 Shovels and Draglines

Most mines recognize the large volume of waste grease that is generated by shovels and draglines and are making efforts to reduce waste generation, especially the generation of hazardous wastes. At the present time, product substitution appears to be the common approach to hazardous waste minimization.

Open Gear Compound

Most mining operations have moved away from TCE additives in open gear compounds, which makes them a hazardous waste, to biodegradable additives. Once the switch is made to a non-hazardous grease, it takes an average of 12 to 24 months to purge the system of the hazardous grease, and during the purging process hazardous waste is generated. A thorough cleaning of the various types of open gears immediately prior to changing to non-hazardous compounds may decrease the purge time. Another waste minimization technique during purging is to separate the different lubricants rather than placing all lubricants in the same container. In this manner the non-hazardous grease is kept separate from the hazardous greases.

When removing the hardened grease during maintenance, the grease is placed in plastic bags and then into 55 gallon steel drums at most mines. However, the plastic bags often clog the blending machinery at disposal facilities during fuel blending. Disposal companies will soon supply a reinforced paper bag that will either partially dissolve following placement in a steel drum or will break up during the agitation that is part of the fuel blending process.

Most mining operations ship both their hazardous and non-hazardous greases off-site for disposal, usually for energy recovery as boiler fuel. Some mines dispose of their non-hazardous greases in landfills located on the mine site. Although such disposal may be legal under landfill permits, landfilling of greases is not recommended as a desirable method of waste grease disposal.

It appears that for hazardous greases, pressure from the mining industry can be an important factor in the development of substitute, non-hazardous products. Vigorous opposition to the hazardous solvent additives in open gear compounds and other machine greases is important in convincing suppliers to invest the funds necessary for non-hazardous substitutes.

In some cases, draglines and shovels can be retrofitted with lubricating systems that are less wasteful or do not require hazardous lubricants. For example, swing cases can be retrofitted to a gear oil spray and bath system (buck lubrication system) that lubricates and cools the gear mesh. Oil requires changing only once every 3 to 4 years, rather than the annual change on older machines. Where there is potential to substantially reduce waste generation by retrofitting, cost of retrofitting must be justified on more factors than reduced waste disposal costs.

Good maintenance of the open gear components and other components that require lubrication is essential in minimizing waste generation for shovels and draglines. Poor maintenance for lubrication systems can greatly increase the grease use, especially with pressure injector systems that either leak or never fully shut off. Record keeping is essential to detect such problems.

Extreme Pressure Greases

As previously mentioned, some EP greases contain lead. While leaded EP greases are being phased out at most mines, leaded lubricants can be very difficult to purge and several years are often required.

Wire Rope Lubricants

In theory, wire rope lubricants could be substantially reduced by applying only what is needed for lubrication. However, there is considerable debate as to how much is really needed, and until that debate is resolved through research, some machine operators will continue to use copious amounts of wire rope lubricants. Other than the cost of this lubricant, there is little incentive for waste minimization because the spent rope lubricant is not recovered. However, some mines steam clean the dragline booms on an annual basis due to the accumulated wire rope lubricant that creates a safety hazard for anyone on the boom.

With the exception of the pennant lines that do not move, replacement of the standard wire rope on shovels with plastic valley wire rope can greatly decrease the need for rope lubrication. Although the plastic valley rope is more expensive, it usually lasts longer than the standard rope.

It appears possible to utilize used oil as a wire rope lubricant. If the acidity of the used oil is above 7.0 and if the oil is filtered, it can be sprayed on the wire ropes. However, used oil does not contain extreme pressure additives required for hoist ropes. During experimental application at a mining operation, wire rope life was not adversely affected by application of used oil, especially when external lubrication, rather than internal, was the goal. However, used oil must be carefully filtered to remove all particles that could plug the lubrication system. In addition, warranty requirements may preclude the use of used oil as a rope lubricant at the present time.

Cam and Slide Lubricants

Substitution to a non-hazardous lubricant has proven difficult, especially in machines with the Monigham cam. During cold weather, a replacement for the TCE additive that will give proper flow characteristics has yet to be formulated. However, some mines not using the Monigham cam have made successful conversions to non-hazardous cam and slide lubricants. Purging the hazardous lubricants from the system often takes 12 months or longer.

Other Lubricants

As with other machine components, timely maintenance that includes lubricant recovery regardless of where it occurs and how difficult it is to dig out can substantially increase the lubricant recovery rate. Replacement of worn parts and conversion to alternate lubrication systems can significantly reduce waste generation.

4.4 SPENT VEHICLE FLUIDS AND ACCESSORIES

4.4.1 Used Oil

Large volumes of used oil, including hydraulic and transmission fluids, are generated by the mines, ranging from 20,000 to 70,000 gallons per year. Due to the large volumes, several relevant options are available for the management and waste minimization of used oil. These options include:

- On-site energy recovery;
- Off-site energy recovery;
- Used as a crude lubricant;
- Reused as a blasting agent mixture;

On-Site Energy Recovery

Burning used oil in an on-site used oil furnace is an acceptable management practice which reduces both disposal costs, long term liability and also reduces heating costs. The used oil burners must be rated at less than 500,000 British thermal units (BTU's) per hour; the gasses from the burner must be vented to the outdoors; and the heater is used only to burn used oil generated on site or accepted directly from do-it-yourself oil changers.

The oil needs to meet on-specification used oil requirements. The burning of off-specification oil is acceptable provided the provisions of 40 CFR 279, Part 279.23 and Subpart G, Part 279.61 are met. The on-specification used oil requirements are listed in the following table.

On-Specification Used Oil

Flash Point	100 degrees Fahrenheit (minimum)
Arsenic	5 ppm (maximum)
Cadium	2 ppm (maximum)
Chromium	10 ppm (maximum)
Lead	100 ppm (maximum)
Total Halogens	1000 ppm (maximum) [1]

[1] A level of halogens up to 4,000 ppm is allowed if it can be proven that hazardous waste has not been mixed with the used oil.

Off-specification used oil means that the oil exceeds one or more of the specification for on-specification used oil unless the used oil has been mixed with hazardous waste. Used oil that has been mixed with hazardous waste is considered hazardous waste. Used oil is considered to be off-specification unless there are laboratory results or other documents to show it is either on-specification used oil or hazardous waste.

Used oil burners typically have a filtering stage prior to the burning stage. Solids filtered may exhibit RCRA toxicity or ignitability characteristics and will need to be appropriately handled.

The burners do have some air emissions. Hydrocarbon organics are readily oxidized in most burners. However, particulate and inorganic emissions may be a concern. Used oil burners can easily meet the Clean Air Act (CAA) requirements. Several used oil burners offer both heating systems and hot water applications so that year round energy recovery can be accomplished. During the winter, the used oil can be used as a fuel for heat and during the summer the system can be used to generate hot water for washing and other applications. The capital costs for these systems are easily offset by the savings on used oil shipments costs, raw fuels costs and the reduced liabilities for off-site recycling.

Off-site Energy Recovery

Off-site energy recovery through fuel blending and supplemental fuel programs is the most common method for used oil recycling currently utilized by the mining industry.

Crude Lubrication

As mentioned earlier, it appears possible to utilize used oil as a wire rope lubricant. If the acidity of the used oil is above 7.0 and the if the oil is filtered, it can be sprayed on the wire ropes. Wire rope life does not appear to be adversely affected by application of used oil, especially when external lubrication, rather than internal, was the goal. However, used oil must be carefully filtered to remove all particulates that could plug the lubrication system.

Blasting Agent

An excellent opportunity for waste minimization for used oil is to reuse it as a blasting agent. However, to date the USEPA has not approved this option.

The technology is available for replacing fuel oil with filtered used oil (up to 50%) in producing the blasting agent ANFO. ANFO is a mixture of ammonium nitrate and fuel oil (ANFO) and is utilized by mining operations. Blasting engineering studies demonstrate that a mixture of up to 80% used oil with the fuel oil does not affect the blasting efficiency for large diameter holes.

