Student Edition

Pollution Prevention Curriculum for Vehicle Maintenance

Iowa Waste Reduction Center
University of Northern Iowa

Printed on Recycled Paper

Table of Contents

Student Handout

Module 1

— An Introduction to Pollution Prevention

The purpose of Module 1 is to define pollution prevention and describe the basics of starting a pollution prevention program. Since "Pollution Prevention" is a common term in the environmental field today, students should understand what it means. Students who may be interested in owning or operating a business should also be familiar with the basics of how to develop a pollution prevention program.

Module 1 Objectives:

When students have completed this module they should be able to:

1. Define pollution prevention, pollution prevention practices and concepts.
   - Know how to start a pollution prevention program.
   - Know how to conduct a simple waste audit to identify pollution prevention opportunities.
2. Understand the effects of hazardous waste, and learn how to recognize hazardous materials.
   - Be familiar with how pollution moves through and affects the environment (soil, water and air).
   - Know the steps to identify and recognize an EPA hazardous waste.
   - Know how hazardous chemicals can affect human health.
   - Use material safety data sheets to identify hazardous materials.
3. Reduce the effect that pollution has on business.
   - Understand the potential to save money through pollution prevention.
   - Understand how to reduce liability through pollution prevention.
   - Choose a good hazardous waste management company.
   - Identify resources for pollution prevention and waste management assistance.

What is Pollution Prevention

Pollution Prevention is any activity, including the use of materials, processes or practices, which reduces or eliminates the creation of pollutants or wastes at the source. Pollution prevention changes the traditional approach to environmental protection. Instead of trying to control the wastes once they have been generated, pollution prevention aims to prevent the initial generation of wastes. The results are reduced volumes and/or reduced toxicity of generated waste. Other terms have been used for this general concept, such as waste reduction, waste minimization and source reduction. Whatever the term, the object is to move from the management of wastes to the management of the source of waste.

Waste Management Hierarchy

The Pollution Prevention Act of 1990 and the policies of the United States Environmental Protection Agency define a specific waste management hierarchy. Source reduction is at the top as the most preferred option. Next is recycling, then treatment and finally disposal. The aim is to move as far as you can up the hierarchy.

Examples of reducing wastes through pollution prevention are:

- Change the way a job is performed.
- Substitute a nonhazardous raw product for a hazardous one.
- Improve work practices and establish good housekeeping procedures to prevent spills and leaks and excessive use of materials.
- Adopt new, cleaner technologies.

Pollution Prevention vs. Pollution Control

Pollution control means "treating" waste before it is released into the environment. This treatment usually involves removing the pollutants in the waste for separate disposal. In pollution control, all of the waste generated has to be disposed of in some manner into the environment.

Pollution prevention means reducing or eliminating a waste before it is generated, or making a waste less hazardous. This can be accomplished by making operations more efficient or using less hazardous materials.

Pollution Prevention vs. Pollution Control

Type of Pollution	Pollution Control	Pollution Prevention
Parts cleaning waste solvents	Ship solvent off site to be burned/recycled.	Replace hazardous solvent with a nonhazardous cleaner.
Wastewater from cleaning vehicle or floor cleaning	Send wastewater to the wastewater treatment plant or a septic system.	Reduce the quantity of water being used. Use dry cleaning methods on floors. Use drip pans and spill prevention. Reduce the amount of oil, solvents, etc. on the floor.
Paint overspray from auto body painting and from a paint booth	Use a paint arrestor to catch solid paint particles from spray operations. Dispose of used arrestors.	Increase and improve transfer efficiency to reduce the amount of overspray.

How Does Pollution Affect the Environment

Pollution occurs when wastes are put into the environment improperly. In general, pollution can occur when wastes are dumped, burned or evaporated, or when storage tanks leak. Some background on pollution in the environment will help show why pollution prevention is important.

Soil Pollution:

Soil can become contaminated when:

- Hazardous wastes are dumped or spilled directly on the ground (for example, when transferred to storage containers, and/or during off-site transportation). Storage containers leak.
- Rainwater falls on wastes stored outside, picks up contaminants from wastes (like lead from car batteries stored outside) and carries them into the soil. This is called leaching out. Water that contains contaminants from wastes is sometimes called leachate.

Visible Evidence of Soil Pollution:

1. Discolored soil (black or brown from used oil, for example)
2. Dying vegetation near a storage or dump site.

Water Pollution:

Water pollution is a problem because it can cause illness, or even death, in humans who drink or swim in polluted water. Water pollution can also kill fish, plants, and other aquatic life.

Groundwater is water that moves underground and supplies wells, rivers, lakes and other water sources. Groundwater sometimes moves quickly and, even when it moves slowly, can spread pollution far from the original source.