The Mine Safety and Health Administration (MSHA) may allow the use of used oil as a partial substitute for fuel oil in the ANFO blasting agent provided a petition for modification allowing its use is granted by MSHA. MSHA requirements may include:

- Only petroleum-based lubrication oil recycled from equipment at the mine shall be used for the purpose of blending with fuel oil in the creation of ANFO. The used oil shall not contain any hazardous waste materials including PCB's.
- Used oil shall be recycled by filtering and then stored in a storage tank and tested before use.
- The filters used in the filtering system are usually 60 mesh and/or 100 mesh arranged in series.
- Tests or analyses shall be checked for water and ethylene glycol.
- The blend of recycled oil and fuel oil (blended oil) shall not exceed 50% (by volume) recycled oil.
- The recycled oil shall be mixed continuously while being blended with fuel oil.
- The recycled oil and blended oil shall not be modified by heating, adding additives (with the exception of fuel oil), or in any other way that could change the relevant properties of the recycled oil.
- Certify compatibility with emulsion.
- The used oil/fuel oil is mixed with ammonium nitrate at the blast hole (not stored prior to use).

The MSHA has developed a "Generic Petition" which provides the more salient information which must be addressed in a Petition for Modification to use used oil in ANFO. The Petition for Modification procedures are outlined in 30 CFR Part 44. The "Generic Petition" from MSHA has been included as Appendix B.

4.4.2 Waste Filters

Most mines have stopped purchasing terne plated filters and are currently phasing them out or have already gotten rid of all such filters. One recycler of used filters requires the filters to be crushed, another recycler will not accept crushed filters. Several commercially available filter crushers are available. In addition, several very effective filter crushers have been designed and built from spare parts by the on-site maintenance personnel.

The scrap metal recycling exemption under the Resource Conservation and Recovery Act (RCRA) is applicable to used oil filters (scrap metal) if they are going to be recycled. However, an undrained or uncrushed oil filters may contain too much oil to qualify for the scrap metal exemption. The filter may be shipped off-site for crushing under the used oil exemption, providing the oil is collected for recycling.

If the crushed or drained filter will be recycled, it is unnecessary to determine whether it exhibits the TCLP toxicity because the scrap metal exemption is applicable. It would also be unnecessary to manifest these used oil filters. However, if the filter will be disposed of, the generator must determine if it is a hazardous waste.

There are various methods of gravity hot draining filters including puncturing the filter and hot draining, hot draining and crushing, and dismantling and hot draining. "Hot drained" means that the filter is drained at or near the engine operating temperature. The length of draining necessary is not specified but 12 to 24 hours appears to be sufficient to remove excess oil.

4.4.3 Transmission and Hydraulic Fluids

Transmission and hydraulic fluids are not typically segregated but are blended with used oil. This mixture can then be recycled off-site, used for energy recovery in used oil furnaces or used as a supplement to the fuel oil requirement for the ANFO blasting agent.

Most mining operations drain the oil, transmission and hydraulic fluids on predetermined preventative maintenance schedules. For instance, haul trucks may be scheduled to change their engine oil, hydraulic and brake/steering fluids after 250 hours of use. A large 240 ton haul truck has a 55 gallon capacity for oil, 230 gallons of hydraulic fluids and a 65 gallon capacity on the brake/steering system. One mine has determined this is unnecessary and has started a new procedure where they remove the fluid filter it, analyze it for metals, viscosity and other critical parameters to check for wear, and replace it in the units. This mine has not drained these fluids from the vehicles for over one (1) year. This procedure is termed "predictive maintenance", which greatly reduces waste generation over the conventional "preventive maintenance" procedures. Several commercial laboratories are available which provide analytical services for "predictive maintenance" programs.

A Predictive Maintenance Laboratory Analyses Form is included in Appendix C.

4.4.4 Antifreeze

The recyclers typically utilize a fractional distillation unit as opposed to a staged filter system. Most of the other mines utilize off-site recyclers. Antifreeze can easily be recycled on-site with filtration units and rust inhibitors additives.

Some mines have switched from ethylene glycol to propylene glycol, which is less toxic and apparently can be burned at power plants.

4.4.5 Batteries

Most mining operations currently recycle their vehicle batteries through existing vendors. Several other options for the minimization of hazardous waste from the spillage of water activated batteries include using sealed nonwater activated batteries and/or gel filled batteries. Advantages of the sealed batteries is that the battery can be placed in any orientation within the equipment. This allows for greater flexibility in use. In addition, sealed nonwater activated batteries do not emit corrosive vapors and extend battery cable life. Some operations have expressed concern over the gel batteries inability to hold a "deep charge" while other contend that they can hold a "deep charge".

4.4.6 Freon

All operations are required to use certified mechanics to capture and recycle refrigerants including freon.

4.5 SHOP AND VEHICLE CLEAN-UP WASTE

All mines utilize some form of floor dry to absorb minor spills and leaks in the maintenance bays. The procedures for the spent floor dry varies between mines and ranges from disposal at the on-site landfill or disposal at off-site landfills.

To increase the useful life of the floor dry, a screening device can be built which allows multiple applications of the absorbent to insure it is utilized to its maximum potential. The used absorbent is passed through a sieve that is placed over a container (i.e., a used, clean 55 gallon drum). The material is allowed to dry in the container prior to reuse. Generally the typical number of reuses is estimated at between two and three applications. The absorbent can then be disposed of in an appropriate manner. Care should also be taken not to use more absorbent material than necessary.

Good housekeeping practices, such as changing leaky spigots or valves and using extra care when changing vehicle fluids, are also necessary to alleviate the need for the floor dry.

Another option utilized by a large fleet maintenance operation is to utilize used oil/grease absorbent as an additive with aggregate by an asphalt plant to make new paving material.

4.6 SOLID WASTES

4.6.1 Scrap Metal

Mines typically recycle scrap metal utilizing off-site vendors. The scrap metal includes broken parts, cuttings from machine shops and in some cases aluminum cans. However, additional materials could be recycled as demonstrated by waste metal containers in dumpsters.

4.6.2 Tires

Most of the light vehicle tires are taken back by vendors for retreading although in some cases they are landfilled on-site. Smaller tires can are also used for "cable trees" and aerial survey markers.

The larger haul truck and scraper tires are typically returned to the vendor and then given away to ranchers and farmers. The ranchers utilize them for water troughs, wind breaks, shelter breaks, salt troughs, etc. Most mines have no trouble getting rid of large tires. However, some mines will not give tires away due to potential liabilities from injury and landfills all the used tires generated at the mine.

Several new uses for old tires are currently being evaluated. Shredded tires are being used in construction projects to replace conventional fill materials in some instances. Several examples of where this material may be used is in road bed construction, building constructions, and landscaping.

Shredded tires have also been incorporated into asphalt, almost doubling the durability and lifetime of the road surface. Section 1038 of the Intermodal Surface Transportation Efficiency Act of 1991 requires states to incorporate scrap tire rubber into asphalt used on federal highway projects by 1994. However, the cost of this process is about twice as high as ordinary asphalt.

Shredded tires are also being used as a fuel for power plants and cement kilns. Studies by several power plants have shown that using shredded tires mixed with coal has actually decreased air emissions for lead, particulate, and nitrogen oxides. The biggest drawback to this technology is the cost of a machine to shred the tires to a 1" X 1" size is approximately $50,000, making these options costly for a company simply looking to dispose of their old tires.

Using tires with extended mileage warranties is another means of reducing waste through using fewer tires. One study of county maintenance facilities showed that the down time and costs necessary to change tires more than offset the cost of the increased mileage tire.

4.6.3 Shovel and Dragline Cable

As mentioned earlier, draglines and shovels utilize a variety of ropes (steel cable) for the hoisting, dragging and release of the digging bucket. These "ropes" range in thickness of 2.5" for shovels to over 3.25" and weigh up to 40 pounds per linear foot. Mines simply backfill the "ropes" into their backfill or on-site landfill. The amount of rope utilized in any given year varies among mines. The length varies from 10,000 to 25,000 yards of rope per year per machine.

A valuable resource is being discarded and revenues could be generated from recycling the metal ropes. Several attempts have been made to try and recycle this material including rolling the cable back up on spools and cutting it into smaller length for transport. Most have met with failure; however, attempts are continuing to find cost effective and rapid ways to cut the cables so that recycling can be accomplished.

4.6.4 Rags

Mines typically segregate solvent rags from other types. Solvent rags are typically drummed, tested for TCLP and handled accordingly. If utilized for general cleanup without hazardous solvents they are placed in a dumpster for off-site or on-site landfilling.

Good housekeeping practices and judicious use of the towels seems to be the best minimization options available at this time. A rag laundry service, common to other fleet maintenance operations, should be considered for reducing the amount of rags disposed and the potential liability associated with solvent coated rags.

4.6.5 Paper

Some paper is recycled from computer printer areas. However, most paper at mines is landfilled either on-site or off-site. Additional paper and corrugated cardboard could be recycled with little effort or up front costs.

4.6.6 Wooden Spools

Wooden spools are typically broken down and used for a variety of uses on site or landfilled. Mines should negotiate with their wire and cable rope vendors to take back the discarded wooden spools.

4.7 PAINTS, STRIPPERS AND THINNERS

4.7.1 Paints

A wide variety of options are available for the waste minimization of paint, paint strippers and paint thinner (solvent) wastes. These options include: inventory control, purchasing controls, housekeeping practices, material segregation and waste exchange

Inventory Control - Rigid inventory control provides a very effective means of source reduction at virtually no cost to the operator. By limiting access to storage areas containing raw materials, this forces the employee to stretch the use of raw materials farther. This also allows the use of raw materials to be more easily monitored.

Purchasing Control - If large quantities of materials are needed then purchasing in bulk is warranted. However, if only minor amounts are needed then smaller containers can be ordered. Purchasing control also effects purchasing choices so it becomes easier to of substitute less hazardous products.

Housekeeping Practices - Specific approaches to drum location, materials transfer methods, leak collection, and drum transfer can effectively limit product loss.

The potential for accidental spills and leaks is highest at the point of transfer of thinners from bulk drum storage to process equipment. Spigots or pumps should always be used to transfer waste materials to storage containers. Material should never be poured directly from drums to smaller containers.

Evaporation is a material loss that can be controlled through the use of tight-fitting lids. The reduction of evaporation will increase the amount of available material and result in lower solvent purchase costs.

Mix Materials According to Need - Many operators mix fixed amounts of materials and any materials not used for the job may be classified as a hazardous waste and need to be disposed of accordingly. Varying cup and can sizes could be an effective means of source reduction in two important ways. It would limit over mixing of paint to be used on a specific project, and decrease the amount of solvent needed for equipment cleanup when doing spot painting and small jobs.

Use High Transfer Efficiency Equipment - A standard piece of equipment used to apply paint is an air spray gun. Typical transfer efficiency is on the order of 20 to 40%. Many of the newer spray application systems have transfer efficiencies of greater than 65%. Since with lower efficiency more paint is wasted, higher efficiency systems are being promoted for use.

Better Operator Training - Transfer efficiency is also a function of operator skill and training. Operators may be very skilled at producing high quality finishes but poorly trained in the ways of reducing paint usage. The proper adjustment of air pressure can increase transfer efficiency by 30 to 60 percent.

Proper Cleaning Methods - In reducing solvent use, greater attention should be paid to the methods employed in equipment cleaning. The practice of filling the cup with solvent, stirring until the paint dissolves, and then repeating the procedure as needed should be discouraged.

Recycle Solvent - Spent solvent can be recycled both on-site and off-site. Simple on-site recycling/reclamation can be accomplished by gravity separation. Distillation units can be installed for recycling solvents on-site. Spent materials can be shipped off-site for recycling if volumes on-site are insufficient for on-site recovery.

Switch to Water-Based Paints and Primers - Waterborne products reduce VOC emissions. These type of paints and primers also reduce the amount of hazardous waste due to the limited amount of solvent in the paints. Other benefits include reduced personal health and safety concerns due to the reduced solvent usage and the reduction in hazardous waste from equipment cleanup.

Use High-Solids Paints - High solids paints are becoming more readily available for surface refinishing. These products have the advantage of reducing VOC emission by up to 75%. However, an in-line heater is required to reduce the viscosity of the high-solids coatings.

Switch From Lacquer to Enamel-Based Paints - Lacquer paints may contain 70 to 90% by volume solvent while enamels contain 55 to 75% by volume solvent. The use of the enamel-based paints can result in a significant reduction of VOC emissions when compared to lacquer based paints.

Consume Paint - All paint should be completely used up. This applies to both paint cans and aerosol containers. Empty containers should be drained and depressurized properly. A hazardous waste determination must be carried out if the waste containers are to be disposed. A better alternative is to recycle the metal paint containers.

Waste Exchange - Excess paint and waste thinners can be listed in waste exchange programs. Waste exchanges are clearinghouse organizations that manage or arrange the transfer of waste between companies/industries. Excess paint can be donated to low income housing projects, orphanages, parks and recreation departments, etc. This provides them with a needed raw product, reduces the disposal costs for the company and improves public relations.

Segregate Materials - Excess paint, stripping solvents and thinners should be segregated in separate waste containers dependent on waste type. Combining leftover paint into a solvent/thinner waste container will further contaminate the quality of the recyclable/reusable material. Waste segregation is an inexpensive alternative to mixing waste and therefore, decreases disposal costs.

4.7.2 Paint Strippers and Thinners

Many of the waste minimization techniques listed above are also applicable to paint strippers and thinners. Several alternatives to traditional solvent/chemical paint stripping are now available. In addition, gravity separation, distillation, and plastic media blasting may also be applicable for some operations.

Gravity Separation - The least expensive method used on-site is gravity separation. Gravity separation allows the paint solids and sludge to settle to the bottom of the accumulating container while the "cleaner" solvent and/or stripper remains on top. The "clean" solvent/stripper can then be reused by removal from the top.

Distillation - For large quantity generators, on-site distillation may prove to be a cost effective alternative. Distillation yields higher grade thinner for reuse than gravity separation. Reclaimed thinner may be used for washing parts and for formulating primers and base coats.

Plastic Media Blasting - Plastic media blasting (PMB) utilizes the concept of sand blasting with the substitution of a plastic for the sand. Paint stripping by PMB is a promising alternative to solvent stripping and is being widely utilized by the Department of Defense for removing paint from aircraft. The spent plastic can be separated from the paint chips and be recycled. The process does produce a small amount of waste (dry paint) but solvents and rinse water are completely eliminated.

5.0 SUMMARY AND CONCLUSIONS

Many options are available to the mining industry for minimizing waste from equipment and fleet maintenance operations. Several of the more common waste minimization techniques have been reviewed in this document. However, many others are available with more being continually developed.

Several mining operations have initiated innovative waste minimization programs. Several of these include:

- Product Substitution - Switch from chlorinated or low flash point (FP) solvents to higher FP solvents, citrus based solvents, or industrial parts washers which utilize hot water and biodegradable soap.
- Product Reformulation - Reformulation of the dragline and shovel grease by several vendors has resulted in a non-hazardous waste grease due to the elimination of the TCE in these formulations. However, it will take approximately one year to purge the "old" greases out of the machinery.
- Purchasing and Inventory controls - Several mines have initiated strict purchasing and inventory controls to eliminate unwanted materials on-site.
- Vendor Contract Negotiation - Several operations have renegotiated their contracts with various vendors to reduce the volume of waste left on mine site. These include: drums, wooden spools, and solvent filter systems on solvent rinse tanks.
- New Uses - One mine has taken the initiative to work through the problems associated with utilizing used oil as a substitute for the ANFO blasting mixture.

The mining industry and their suppliers need to focus on additional options for product substitution, product reformulation, reuse and recycling. The mining industry should continue to place pressure on their vendors to provide waste minimization options and nonhazardous products. In addition, renegotiating contracts to reduce the amount of waste should be a high priority within the mining industry.

Numerous relevant reference articles are available to mining and fleet maintenance operations. A list which includes EPA Guidance Documents and articles on waste minimization opportunities for absorbents, antifreeze, batteries, filters, freon, greases/lubricants, metals, oil, paint, plastic, paint stripping, radiators, rags/shop towels, solvents, tires, and waste water are included in Appendix D.

6.0 WASTE MINIMIZATION ASSESSMENT WORKSHEETS

The worksheets provided in this section are intended to assist mining operations is systematically evaluating waste generation processes and in identifying waste minimization opportunities. These worksheets include only the waste manumission assessment phase of the procedure described in the Waste Minimization Opportunity Assessments Manual. A comprehensive waste minimization assessment includes a planning and organizational step, an assessment step that includes gathering background data and information, a feasibility study on specific waste minimization options, and an implementation phase. A list of the Waste Minimization Assessment Worksheets included in this document are listed below.