Water can become contaminated when:

- Materials are spilled during use.
- Wastes are spilled while being transferred to storage containers, and/or during off-site transportation.
- Waste is dumped directly into a body of water.
- Waste is dumped in a drain that discharges outside.
- Waste dumped on the ground soaks through the soil to the groundwater.
- Rainwater falls on wastes stored outside, forms leachate and runs off into a body of water, or soaks into the groundwater.

Note that it sometimes takes only a very small amount of waste to pollute a large body of water. For example, ***only one gallon of oil can contaminate one million gallons of water.*** Groundwater often becomes polluted when soil has been contaminated.

Visible Evidence of Water Pollution:

1. An oil sheen on a body of water or in rainwater runoff.
2. Garbage floating in rivers, lakes and streams.
3. Dying fish or reduced fish population.
4. Foul smelling streams or tributaries.

Air Pollution

Air pollution is caused when wastes are released into the air by:

Evaporation.
Burning.
Venting.
Spraying or exhausting into the atmosphere.

Common air pollutants found in vehicle maintenance shops are volatile organic compounds (VOCs). VOCs are chemicals (like those found in most paints and solvents) that evaporate rapidly. When VOCs evaporate into the air, they react with other chemicals and sunlight to form smog.

Solvents and other volatile wastes can evaporate when they are sprayed, used for cleaning, stored uncovered or spilled.

Another common air pollutant is associated with halogenated solvents. "Halogenated" solvents are those that contain a halogen element. The most common halogen element found in parts washing solvents is chlorine. Methylene chloride is often found in carburetor cleaners, for example. Halogenated solvents are suspected to contribute to holes in the ozone layer. The ozone layer is important because it protects the earth from the sun's damaging effects. Skin cancer in humans is on the rise because of the effects of exposure to the sun.

Visible Evidence of Air Pollution:

1. Smoke from an industrial stack.
2. Dust particles in the air near grain handling activities.
3. Exhaust from vehicles.
4. Paint particles in the air or settled on the ground outside paint exhausts.

Health Hazards of Common Vehicle Maintenance Chemicals

Hazardous materials in the workplace can cause harm to human health. Hazardous chemicals can enter the body by:

Inhalation - breathing into the lungs.
Absorption - soaking into the skin.
Ingestion - eating or drinking.

Potential Adverse Health Affects of Common Vehicle Maintenance Chemicals

There are potential health effects from exposure to common vehicle maintenance chemicals.

Petroleum-based solvents used in parts cleaning (mineral spirits, methylene chloride) or painting (toluene, xylene).

Contact dermatitis (a skin rash)
Central Nervous System (CNS) depression by inhalation, absorption or ingestion (symptoms: nausea, vomiting, disorientation, fatigue)
Reproductive problems and birth defects
Death from breathing in concentrated fumes
Some studies have linked certain solvents with cancer in laboratory animals

Oil used in lubrication. (Please note that used oil may be contaminated with benzene and/or lead).

Skin and eye irritation
Diarrhea if ingested

Lead and other heavy metals found in batteries, paints, used oil, antifreeze and used parts wash solvent. The body accumulates lead, and health problems result when blood lead levels are too high. Possible health effects of lead are:

Brain damage possibly resulting in mental retardation and learning disabilities.
Kidney disease.
Reproductive problems and birth defects.

Ethylene glycol (antifreeze). Children and small animals are attracted to the sweet taste of ethylene glycol. (Note that used antifreeze may also contain lead or benzene).

Central nervous system disturbance (nausea, seizures)
Liver and kidney damage
Coma
Death

Materials contaminated with shop wastes can also cause health hazards. For example, absorbent put on the floor absorbs spills of oil and antifreeze. Used oil absorbent might be hazardous if it has soaked up hazardous chemicals. Other wastes that become contaminated are:

Used shop rags
Floor drain sludge
Paint booth filters

Chemical/Contaminant	Route of Entry	Exposure Activity
Parts Wash Solvent	Absorbed through skin Inhaled as vapors	Parts Washing Accidental-improper disposal, dumping solvent on the ground, improper storage, leaking storage containers
Antifreeze	Ingestion	Contact with improperly stored or disposed antifreeze (antifreeze dumped on ground or into a body of water)
Lead (in used oil, antifreeze, batteries, parts wash solvents, paint wastes)	Ingestion of foods contaminated with lead Inhalation of lead contaminated dust	Improper disposal and/or storage of waste products.

Pollution Prevention Can Save Money

When a company generates waste (both hazardous and nonhazardous), it may be wasting money in several ways:

1. Health costs resulting from employee exposure to hazardous materials.
   When employees are exposed to hazardous materials, the risk of illness and accidents increases. In addition to harming employees, these illnesses may result in lost work time and workers compensation claims, which cost the business money.

2. Wasted raw materials.
   When wastes are generated because of careless operating practices, materials are wasted and the business has to buy more to replace the wasted material.