Firm ______ Site ______ Date ______	Waste Minimization Assement Proj. No. ______	Prepared By ______ Checked By ______ Page ____ of ____

WORKSHEET
1a

WASTE SOURCES

Shop Clean-Up	Significance at Mine		
	Cost	Vol.	Haz.
Spills & leaks (non-hazardous)			
Spills & leaks (hazardous)			
Shop rags			
Absorbents			
Area wash water			
Clarifier sludges			
Scrap metal			
Container disposal (paper/plastic)			
Pipeline/tank drainage			
Evaporative losses			
Other			
Parts Cleaning			
Spent solvent cleaner			
Spent carburator cleaner			
Spent brake cleaner			
Evaporation losses			
Leaks and spills (solvents)			
Spent alkaline cleaner (Diptanks)			
Leaks and spills (alkali)			
Rinse water discharge (parts washers)			
Sludges			
Filter waste			
Other			

Firm ____ Site ____ Date ____	Waste Minimization Assessment Proj. No. ____	Prepared By ____ Checked By ____ Page ____ of ____

WORKSHEET 1b

WASTE SOURCES

Maintenance Shop Wastes	Significance at Mine		
	Cost	Volume	Haz.
Motor oil			
Oil filters			
Gear and lube oils			
Transmission fluid			
Brake fluid			
Other filters			
Radiator coolant			
Terne plated filters			
Brakes (asbestos)			
Radiators (lead)			
Batteries (lead & acid)			
Junk parts			
Tires			
Other			
Mining Operation Wastes			
Wooden spools			
Dragline cable			
Dragline greases			
Field solvents			

Firm ______________________
Site ______________________
Date ______________________

Waste Minimization Assessment

Project Number ______________

Prepared By ______________
Checked By ______________
Page _____ of _____

WORKSHEET 2a

WASTE MINIMIZATION: Material Handling

A. DRUMS, CONTAINERS, AND PACKAGES

Are drums, packages and containers inspected for damage before being accepted? Yes No

Describe handling procedures for damaged items: ______________________________

Is there a formal personnel training program on raw material handling, spill prevention proper storage techniques, and waste handling procedures? Yes No

How often is training given and by whom? ______________________________

Is obsolete raw material returned to the supplier? Yes No

Is inventory used in first-in first-out order? Yes No

Are stored items protected from damage, contamination, or exposure to rain, snow, sun and heat? Yes No

Is the dispensing of raw materials supervised and controlled? Yes No

Are users required to return empty containers before being issued new supplies? Yes No

Do you maintain and enforce a clear policy of using raw materials only for their intended use? Yes No

Is the inventory system computerized? Yes No

Does the current inventory control system adequately prevent waste generation? Yes No

What information does the system track? ______________________________

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WORKSHEET 2b

WASTE MINIMIZATION: Material Handling

B. BULK LIQUIDS HANDLING

What safeguards are in place to prevent spills and avoid ground contamination during the filling of storage tanks?

High level shutdown/alarm ___ Secondary containment ___

Flow totalizers with cutoff ___ Other ___

Describe the system: ____

Are all storage tanks routinely monitored for leaks? If yes, describe procedure and monitoring frequency for above-ground/vaulted tanks: ____

Underground tanks: ____

How are the liquids in these tanks dispensed to the users? (i.e., in small containers or hard piped.) ____

What measures are employed to prevent the spillage of liquids being dispensed? ____

When a spill of liquid occurs in the facility, what cleanup methods are employed (e.g., wet or dry?) Also discuss the way in which the resulting wastes are handled: ____

Firm ____ Site ____ Date ____	Waste Minimization Assessment Project Number ____	Prepared By ____ Checked By ____ Page ____ of ____

WORKSHEET 3

MINIMIZATION OPTIONS:
Material Handling

Meeting Participants ____________________

Suggested Waste Minimization Options	Currently Done Yes/No?	Rationale/Remarks or Options
A. Drums, Containers, and Packages		
Raw Material Inspection		
Proper Storage/Handling		
Return Obsolete Material to Supplier		
Minimize Inventory		
Computerize Inventory		
Formal Training		
Waste Segregation		
B. Bulk Liquids Handling		
High Level Shutdown/Alarm		
Flow Totalizers with Cutoff		
Secondary Containment		
Air Emission Control		
Leak Monitoring		

Firm ______ Site ______ Date ______	Waste Minimization Assessment Project Number ______	Prepared By ______ Checked By ______ Page ____ of ____

WORKSHEET 4a

WASTE MINIMIZATION: Parts Cleaning

A. SOLVENTS

Do you use parts cleaning solvent for uses other than cleaning parts? Yes No

Have you established guidelines as to when parts should be cleaned with solvents? Yes No

Do you use solvent sinks instead of pails or dunk buckets? Yes No

Are solvents sinks and/or buckets located near service bays? Yes No

Do you allow cleaned parts to drain inside the sink for a few minutes to minimize dripping of residual solvent onto the shop floor? Yes No

Are you careful when immersing and removing parts from the solvent bath so as not to create splashes? Yes No

Do you keep all solvent sinks/buckets covered when not in use? Yes No

Do you lease your solvent sinks? Yes No

If yes, does your lease include solvent supply and spent solvent waste handling? Yes No

Have you installed filters on solvent sinks? Yes No

If you own your solvent sinks, does a registered waste hauler collect your dirty solvent for recycling or treatment? Yes No

Does the current inventory control system adequately prevent waste generation? Yes No

Do you own on-site solvent recovery equipment such as a distillation unit? Yes No

If yes, how are the solvent residues handled ______________________________

____

____

What other methods are you using to reduce solvent use/waste? ______________________________

____

____

B. AQUEOUS CLEANERS

Do you use dry pre-cleaning methods such as baking and/or wire brushing to reduce loading on the aqueous cleaner? Yes No

Have you switched from caustic-based cleaning solutions to detergent-based cleaners? Yes No

Do you use drip trays on hot tanks to minimize the amount of cleaner dripped on the floor? Yes No

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WORKSHEET 4b

WASTE MINIMIZATION: Waste Handling

B. AQUEOUS CLEANERS (continued)

Are the hot tanks/jet spray washers located near the service bays?	Yes	No
Do you pre-rinse dirty engine parts in a tank of dirty cleaning solution so as to reduce loading on the clean tank??	Yes	No
Do you routinely monitor solution composition and make adjustment accordingly?	Yes	No
Do you routinely remove sludge and solids from the tank?	Yes	No
Are sludge and solids screened out before they reach the waste sump?	Yes	No
Have you installed still rinses or converted free running rinses to still rinses? (Spent rinse water cna be used as make-up to your cleaner bath if you use demineralized water.)	Yes	No
Is your cleaning tank agitated?	Yes	No
If yes, do you use mechanical agitation instead of air agitation?	Yes	No
Do you lease your hot tank(s)/jet spray washer(s)?	Yes	No
Do you own your hot tanks/jet spray washer(s)?	Yes	No
Do you own on-site aqueous waste treatment equipment?	Yes	No
Does a hazardous waste hauler collect aqueous waste for recycling or treatment?	Yes	No

If not, how is your waste handled and disposed of? ______________________________

____

____

Firm ____ Site ____ Date ____	Waste Minimization Assessment Project Number ____	Prepared By ____ Checked By ____ Sheet ___ of ___ Page ___ of ___

WORKSHEET 5 **OPTION GENERATIONS:**
Parts Cleaning

Meeting Format (e.g., brainstorming, nominal group technique) ____
Meeting Coordinator ____
Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Yes/No?	Rationale/Remarks or Option
A. Solvents		
Proper solvent use		
Established guidelines		
Use solvent sinks		
Careful drainage		
Cover tanks		
Lease equipment/service		
Recycle solvent		
B. Aqueous Cleaners		
Dry pre-cleaning		
Use detergents		
Drip trays		
Pre-rinse parts		
Monitor solution		
Remove sludge and solids		
Employ still rinse		
Use demineralized water		
Use mechanical agitation		
Lease equipment		

Firm ______ Site ______ Date ______	Waste Minimization Assessment Project Number ______	Prepared By ______ Checked By ______ Page ____ of ____

WORKSHEET 6a

WASTE MINIMIZATION: Waste Handling

A. ENGINE, LUBRICATING AND COOLING FLUIDS

Do you test fluid quality, including engine, lubricating and cooling fluids, to determine when they should be changed? Yes No

When fluids must be drained either to test for wear or service a part, are they stored in a clean container so they may be re-used? Yes No

Have you had experience using any longer lasting synthetic motor, lubricating and cooling fluids? Yes No

If yes, please explain: ______________________________

____

____

Do you currently employ rigid inventory controls to minimize fluid use? Yes No

Describe: ______________________________

____

____

Are all waste fluids kept segregated? Yes No

If not, have you notified your waste hauler or recycler? Yes No

Have you ever had a load of waste fluid rejected by a hauler or recycler because of cross contamination? Yes No

Please describe how you store and dispose of waste fluids (motor and lube oils, greases, transmission fluids and spent anti-freezes). ______________________________

____

____

Firm ______ Site ______ Date ______	Waste Minimization Assessment Project Number ______	Prepared By ______ Checked By ______ Page ____ of ____

WORKSHEET 6b

WASTE MINIMIZATION: Waste Handling

B. PAINT APPLICATION (CONTINUED)

Could more rigid controls be implemented in your shop? ______

Are paints mixed according to need? Is the volume of paint mixed based on the surface area to be painted? Yes No

Have you tried high efficiency spray application equipment in your shop? Yes No

Did it reduce the amount of paint sprayed? Yes No

Did it affect finish quality? Yes No

Describe how you minimize overspray waste ______

C. OTHER WASTES

Do you recycle your used batteries? Yes No

Are your used batteries stored in a warm, dry secure place? Yes No

Does a recycler or equipment leasing service collect your spent antifreeze? Yes No

Do you use a collection/recycling system to service air conditioning units? Yes No

Do you sell or give worn parts to a re-manufacturer? Yes No

Do you have any suggestions for reducing other wstes? ______

Firm ________ Site ________ Date ________	Waste Minimization Assessment Project Number ________	Prepared By ________ Checked By ________ Page _____ of _____

WORKSHEET 7

MINIMIZATION OPTIONS:
Waste Handling

Meeting Participants ________________________________

Suggested Waste Minimization Options	Currently Done Yes/No?	Rationale/Remarks on Option
A. Waste Oils and Coolants		
Test fluid quality		
Store fluids for reuse		
Use longer lasting fluids		
Keep wastes segregated		
Send to recycler		
Predictive maintenance		
Used as blasting agent		
B. Paint Applications		
Use rigid inventory controls		
Mix smaller batches of paint		
Use high-efficiency sprayer		
Minimize overspray		
C. OTHER WASTES		
Drain filters and dispose properly		
Recycle batteries		
Collect/recycle refrigerant		
Sell or give parts to re-manufacturer		

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WORKSHEET
8

WASTE MINIMIZATION: Material Substitution

A. ABRASIVE BLASTING

Is the blasting media used in the shop considered hazardous (e.g., lead shot)?	Yes	No
If so, can other lesser/non-hazardous materials be substituted? (e.g. plastic media)	Yes	No
Describe results of any substitution attempts:	Yes	No
Are dust suppression collection systems employed during abrasive blasting?	Yes	No
Is this dust collectected and recycled or reused??	Yes	No
Would the installation of a dust collection system allow for reuse?	Yes	No

Explain how blasting dusts are handled and the potential for reuse: ______________________________

____

____

B. CHEMICAL STRIPPING

Are any chemical stripping agents used in the shops considered hazardous (e.g. chlorinated solvents)?	Yes	No
If so, can other non-hazardous materials substitute for the hazardous materials?	Yes	No

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WORKSHEET 9 — MINIMIZATION OPTION: Material Substitution

Meeting Participants ______

Suggested Waste Minimization Options	Currently Done Yes/No?	Rationale/Remarks on Option
A. Paint Removal		
Blasting media substitution		
Substitute blasting for chemical stripping		
Less hazardous strippers		
B. Painting Operation		
Use low VOC paints		
Use less toxic paints		
Maximize use of water based paints		

Firm ______ Site ______ Date ______	Waste Minimization Assessment Project Number ______	Prepared By ______ Checked By ______ Page ____ of ____

WORKSHEET 10

WASTE MINIMIZATION: Good Operating Practices

A. GOOD OPERATING PRACTICES

Are plant material balances routinely performed?	Yes	No
Are they performed for each material of concern (e.g. solvent) separately?	Yes	No
Are records kept of individual wastes with their sources of origin and eventual disposal?	Yes	No
Are the operators provided with detailed operating manuals or instruction sets?	Yes	No
Are all operator job functions well defined?	Yes	No
Are regularly scheduled training programs offered to operators?	Yes	No
Are the employee incentive programs related to waste minimization?	Yes	No
Does the plant have an established waste minimization program in place?	Yes	No
If yes, is a specific person assigned to oversee the success of the program?	Yes	No

Discuss goals of the program and results: ______________________________

____

____

Has a waste minimization assessment been performed at this plant in the past? If yes, discuss: ______________

____

____

B. HOUSEKEEPING

Are dirty parts removed and placed on a drip pan instead of directly on the shop floor?	Yes	No
Are all work areas kept clean and neat?	Yes	No
Do your workers wipe up small spills of fluid as soon as they occur?	Yes	No
Do you have an award program for workers who keep their work areas clean (i.e., prevent leaks and spills)?	Yes	No
Do you use a laundry service to clean your rags and uniforms?	Yes	No
Do you use a biodegradable detergent for cleaning shop floors?	Yes	No
Have you tried using a steam cleaner in place of chemical cleaners?	Yes	No
Do you discharge area washdown wastewater to a POTW or industrial sewer, instead of to the storm drain?	Yes	No

If not, how is this waste handled? ______________________________

____

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WORKSHEET 11

MINIMIZATION OPTIONS:
Good Operating Practices

Meeting Participants ____

Suggested Waste Minimization Options	Currently Done Yes/No?	Rationale/Remarks on Option
Perform Material Balances		
Keep Records of Waste Sources & Disposition		
Waste/Materials Documentation		
Provide Operating Manuals/Instructions		
Employee Training		
Increase Plant Sanitation		
Establish Waste Minimization Policy		
Set Goals for Source Reduction		
Conduct Annual Assessments		
Use Drip Pans		
Wipe up Spills (Cotton Rags, Paper Towels)		
Keep Bays Clean		
Award Program		
Use Laundry Service		
Use Biodegradible Detergents		
Use Steam Cleaners		
Discharge to POTW/Industrial Sewer		

APPENDIX A

WASTE CLASSIFICATION AND HANDLING FORM

WASTE CLASSIFICATION

Aerosol cans
Antifreeze (glycol)
Asbestos components
Empty containers
Equipment batteries
Equipment tires
Filters (engine oil)
Filters (gasoline)
Filters (terne plated)
Filters (other)
Floor dry - absorbent
Freon recycling (air conditioning)
Ignitable (flammable) liquids
Rags (hazardous)
Rags (other)
Scrap metal
Sludge - maintenance/lube bay
Sludge - wash bay
Solvent - combustible
Solvent - ignitable
Trash (miscellaneous)
Used grease (non-chlorinated)
Used grease (chlorinated)
Used oil
Used paint

AEROSOL CANS

Regulation	- Pressure and contents are hazardous
Procedure	- Review MSDS for hazardous ingredients
	- Separate by characteristics
	- Puncture cans - chemical specific
Storage	- Drain fluid into lined DOT approved drums
Label	- Label drum "Hazardous Waste - Flammable"
	- Label drum "Hazardous Waste - Oxidizer"
	- Label drum "Hazardous Waste - ???"
Disposal	- Place drained, punctured cans in dumpster
	- TCLP drum residue and incinerate
NOTE	- **NOT FOR USE WITH HERBICIDES OR PESTICIDES!**

ANTIFREEZE (GLYCOL)

Regulation	- Used antifreeze may contain TCLP metals, sinks into groundwater (Specific Gravity > 1)
Procedure	- Regulations are vague
	- Recycling encouraged
	- Accumulate quantity for TCLP testing
	- TCLP mandatory before you recycle
Storage	- Store in used antifreeze tank
Label	- Label tank "Used Antifreeze"
Disposal	- Recycle if passing TCLP
	- Incinerate if failing TCLP
Records	- Maintain accumulation and recycling records
NOTE	- **SLUDGE GENERATED DURING RECYCLING?**
	- **GLYCOL WILL BE REGULATED UNDER CLEAN AIR ACT**