   Examples of careless operating practices are spilling materials, not keeping storage containers covered or in good condition, using more materials than needed, and allowing volatile products (those with low vapor pressures, such as solvents) to evaporate by leaving lids and caps off.

3. Hazardous waste disposal costs.
   State and federal laws require hazardous waste to be transported, stored, and disposed of or recycled by EPA-permitted hazardous waste management companies. These services are expensive. Hazardous waste disposal can cost as much as $700 or $800 per 55-gallon drum, depending on the waste. Reducing hazardous wastes will save money in disposal fees.

4. Costs for managing wastes.
   In addition to disposal fees, other costs for managing wastes include:
   Time spent handling waste (properly labeling and storing wastes, and inspecting and maintaining storage areas).
   Time spent filling out paperwork.
   Federal and local fees for waste generation and air emissions.
   Facility work space used for waste storage.

5. Environmental liability.
   "Cradle-to-Grave" liability means that the company that generates the waste (generator) is responsible for waste from the time it is generated until it is disposed. If the waste is accidentally spilled during transportation, or is disposed of improperly, the generator is responsible and can be held liable for clean-up costs. Hazardous waste clean-up can cost from hundreds of thousands to tens of millions of dollars. The best way to reduce liability is to reduce waste generated. Another way is to dispose or recycle wastes properly through an EPA-permitted hazardous waste management company.

How to Recognize an EPA Hazardous Waste

Every business must determine whether the wastes they generate are hazardous or non-hazardous according to Environmental Protection Agency (EPA) regulations. The EPA defines wastes as hazardous if they:

1. Exhibit a hazardous waste **characteristic**, and/or
2. If they are found on any of four specific **lists** of hazardous wastes.

The Material Safety Data Sheet (MSDS) for a product may contain pertinent information about the hazardous characteristics of the product. Information about MSDS is contained within this module.

Four Characteristics of an EPA Hazardous Waste

If a waste exhibits any of these four characteristics, it is defined as hazardous: ignitability, corrosivity, reactivity, and toxicity.

Ignitability - A liquid waste with a flash point of less than 140°F is an ignitable hazardous waste. Solid wastes capable of spontaneous combustion are also ignitable. Ignitable hazardous wastes have the EPA waste code D001. Examples of ignitable hazardous wastes are:

Parts washer petroleum solvents.
Solvent-based paint waste.
Waste kerosene or gasoline.

Corrosivity - Aqueous wastes that have a pH less than or equal to 2.0, or greater than or equal to 12.5 are considered corrosive hazardous wastes. Corrosive hazardous wastes have the EPA waste code D002. Examples of corrosive hazardous wastes are:

Acid or alkaline cleaning solutions.
Battery acid.

Reactivity - A waste is reactive if it reacts violently with water, forms potentially explosive mixtures with water, generates toxic gases when mixed with water, contains cyanides or sulfides that are released when exposed to acid or alkaline materials, or is explosive. Reactive hazardous wastes have the waste code D003. An example of a reactive hazardous waste is:

Pressurized aerosol cans

Toxicity - A waste is a toxic hazardous waste if it fails the "Toxicity Characteristic Leaching Procedure" (TCLP) lab test for any one of 40 TCLP parameters. The TCLP test is designed to determine whether hazardous ingredients will leach ("leak") out of a waste after it is landfilled. When hazardous ingredients leach out of wastes in a landfill, soil and groundwater can become polluted. If laboratory results for a sample exceed one or more of the regulatory limits, the waste is a toxic hazardous waste. Examples of toxic hazardous wastes are:

Paint-contaminated wastes (used spray booth filters, overspray masking , etc.) that contain metal-based pigments such as lead and/or chromium.
Oil-contaminated wastes, such as used oil absorbent or rags.

To determine if a waste is toxic, use one of the following procedures:

1. *Toxic Characteristic Leaching Procedure (TCLP)*
   Collect a representative sample of the waste.
   Send the sample to a laboratory to be analyzed for the TCLP parameters that might be present in the waste.
   If test results indicate that one or more TCLP parameters are present at concentrations equal to or above regulatory limits in the TCLP table, the waste is hazardous and must be managed as a hazardous waste.
   If test results indicate all TCLP parameters are below regulatory limits, the waste is not hazardous due to toxicity.

2. *Thorough Knowledge*
   To make a hazardous waste determination using thorough knowledge, keep sufficient evidence on file to prove that the waste is not a listed hazardous waste and does not exhibit any of the characteristics of a hazardous waste - including toxicity. Such documentation might include Material Safety Data Sheets (MSDSs), certification from the manufacturer that the product contains no hazardous materials, and specific information about potential contaminants in the waste. For example, if a nonhazardous cutting fluid is used to machine parts containing lead, the waste cutting fluid may be hazardous because of lead it picked up during machining. The EPA decides when thorough knowledge may be used in place of laboratory testing.