ASBESTOS COMPONENTS

Regulations	- Asbestos and PCB's are TSCA regulated wastes
Procedure	- Review MSDS for asbestos content/structure
	- Check old haul truck grid resisters
	- Wrap components in plastic bags
Storage	- Place in a covered DOT approved drum
Label	- Label drum "Hazardous Waste"
	- Label drum "Non-Friable Asbestos"
Disposal	- Permitted Landfill Only!
Records	- Maintain accumulation and disposal records
NOTE	- **FOLLOW TSCA DISPOSAL PROCEDURE!**

EMPTY CONTAINERS

Regulation	- EPA allows burial of "empty" containers - inc. barrels, cans, aerosols, and misc. containers
Procedure	- Maximize use of recyclable containers - Empty containers by commonly employed means, i.e. turning upside down - If viscous material is present, may not contain more than 1" in bottom of container.
Storage	- Store recyclable containers in warehouse yard - Place nonrecyclable drums in solid waste cell
Disposal	- Return recyclable containers to vendor - Crush empty drums and bury in solid waste cell
Records	- Maintain recycling, disposal, and surveyed location records
NOTE	- **MAXIMIZE USE OF RECYCLABLE CONTAINERS**

EQUIPMENT BATTERIES

Regulation	- Used batteries are regulated as hazardous waste if not exchanged or recycled
Procedure	- Return used battery to vendor
Storage	- Store used batteries in warm, protected areas
Label	- Use exact wording "Wet battery returned for regeneration or reclamation"
Disposal	- Obtain signed receipt from vendor
Records	- Maintain records of battery transfer to vendor
NOTE	- **AVOID USING WORDING "DISPOSAL"**

EQUIPMENT TIRES

Regulation	- State law mandates proper disposal or recycling - If onsite, in approved solid waste cell - State also allows stock troughs and personal wind breaks only
Procedure	- Contact engineering for appropriate location
Storage	- Accumulate for disposal - minimize solid waste cell disposal
Label	- None
Disposal	- Bury or alternate use - determine postmine surface restrictions
Records	- Maintain recycling and disposal records
NOTE	- **AVOID OFFSITE DISPOSAL LIABILITY**

FILTERS (ENGINE OIL)

Regulation	- EPA allows disposal of hot, gravity drained engine oil filters
	- Recycling is recommended disposal method
Procedure	- Review MSDS for lead content/structure
	- If filter is terne plated - recycle (see below)
	- Hot gravity drain filter, then crush if appropriate
Storage	- Place in a covered DOT approved drum
Disposal	- Recycle, landfill, or bury in solid waste cell
Records	- Maintain recycling and disposal records
NOTE	- **ONLY ENGINE OIL FILTERS ARE EXEMPT**

FILTERS (GASOLINE)

Regulation	- Gasoline filters are hazardous waste and are not recyclable
Procedure	- Drain filter for 24 hours - do not crush
	- Assume TCLP fails flammability/benzene
Storage	- Place in a covered DOT approved drum
Label	- Label drum "Hazardous Waste"
Disposal	- Dispose of as hazardous waste (D001 & D018)
Records	- Maintain accumulation and disposal records
NOTE	- **GASOLINE FILTERS ARE NOT RECYCLABLE**

FILTERS (TERNE PLATED)

Regulation	- Lead plated (terne) filters are recyclable
	- If not recycled, they must be managed as hazardous waste
	- Coolant, lube, fuel, hydraulic, or air filters
Procedure	- Manufacturer should identify potential filters
	- Hot gravity drain filter and crush
Storage	- Place in a covered, DOT approved drum
Label	- Label drum "Used Oil Filters"
Disposal	- Recycle through reputable facility
Records	- Maintain recycling records

FILTERS (OTHER)

Regulation	- Only non-terne engine oil filters are disposable
	- Recycle all others filters, i.e. coolant, hydraulic, diesel fuel, terne filters
Procedure	- Hot gravity drain filter and crush (if appropriate)
Storage	- Place in a covered DOT approved drum
Label	- Label drums "Used Oil Filters"
Disposal	- Recycle
Records	- Maintain recycling records
NOTE	- **ONLY ENGINE OIL FILTERS ARE EXEMPT**

FLOOR DRY - ABSORBENT

Regulation	- Contaminated material passing TCLP criteria
	- Contains non-hazardous solvents, oils, greases
	- If material fails TCLP or is used to clean up hazardous materials, it must be managed as hazardous waste
Procedure	- Separate from contaminated material
Label	- None required
Disposal	- Place land treatment area, TPH test, and aerate
	- When TPH acceptable, place in solid waste cell
Records	- Maintain test and treatment records
NOTE	- **LAND TREATMENT PERMIT MAY BE REQUIRED**

FREON RECYCLING

Regulation	- Chlorofluorocarbons regulated under Clean Air Act
	- Only off road units are exempt
Procedure	- Mandatory ASE or MACS training
Labels	- Specific requirements for recycling unit
Storage	- Specified recovery units
Disposal	- None - recycle
Records	- Maintain training records/unit specifications
	- Certificate of Compliance
NOTE	- **UNIT IN PLACE BY 1992, COMPLIANCE BY 1993**

IGNITABLE (FLAMMABLE) LIQUIDS

Regulation	- RCRA Ignitable liquids (<140 °F) hazardous
Procedure	- Review MSDS for hazardous ingredients
	- TCLP for characteristics
	- Keep separate from non-flammable liquids
Storage	- Place in a covered DOT approved drum
Label	- Label drum "Hazardous Waste - Flammable"
Disposal	- Dispose of as hazardous waste
Records	- Maintain accumulation and disposal records

RAGS (HAZARDOUS)

Regulation	- Contaminated rags may fail TCLP criteria or may be listed hazardous waste
	- Flammable or chlorinated solvent residue
Procedure	- Review MSDS for contaminants
	- Separate from non-flammable rags
	- Separate from non-chlorinated rags
	- TCLP to determine hazardous characteristics
Storage	- Place in a covered DOT approved drum
Labels	- Label two drums "Hazardous Waste"
	- Label both drums "Flammable"
	- Label one drum "Chlorinated Solvent"
Disposal	- Hazardous waste facility
Records	- Maintain accumulation and disposal records

RAGS (OTHER)

Regulation	- Contaminated rags passing TCLP criteria - Non-hazardous solvents, oils, greases
Procedure	- Review MSDS for contaminants - Separate from contaminated rags
Labels	- None required
Disposal	- Discard to dumpster or solid waste cell
Records	- Maintain solid waste cell disposal records

SCRAP METAL

Regulation	- Solid waste disposal
Procedure	- Collect for salvage or disposal
Labels	- None required
Disposal	- Recycle for beneficial use - Discard to dumpster or solid waste cell
Records	- Maintain disposal and/or recycling records

SLUDGE - MAINTENANCE/LUBE BAY

Regulation	- Sludge from maintenance areas may contain groundwater pollutants (antifreeze, oils)
Procedure	- Inspect vacuum truck for contamination - Vacuum sludge residue from waste oil separators and floor drains
Storage	- None
Label	- None required
Disposal	- Place land treatment area, TPH test, and aerate - Test until TPH acceptable and place in solid waste cell
Records	- Maintain test and treatment records
NOTE	**- LAND TREATMENT PERMIT MAY BE REQUIRED** **- SLUDGES REQUIRE A HAZARDOUS WASTE DETERMINATION. SLUDGES MAY FAIL A TCLP OR CONTAIN LISTED SOLVENTS. IF SO, THEY MUST BE MANAGED AS HAZARDOUS WASTE.**

SLUDGE - WASH BAY

Application	- Sludge from equipment washdown may contain oil
Procedure	- Inspect vacuum truck for contamination - Vacuum sludge residue from sediment trap
Storage	- None
Label	- None required
Disposal	- Periodically test for TPH content - If acceptable, discharge anywhere - If unacceptable, place in approved land treatment area and aerate
Records	- Maintain test and treatment records
NOTE	**- SEE NOTE ABOVE**

SOLVENT - COMBUSTIBLE

Regulation	- Untested solvents are assumed hazardous
Procedure	- Review MSDS for hazardous ingredients
	- TCLP for characteristics
	- Passing - mix with used oil
	- Failing - treat as hazardous waste
Storage	- Place in a covered DOT approved drum
Label	- Label drum "Hazardous Waste"
	- Label drum with other TCLP characteristics
Disposal	- Recycle through tolling agreement or dispose of as hazardous waste (TCLP)
Records	- Maintain accumulation and disposal records