3. *Assume the Waste is Hazardous and Designate it as Hazardous*
   You can also assume that a waste is hazardous and manage it as such. Assuming a waste is hazardous can save laboratory testing costs for small volume waste streams or waste streams that have a high likelihood of being hazardous.

TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

Parameter	Regulatory Level (mg/l)	EPA Hazardous Waste Code
Arsenic*	5.0	D004
Barium*	100.0	D005
Benzene	0.5	D018
Cadmium	1.0	D006
Carbon tetrachloride	0.5	D019
Chlordane	0.03	D020
Chlorobenzene	100.0	D021
Chloroform	6.0	D022
Chromium*	5.0	D007
m-Creso	200.0	D024
o-Creso	200.0	D023
p-Creso	200.0	D025
Cresols (total)	200.0	D026
1,4-Dichlorobenzene	7.5	D027
1,2-Dichloroethane	0.5	D028
1,1-Dichloroethylene	0.7	D029
2,4-Dinitrotoluene	0.1	D030
Endrin	0.02	D012
Heptachlor	0.008	D031
Hexachlorobutadiene	0.5	D033
Hexachlorobenzene	0.13	D032
Hexachloroethane	3.0	D034
Lead*	5.0	D008
Lindane	0.4	D013
Mercury*	0.2	D009
Methoxychlor	10.0	D014
Methyl ethyl ketone	200.0	D035
Nitrobenzene	2.0	D036
Pentachlorophenol	100.0	D037
Pyridine	5.0	D038
Selenium*	1.0	D010
Silver*	5.0	D011
Tetrachloroethylene	0.7	D039
Toxaphene	0.5	D015
Trichloroethylene	0.5	D040
Vinyl chloride	0.2	D043
2,4-D	10.0	D016
2,4,5-TP	1.0	D017
2,4,5-Trichlorophenol	400.0	D041
2,4,6-Trichlorophenol	2.0	D042

*Heavy Metals

Listed Hazardous Wastes

EPA has designated specific materials as hazardous waste due to their consistent nature and widespread distribution. There are four "lists" of hazardous waste, known by the letter used in the hazardous waste number. Thus, we have the "F," "K," "P" and "U" listed wastes. Each of these lists is explained briefly below.

F-Listed Wastes - The F-listed wastes include a wide variety of commonly found wastes, ranging from solvents to wastewater treatment sludge to dioxin contaminated materials.

K-Listed Wastes - These are hazardous wastes from specific processes, many of which are chemical or pesticide manufacturing. Examples are "distillation bottoms from the production of aniline," or "wastewater treatment sludge from the production of toxaphene." K-listed wastes are uncommon in vehicle maintenance operations.

P-Listed Wastes - P-listed wastes are acutely toxic chemicals in the unused form only.

U-Listed Wastes - U-listed wastes are toxic commercial chemicals, off-specification products, or manufacturing chemical intermediates, also only in the unused form.

Following are examples of F-listed wastes that might be generated from vehicle maintenance activities:

F001 - Spent halogenated solvents used in degreasing, or still bottoms from the recovery of spent solvents. Solvents include:
- Methylene chloride
- 1,1,1-trichloroethane
- Chlorinated fluorocarbons (freons)

F002 - Spent halogenated solvents and still bottoms from uses other than degreasing.
- Methylene chloride
- Trichloroethylene
- 1,1,1-trichloroethane

F003 - Spent non-halogenated solvents and still bottoms that are ignitable.
- Xylene
- Acetone

F004 - Spent non-halogenated solvents and still bottoms.
- Nitrobenzene

F005 - Spent non-halogenated solvents and still bottoms.
- Toluene
- Methyl ethyl ketone (MEK)
- Benzene

Material Safety Data Sheets (MSDS)
MSDS give hazardous material and health hazard information for specific chemicals. It is important to know how to read MSDS for safety and pollution prevention reasons.

Material Safety Data Sheets help you identify the human health effects of a product, whether the product is hazardous, and what to do if you are exposed to it. MSDS all contain the same basic information, but have different formats.

Most MSDS are organized into the following sections:

1. Material Manufacturer and Identification
   This section gives the product name, and the name, address and emergency telephone number of the manufacturer.

2. Hazardous Ingredients
   This section lists product ingredients which are regulated by the federal government because they cause harmful health or environmental effects. If one or more ingredients are listed here, the spent product may qualify as a hazardous waste. The MSDS should specify how the product is regulated, for example, whether it is regulated by EPA.

3. Physical and Chemical Data
   This section describes the physical characteristics of the product including the odor and appearance, whether it is a liquid or solid at room temperature, evaporation rate, etc.

4. Fire and Explosion Hazard Data
   This section describes the circumstances under which the product may ignite or explode. This is where the flashpoint can be found (a flashpoint under 140° Fahrenheit is considered hazardous). Special fire-fighting procedures are given, such as what material to use to put out a fire.

5. Reactivity Data or Special Precautions
   This section tells how the product will react under particular environmental conditions, and which chemicals are incompatible with the product and should not come into contact with it.

6. Health Hazard Data
   This section describes the potential known health effects of the product. It describes the routes of entry into the body by which the product can cause harm (like absorption through skin, inhalation or ingestion). It also gives the possible effects of short and long-term exposure and the emergency and first aid steps to be taken after exposure.

What an MSDS Doesn't Tell You

MSDS can be used to help determine if a product is hazardous or not, however, MSDS have the following limitations:

Not all ingredients are always listed on an MSDS. Manufacturers are not required to list every ingredient if the percentage is very low, or the information is considered proprietary ("trade secret").

After use, products may contain hazardous contaminants that are not listed on the MSDS. For example, oil absorbent is usually made of clay, which is not hazardous, but after use it may contain oil, antifreeze, solvents, etc.

Glossary of MSDS Terms

The following is a list of terms and abbreviations commonly found on the MSDS.

Absorption – The process by which a substance can be readily taken into the body. Some chemicals can be absorbed through unbroken skin.

Acid – A compound that contains hydrogen (H+) and one or more other elements which, in the presence of some solvents or water, react to release hydrogen. Acids have a pH between 6.9 and 1. A waste is hazardous (according to federal EPA regulations) if the pH is less than 2.0. Acids turn litmus paper red, and can be used to neutralize bases.

Acute Health Effects – Signs and symptoms (such as headaches, dizziness, skin or eye irritation, coma or death) that result from a single exposure. Symptoms usually occur shortly after exposure.

Alkali – See base.

Aqueous – A water-based solution.

Base – A compound that contains a hydroxyl ion (OH-) and one or more other elements which can react to release hydroxyl ions. Bases have a pH between 7.1 and 14. A waste is hazardous according to federal EPA regulations if the pH is greater than 12.5. Bases turn litmus paper blue, and can be used to neutralize acids.

Carcinogenic – Any cancer-causing substance.

Caustic – A strong base that irritates, burns or destroys living tissue. An example of a caustic material is sodium hydroxide.

Chronic Health Effects – Symptoms or health problems (such as cancer, liver or kidney damage or birth defects) that develop gradually and occur from repeated exposure over an extended period of time.

Combustible Liquid – Any liquid with a flash point below 100°F.

Concentration – The percentage of a substance in a given amount of air, solid or liquid. For example, a paint might have a concentration of 70% solvent and 30% pigment. Percentage may be by weight or volume.

Corrosive – Any material that causes visible destruction of, or irreversible alterations in, human skin tissue or metal at the site of contact. An example of a corrosive is sulfuric acid found in lead acid batteries.

Dermal – Used on or referring to the skin.

Explosive – Can detonate or explode through exposure to heat, sudden shock, pressure or incompatible substances.

Flammable Limits – The lowest and highest concentrations of vapor or gas in the air that will ignite when exposed to a spark or flame.

There are two types: the Lower Flammable Limit (LFL or LEL) and the Upper Flammable Limits (UFL or UEL). Products with wide flammable limits may ignite either near or far away from an ignition source, while products with narrow flammable limits may ignite only near the ignition source. When considering the explosion hazards, the LFL is the most important. The lower the LFL, the smaller amount of a substance needed in the air before it can ignite.

Flashpoint – The lowest temperature at which a liquid produces enough vapor to form an ignitable mixture with air. A liquid with a flashpoint under 140°F is considered hazardous as defined by the EPA.

Incompatible – Materials that could cause dangerous reactions from direct contact with one another.

Ignitable – According to the EPA, a liquid that has a flashpoint under 140°F is considered hazardous because of ignitability.

OSHA – Occupational Safety and Health Administration. OSHA legislation governs safety issues in the workplace.

Oxidizer – A chemical other than a blasting agent or explosive that contains oxygen and may start or assist combustion in other materials. Examples are chromic acid, concentrated nitric acid and potassium permanganate.

PEL – Permissible Exposure Limit – The safe exposure level set by OSHA, (See also TLV.)

pH – A symbol used to quantify the level of acidity or alkalinity. Strong acids have a pH near 1, strong bases near 13 or 14. A pH level of 7 indicates neutrality.

Reactivity – The ability of a material to undergo chemical reaction with the release of energy or heat.

Regulated Waste – If a waste is listed as being a "regulated hazardous waste," this means a business must follow special precautions while managing the waste and/or comply with special record keeping and reporting requirements. Contact your local regulatory agency to determine all applicable regulations.

RCRA – Resource Conservation and Recovery Act. RCRA is the federal legislation which outlines how solid and hazardous waste should be managed.