SOLVENTS - IGNITABLE

Regulation	- RCRA Ignitable liquids - flash point <140 °F are hazardous waste
Procedure	- Review MSDS for hazardous ingredients
	- TCLP for characteristics
Storage	- Place in a covered DOT approved drum
Label	- Label drum "Hazardous Waste"
	- Label drum with other TCLP characteristics
Disposal	- Recycle through tolling agreement or dispose of as hazardous waste (TCLP)
Records	- Maintain accumulation and disposal records
NOTE	- **REMEMBER, TO MINIMIZE SOLVENT USAGE, "SPRAY THE RAG - NOT THE PART"**

TRASH (MISCELLANEOUS)

Regulation	- Solid waste disposal
Procedure	- Separate from other listed waste
Storage	- Place in dumpster or drum
Label	- none
Disposal	- County landfill or solid waste cell
Records	- Maintain accumulation and disposal records
NOTE	- **MAINTAIN WASTE CELL TO MINIMIZE LITTER**

USED GREASE (NON-CHLORINATED)

Regulation	- Non-flammable, non-chlorinated grease will be regulated as "used oil"
Procedure	- Review MSDS for hazardous ingredients
	- Confirm with a Specification Oil Analysis
	- Collect for energy recovery / no deris
	- Separate by product
Storage	- Place in a covered DOT approved drum
Label	- Label "Used Oil"
Disposal	- Use for energy recovery

USED GREASE (CHLORINATED)

Regulation	- Unmixed chlorinated grease may be regulated as "off-specification used fuel oil"
Procedure	- Review MSDS for hazardous ingredients
	- Confirm with a Specification Oil analysis
	- Collect for energy recovery / no deris
	- Separate by product
Storage	- Place in covered DOT approved drums
Label	- Label "Off-Specification Used Fuel Oil"
Disposal	- Ship as boiler fuel for energy recovery
Records	- Maintain accumulation and disposal records

USED OIL

Regulation	- Special regulations apply for used oil
	- Flashpoint > 100 °F, otherwise may be hazardous waste
	- Must contain <1000 ppm total halogens, otherwise may be hazardous waste
	- If between 1000 ppm - 4000 ppm total halogens, must be able to prove oil was not mixed with a hazardous waste, otherwise hazardous waste
Procedure	- Review MSDS for hazardous ingredients
	- Periodically re-verify Specification Oil Analysis Test
	- Pump directly into bulk storage tank(s)
Storage	- Above ground waste oil tanks/drums
Label	- Label containers "Used Oil" or "Off-Specification Used Oil Fuel"
Disposal	- Consume through used oil heaters
	- Ship to approved facility with licensed transporter
Records	- Maintain consumption and recycling records
NOTE	- **DO NOT REFER TO AS "WASTE OIL"**
	- **AVOID/MINIMIZE OFFSITE DISPOSAL TO REDUCE LIABILITY**
	- **SPECIAL REGULATIONS APPLY FOR OFF-SPECIFICATION OIL**
	- **NEVER MIX WITH HAZARDOUS LIQUIDS**

USED PAINT

Regulation	- Used paints may be RCRA regulated, including oil, latex, and lead based paints
Procedure	- Consume through beneficial use if possible - Spray paint - use AEROSOL CAN DISPOSAL - Review MSDS for hazardous ingredients - TCLP for characteristics if necessary
Storage	- Separate unused paint by characteristics and store in DOT drums
Label	- Latex based - "Non-Hazardous Waste" - Lead based - "Hazardous Waste - Lead" - Oil based - "Hazardous Waste - Flammable"
Disposal	- Latex based - solidify and landfill - Lead based - licensed industrial boiler - Oil based - licensed industrial boiler
NOTE	**- REVIEW REGULATION FOR DISPOSAL**

APPENDIX B

GENERIC PETITION

30 CFR 77.1304 (a)
30 CFR 56.6309 (b)

1. Only petroleum-based lubrication oil, which is recycled from equipment at the ______________ Mine shall be used for the purpose of blending with fuel oil in the creation of ANFO. The oil shall not contain any hazardous waste material listed in Subpart D, Title 40 Code of Federal Regulations 261. Provisions shall be in place to ensure that the used oil is not contaminated with PCB's.

2. The used oil shall be recycled by filtering and then storing in a storage tank used exclusively for this purpose. The contents of the storage tank shall, after testing and meeting specifications as provided in item 4 below, be considered a batch and no additional oil or other products, with the exception of diesel fuel, shall be added until the contents of the tank have been fully depleted.

3. Filters used in the filtering system shall be capable of filtering particles down to at least 150 microns. These filters shall be cleaned/replaced on a regularly scheduled basis and whenever the filter becomes clogged to the extent that a pressure differential of 50 psi exists across the filter inlet and outlet. A bypass system should be designed into the pump or piping network such that no used oil is allowed to be transferred into the blend tank by passing through a filter which has a pressure differential of 50 psi or more across the filter inlet and outlet. Records, including the dates, of all filter cleaning/replacing activities shall be kept on the mine property and made available to MSHA upon request for a period of at least three years.

4. Tests of analyses shall be conducted on each storage tank of recycled oil after the entire contents of the storage tank are thoroughly mixed and before blending with fuel oil to ensure that the used oil meets the following specifications:

(1)	Arsenic	5 ppm maximum
(2)	Cadmium	2 ppm maximum
(3)	Chromium	10 ppm maximum
(4)	Lead	100 ppm maximum
(5)	Total Halogens	1,000 ppm maximum
(6)	Flash point	100 F minimum

These specifications were derived from Table 1 in 40 CFR 279.11.

Flash point shall be verified using an open cup ASTM test.

Any test result on the contents of the storage tank which is outside these specifications shall have the contents retested immediately. Any two consecutive test results on the same contents of a storage tank which is outside these specifications shall be reported to MSHA, and the contents of the storage tank shall not be blended with diesel fuel for use in making ANFO unless prior authorization is obtained from MSHA. The contents of the storage tank shall be considered a batch of recycled oil after it is proven to be within these specifications. Prior to filtering the oil in the storage tank, the oil shall be considered "used oil".

The frequency of testing and analyses for these specifications may be reduced upon the adequate submittal of records to the MSHA District Manager showing a demonstrated record of meeting the specifications, and a written authorization from the MSHA District Manager allowing the reduction in testing frequency.

5. The recycled oil shall be checked for water and ethylene glycol prior to blending with diesel fuel. If significant concentrations are obtained, they shall be drained from the batch prior to blending.

   High viscosity oils of 90W or above shall be restricted to less than 10 percent of the total quantity of recycled oil in the storage tank.

6. The blend of recycled oil and diesel fuel (hereinafter called blended oil) shall not exceed 50 percent (by volume) recycled oil. An absorption test on the recycled oil shall be performed prior to blending with fuel oil to determine the proper mixing ratio.

7. The recycled oil shall be mixed continuously while being blended with diesel fuel. Mixing shall ensure recirculation of at least three times the total volume of diesel fuel and recycled oil.

   The blending date, blend mix ratio of diesel fuel to recycled oil for each batch, and the quantity in gallons of each ingredient in the blended oil batch shall be recorded. The gallons of each grade of diesel fuel shall also be recorded. These records shall be maintained at the mine property and made available to MSHA upon request for at least three years.

8. The recycled oil and blended oil shall not be modified by heating, adding additives (with the exception of diesel fuel), or in any other way that could change the relevant properties of the recycled oil.

9. The blended oil shall be remixed within 24 hours of beir drawn into any bulk mixing vehicle. This remixing sha

recirculate at least 25 percent of the total volume of blended oil remaining in the storage tank. Mixing procedures shall ensure that two consecutive viscosity samples, taken at least 5 minutes apart, are within 10 percent of each other before loading into the bulk mixing vehicle.

10. Each new batch of blended oil shall be tested for the sensitivity of the blended oil and ammonium nitrate prills to a No. 8 strength detonator prior to their loading in any holes. For each new batch of blended oil, this test shall be performed on at least 3 samples, each having minimum dimensions of 3-3/8" in diameter and 6-3/8" long. Each detonator shall be placed near the center of each sample. Each sample container must be non-rigid, such as paper products, to minimize confining effects upon initiation. Records of whether or not each sample detonated shall be maintained on the mine property and made available to MSHA upon request for at least 3 years.