Solubility in Water – The quantity of a product that will dissolve in water at room temperature. It is expressed either as a percentage or by one of the following terms:

negligible = less that 0.1%
slight = 0.1 to 1%
moderate = 1 to 10%
appreciable = more than 10%
complete = 100%

The term has important health implications. For instance, gases with low water solubility are more likely to reach the deep tissues of the lungs; highly soluble gases are more likely to dissolve into the moist mucous membranes of upper airways.

Specific Gravity – The ratio of the weight of a product's known volume to the weight of an equal amount of water. A specific gravity of greater than 1 means it will float in water. Most flammable liquids are lighter than water. Specific gravity can be used to find the density of a material.

TLV – Threshold Limit Value. Safe exposure level set by the American Conference of Governmental Industrial Hygienists (ACGIH). Refers to airborne concentrations of substances and exposure levels under which most people can work constantly for eight hours a day, five days a week, with no harmful effects. There are three categories of TLV's specified:

a.) Time Weighted Average (TLV/TWA) - The normal time-weighted average concentration for a normal 40-hour work week.
b.) Short term Exposure Limit (TLV/STEL) - The recommended exposure concentration above the TWA for a limited number of 15-minute exposure periods.
c.) Ceiling Exposure Limit (TLV/C) - The recommended exposure concentration that should not be exceeded at any time during the work period.

Toxicity – The ability of a substance to harm living organisms. The toxicity of a chemical is measured using animal studies. OSHA uses three categories for this:

a.) Oral LD50 - Lethal dose 50% test. The median lethal dose (LD50) that kills 50% of lab animals receiving it. Oral LD50 is expressed as milligrams of chemical per kilogram of test animal's body weight. OSHA considers a chemical to be toxic if the oral LD50 is between 50 and 500 mg/kg.
b.) Skin LD50 - A dose that kills 50% of lab animals that had concentrations applied directly to their bare skin for 24 hours. Skin LD50 is also expressed in mg/kg, and the OSHA considers a chemical to be toxic if the LD50 is between 200 mg/kg and 1000 mg/kg.
c.) Inhalation LC50 - Lethal concentration 50% is the concentration of a chemical in the air needed to kill 50% of lab animals that breathed it.

LC50 is expressed in parts per million (ppm) for bases and vapors, and milligrams/liter (mg/l) for mists, fumes and dusts.

Vapor Density – The weight of a vapor or gas compared to an equal volume of air. Air is rated as 1. Vapors heavier than air (toluene is 3.2) accumulate in low areas where they may pose health hazards.

Vapor Pressure – How easily a liquid will evaporate and is measured in millimeters of mercury (mm Hg). Liquids with higher vapor pressures require better ventilation. A liquid is considered volatile when its vapor pressure exceeds 5 or 6 mm Hg.

Choosing a Waste Management Company

Reducing waste is the best way to reduce environmental liability. When you cannot avoid generating a waste, protect your business by dealing only with reliable waste management companies to recycle or dispose of your waste. No matter how good the waste management company, remember that ***no one can take away your liability once you have generated a waste***, despite advertising claims.

Following are some tips to help you make a good choice:

When choosing companies to recycle or dispose of your hazardous waste, ask the following questions:

1. Does the company have an EPA permit to transport, store, and/or dispose of hazardous waste?

Hazardous waste must be recycled on site, or transported off site for treatment, storage or disposal by an EPA-permitted hazardous waste management company.

2. Does the company use a hazardous waste manifest for shipments of hazardous waste? Is proof of disposal or recycling provided in a timely manner?

A hazardous waste manifest is required with off-site shipments of hazardous waste. A manifest is a multiple carbon copy document that is signed by the waste generator and transporter when the waste is picked up. It is signed every time the waste changes hands. Finally, the manifest is signed by a representative of the waste disposal or recycling facility. The final copy is then returned to the generator as proof that the waste reached the proper disposal/recycling destination.

3. Does the company have insurance to cover accidental spills?

Insurance is the first layer of protection for your business in case of an accident resulting in spills, injury, property damage, etc.

4. What is the cost for services? If it is a recycling service, do they return or keep your recycled product?

Choose among reputable waste management companies for the best deal. Pay for good service, not a brand name.

5. Is the company willing to negotiate a contract that fits your shop's needs?
A service schedule that does not fit the needs of a shop may result in increased waste generation. An example of this would be if parts wash solvent was changed out while it was still usable.

6. Does the company follow Department of Transportation (DOT) requirements?

Note: For lists of hazardous waste management companies, contact your local environmental assistance program, trade association or regulatory agency.

How to Obtain Waste Management Assistance

For environmental assistance, contact one of the following sources:

Organization	Activity
Regulatory Local, state or federal government agency	Enforce environmental regulations, perform inspections, issue permits and answer questions.
Non Regulatory Local, state or federal assistance program	Answer questions, provide detailed technical assistance, services are usually free and confidential to small businesses.
Consulting Firm Private company	Provides detailed environmental services for a fee. Usually confidential.
Labs Environmental Testing Laboratory	Provides laboratory testing services for a fee.
Trade Association	Organizations that represent different industries, often provide updates on environmental and other regulations and provide referrals to obtain further information.
Electronic Media Internet and World Wide Web	Home pages, bulletin boards, discussion rooms for associations, regulatory agencies and technical assistance services.