11. When low temperatures cause the blended oil to become too viscous for proper absorption (at least 6 percent fuel by weight) in the ammonium nitrate prills, use of the blended oil shall be suspended. Viscosity tests and absorption tests at various temperatures may be performed to obtain their correlation with temperature. Once these correlations are obtained, field viscosity tests of the blended oil, at temperatures which are the same or below the temperature at which the holes are to be loaded, can be performed to verify proper absorption.

    In the event proper absorption cannot be obtained as a result of high viscosity, additional diesel fuel may be added to the blended oil and thoroughly mixed. However, records of the blend date, blend mix ratio, and quantity of each ingredient as required by item 8 shall be maintained and made available for inspection by MSHA for at least three years. Retesting for sensitivity to a No. 8 blasting cap, as specified in item 10, shall not be required for this new blend.

12. The blended oil shall be transported and used in a closed system which prevents skin contact, inhalation of vapors, and ingestion of the ANFO products.

13. Blasting records for each shot employing the blended oil shall be maintained and identified as a specific blended oil batch. The records shall include the date(s) of loading and blasting, weather conditions, type of initiation system(s), primer type(s) and size(s), size and depth of all borehole(s), number and location within the shot of all borehole(s) and all misfires, quantities of ANFO used in the shot, and quantities as well as type, of emulsions (heavy ANFO) employed in the shot. The use of any plastic hole liners shall also be recorded. These records shall be maintained on the mine property and made available to MSHA upon request for at least

3 years.

14. Misfires which are reasonably suspected to have been caused by the blended oil shall be reported to the MSHA District Manager immediately.

15. Material Safety Data Sheets for the recycled oil and diesel fuels shall be maintained on the mine property and made available to MSHA upon request.

16. The oil blending facility shall not be put into operation until an on-site inspection is conducted by MSHA and detailed drawings of the entire used oil and blending facilities, including product flow directions, are submitted and approved by MSHA.

17. The prill/blended oil mixture shall not be used in blasting operations underground or in confined spaces.

18. The prill/blended oil mixture shall be used only on the ________________ Mine property. Mixing of the blended oil and ammonium nitrate prill is intended for immediate use in loading holes and is not allowed to be stored as a mixed product.

19. A lockout system shall be provided on the oil storage tank facilities to prevent unauthorized tampering. Only properly trained authorized personnel shall have keys to operate the lockout system.

20. Within 60 days after this Proposed Decision and Order becomes final, the Petitioner shall submit proposed revisions for its approved 30 CFR Part 48 training plan to the District Manager. These proposed revisions shall include initial and refresher training regarding compliance with the conditions stated in the Proposed Decision and Order.

Customer Report

CUSTOMER NUMBER:
UNIT NUMBER:
PHONE NUMBER:
RECEIVED DATE:

EQUIPMENT:
SENDER:
SAMPLE FROM:
PRODUCT:
SAE:

SAMPLE DATE: 12/19/92

PHYSICAL TESTS				WEAR METAL, PPM							ADDITIVES AND OTHER METALS, PPM												
VISCOSITY SUS-210°F	SAE GRADE 210°F	SOLIDS % VOLUME	WATER FUEL DILUTION ANTI-FREEZE	CHROMIUM	COPPER	IRON	LEAD	TIN	ALUMINUM	SILICON (DIRT)	ANTIMONY	BARIUM	BORON	CADMIUM	CALCIUM	MAGNESIUM	MOLYBDENUM	NICKEL	PHOSPHORUS	SILVER	SODIUM	TITANIUM	ZINC
46	10	0.0	NNN	0	1	2	1	0	0	1	0	0	6	0	3986	0	0	0	896	0	33	0	1101
46	10	0.0	NNN	0	0	2	1	0	0	1	0	0	1	0	4362	0	0	0	968	0	32	0	1099
46	10	0.0	NNN	0	1	2	1	0	0	2	1	0	2	0	4236	2	0	0	916	0	32	0	1055
46	10	0.0	NNN	0	1	2	0	0	0	1	1	0	4	0	3968	12	1	0	838	0	31	0	1119
46	10	0.0	NNN	0	1	1	0	0	0	2	0	0	4	0	3776	0	0	0	777	0	31	0	896
45	10	0.0	NNN	0	1	2	1	0	0	1	0	0	1	0	4526	7	0	0	960	0	32	0	1127
46	10	0.0	NNN	0	0	1	0	0	0	1	1	0	1	0	3724	0	0	0	771	0	28	0	858
46	10	0.0	NNN	0	1	2	0	0	0	2	1	0	1	0	4353	0	0	0	940	0	30	0	1051

ICE RECOMMENDATIONS (CURRENT SAMPLE ONLY)

S NORMAL FOR THIS SAMPLE. RESAMPLE AT
L INTERVAL.

TEST DATE	HOURS	OIL ADDED
042892	0	0
060492	0	0
062592	0	0
080492	0	0

APPENDIX D

ADDITIONAL WASTE MINIMIZATION ARTICLES

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2. **"Waste Management Guidance for Oil Clean-Up,"** Minnesota Technical Assistance Program, July 1991.

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3. **"Ethylene Glycol Antifreeze - Waste Reduction Options."**

4. **"How to Successfully Recycle Your Ethylene Glycol Antifreeze,"** Centaur Equipment Management Corporation.

5. D. Neu, **Maintaining Coolant Quality to Reduce Waste,"** Summary, Minnesota Technical Assistance Program, Summer 1988.

6. **"Prolonging Machine Coolant Life,"** Fact Sheet, Minnesota Technical Assistance Program, June 1991.

7. **"GM Approves Use of Recycled Coolants,** Automotive News Service, November 11, 1991.

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1. **"Waste Audit Study: Automotive Repairs,"** Alternative Technology Section, Toxic Substances Control Division, California Department of Health Services, May 1987.

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4. **"Hazardous Waste Minimization Manual for Pennsylvania's Vehicle Maintenance Industry,"** Center for Hazardous Materials Research, University of Pittsburgh Applied Research Center, October 1987.

5. **"Guides to Pollution Prevention: The Automotive Refinishing Industry,"** Environmental Protection Agency, Risk Reduction Engineering Laboratory and Center for Environmental Research Information, Office of Research and Development, October 1991.

6. **"Guides to Pollution Prevention: The Automotive Repair Industry,"** Environmental Protection Agency, Risk Reduction Engineering Laboratory and Center for Environmental Research Information, Office of Research and Development, October 1991.

7. M. Townsend, **"Hazardous Waste Minimization: Automobile Dealership Repair Facility,"** Recycling and Waste Minimization, Front Range Community College, Term Project, Spring 1992.

8. R. L. Millette, L. L. Millette, **"Hazardous Waste Minimization: City of Louisville,"** Recycling and Waste Minimization, Front Range Community College, Term Project, Spring 1992.

9. S. Simsiman, **"Waste Assessment: Denver Public Works Fleet Maintenance,"** Pollution Prevention & Waste Reduction Program, Colorado Department of Health, June 1, 1992.

10. K. Lippoldt, **"Hazardous Waste Minimization: Fender's Bender Fixer Shop,"** Recycling and Waste Minimization, Front Range Community College, Term Project, Spring 1992.

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16. **"Hazardous Waste Management Advice for Automobile Dealers,"** Iowa Waste Reduction Center, University of Northern Iowa, 1991.

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18. **"Handbook for EPA Waste Minimization in Permitting Training Course: Region VII,"** Environmental Protection Agency, Science Applications International Corporation, August 1991.

19. **"Achievements in Source Reduction for Ten Industries in the United States,"** Environmental Protection Agency, Office of Research and Development, Science Applications International Corporation, September 1991.

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35. **"Fact Sheet: Pollution Prevention Opportunities for the Automotive Recycling Industry,"** Environmental Protection Agency, Region VIII, Hazardous Waste Management Division, Hazardous Waste Minimization Program, May 1992.

36. S. Dharmavaram, J. B. Mount, B. A. Donahue, **"Automated Economic Analysis Model for Hazardous Waste Minimization,"** Journal of the Air & Waste Management Association, 1990.

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48. **"Guides to Pollution Prevention: The Fabricated Metal Products Industry,"** Environmental Protection Agency, Office of Research and Development, Risk Reduction Engineering Laboratory, July 1990.

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2. **"Cutting Fluid Management in Small Machine Shop Operations,"** Iowa Waste Reduction Center, University of Northern Iowa.

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