Definitions:

Regulatory - The agency has the authority to assess fines for violations of the law.
Non-regulatory - The agency lacks the authority to assess fines or penalties.
Confidential - The agency keeps information obtained from clients protected and private.

Write in State and Regional Programs

Business Scenarios

The following business scenarios discuss real environmental problems or waste questions that arise. Where could the business go for help?

Scenario #1
Auto Repair Shop A has a drum of waste solvent that needs to be disposed. The shop is not sure what to do. Where can they turn for answers?

Scenario #2
Auto Repair Shop B isn't sure if it is in compliance with environmental regulations, and would like someone to come in and offer waste management suggestions. Shop B does not have enough money to hire a consultant. Who could they call?

Scenario #3
Business C has an underground storage tank (UST). There is evidence that it is leaking. Who should they call to determine whether or not it is leaking?

Student Handout

Module 2

— Spill Prevention

The purpose of Module 2 is to help students and instructors prevent spills in the shop through careful work practices and hazardous waste storage.

Module 2 Objectives:

When students have completed this module they should be able to:

1. Recognize hazardous waste contamination in the workplace.
2. Identify where spills and leaks are likely to occur.
3. Prevent spills from occurring.
   - Conduct preventive maintenance inspections to identify and fix leaking equipment.
   - Adopt careful work practices to avoid accidents.
   - Use funnels when filling drums.
4. Contain spills to the floor using reusable materials.
   - Drip pans
   - Absorbent socks
5. Clean up spills using reusable materials, and reclaim spilled fluids when possible.
   - Dedicated mop and bucket
   - Launderable shop rags
   - Squeegee
   - Place recovered fluids into the appropriate waste container (for example, used oil in the used oil container).
6. Implement good housekeeping techniques.
   - Keep work area neat.
   - Clean spills as soon as they happen.
7. Learn proper hazardous material storage.

Spill Prevention and Cleanup in the Shop

One of the easiest ways to prevent pollution in the shop is to avoid spilling hazardous materials. You can avoid spills by working carefully and taking precautions. Knowing what operations might result in spills is important.

Some common operations where spills and leaks are likely to occur include:

- Oil changes
- Radiator flush and fill
- Radiator repair
- Parts washing
- Carrying dripping parts across the room

Preventing Spills

What can you do to prevent spills? Remember these tips:

- Practice good housekeeping - cluttered work areas increase the chance of spills and accidents.
- Keep work areas neat and clean.
- Put all tools, equipment and materials away when they are not being used.
- Work carefully to avoid accidents.
- Don't place containers of liquids where they might be knocked over.
- Cover drains in work area (with a rubber mat or anything that makes a seal over the drain).
- Use drip pans underneath work to catch spills.
- Use drip pans every time spills are possible.
- Set dripping parts on drip pans or on racks over drips pans, rather than on the floor.
- A little bit of effort to use a drip pan can save a lot of clean-up time.
- Use funnels when filling hazardous material storage containers to prevent drips and spills.

What to Do When Spills Occur

Even when drip pans are used and the service technician is careful, some spills will still happen. When spills occur in the shop, remember to:

1. Quickly stop the source of the spill. For example, put the tipped container upright.

2. Prevent the spill from leaving the facility. Cover drains or block doorways. Absorbent "socks" can be placed on the floor or around equipment to contain spills and leaks. These socks are filled with an absorbent material and can be wrung out and reused.

3. Absorb the spill using a reusable material such as a mop and bucket or launderable rags.

   Once the majority of a spill has been cleaned up using a reusable material, the residue left on the floor can be cleaned using a mild soap and water solution. If the floor is still slippery, use a small amount of disposable oil absorbent. Save the oil absorbent for reuse whenever possible.

4. If the material from the spill can be recovered, put it into the appropriate waste container. For example, put used oil into the used oil container.

5. Store wastes from clean up in labeled, sealed containers prior to disposal.

Disposal of Spill Cleanup Materials

If the liquid cannot be recycled then it should be put into a container labeled "Used Spill Cleanup Materials" and disposed of properly. A hazardous waste determination will be necessary to figure out whether the waste must be disposed of as hazardous or nonhazardous.

Disposable materials used for clean up, such as clay absorbent or "absorbent socks," are potentially hazardous because of the liquids they absorb. Clean-up materials may contain solvents, fuel, used antifreeze, used oil or other liquids commonly found in vehicle maintenance. These materials must be classified as hazardous or nonhazardous prior to disposal. If the used absorbents contain high levels of lead or benzene (found in some petroleum product blends), the waste will be unsafe for landfill disposal and must be managed as a hazardous waste. Contact a local assistance program if you have questions about how to manage spill clean-up waste properly.

Alternative Cleanup Methods

Often disposable oil absorbent (clay or "kitty litter") is used to absorb spills. This creates additional waste to be cleaned up and disposed of. And, once the liquids are soaked into oil absorbent, they cannot be recycled and must be disposed. Instead of throwing disposable oil absorbent on a spill, it is better to use:

1. A mop and bucket dedicated to cleaning spills
   A special mop and bucket with a wringer can be used to clean larger spills. Mop up the spill and then wring the liquid into the bucket. The recovered liquid should then be placed in the appropriate waste container. Put used oil in the used oil container, antifreeze in the antifreeze container, etc. Make sure all containers are labeled properly.

2. Launderable cloth shop rags
   Launderable rags can be used to clean smaller spills. Once the rags are used to soak up a spill, recover the liquid by wringing the rag out into the appropriate waste container. Again, put used oil in the used oil container, antifreeze in the antifreeze container, etc.

3. A squeegee to push the spill into a smaller area, where it can be scooped up with a flat-bladed shovel
   Use a squeegee for spills that spread out over a large area to push the spill into a smaller area so that it is easier to clean up with a mop or launderable rags. You may be able to use a flat-bladed shovel to pick up some spills.

Spill Cleanup Kits

Every facility should have a spill cleanup kit. Keep the kit in a location that is

easy to reach, and make sure every employee knows where it is. A spill cleanup kit should contain adequate supplies to clean and contain spills, for example:

- Mop and bucket
- Launderable rags
- Drain covers
- Storage container for spill clean-up wastes
- Absorbent socks or pads

Spill Prevention in Hazardous Material Storage Area

All hazardous waste and materials (solvent, antifreeze, oil, paint, etc.) should be stored carefully to prevent spills and leaks.

Regularly inspect storage containers for leaks. Fix leaks immediately, or report the leak to the person in charge of fixing the leak (service manager, for example).

Use secondary containment to stop leaks from spreading. Secondary containment is a structure that surrounds the primary storage container and will hold material if the primary storage container leaks. Examples of secondary containment are a concrete floor and walls around storage containers, a double-walled tank, or smaller storage containers placed inside larger containers.

Be careful when adding waste to a container. Use funnels if necessary. After use, remove the funnel, close the drum, and store funnels over a drip pan to catch drips.

Segregate wastes. Keep different types of waste separate. Segregated wastes are easier to reuse or recycle. For example, chlorinated solvents such as methylene chloride should not be mixed with non-chlorinated (mineral spirits) solvents.

Label containers with the appropriate name to eliminate cross-contamination of wastes (putting waste in the wrong container).

Keep storage containers closed except when adding or removing waste. The container should be closed tightly to prevent material from spilling out if the container accidentally tips over. Open containers allow evaporation and increase the risk of spills. Leaving containers open also increases the chance that materials will be accidentally contaminated by water (for containers stored outdoors) or other materials.

Store hazardous materials away from drains to prevent contamination from spreading quickly in case of a spill.

Pollution Prevention Questionnaire

Spill Prevention

1. Are all of your hazardous material/waste storage containers in good condition?
____ Yes ____No

You should regularly inspect all storage tanks for damage and leaks. Immediately repair or replace damaged containers.

2. Do you have drip pans available to use during repairs? ____Yes ____No

Drip pans of different sizes should be available to catch spills or drips during repairs.

3. Do you have a spill cleanup kit? ____Yes ____No

Cleaning up spills quickly before they spread is very important. To facilitate cleanups, every shop should have a spill cleanup kit. Employees should know where the kit is, and how to use it.

Student Handout

Module 3

— Parts Washing

The purpose of Module 3 is to introduce students to good parts washing practices and to introduce alternatives to hazardous solvents for parts washing.

Module 3 Objectives:

When students have completed this module they should be able to:

1. Reduce hazardous waste generated in parts washing by using solvent efficiently.
   - Use only the size and number of parts washers necessary.
   - Prevent loss through evaporation by keeping parts washer lids closed and spray nozzles turned off when not in use.
   - Drain parts thoroughly before removing them from wash basin.
   - Avoid unnecessary cleaning. (How clean is clean and why is the part cleaned?)
   - Replace solvent only when it can no longer be used (negotiate a service contract).
   - Rotate parts wash solvent to reuse dirty solvent for precleaning.

2. Identify alternatives to petroleum solvent-based parts washing.
   - List alternatives to traditional solvent parts washing.
     - Hot soap washers.
     - Aqueous cleaners.
     - Alternative solvents.
   - Know how to figure a simple cost-benefit/payback period when replacing solvent parts washers with a hot soap washer.

3. Demonstrate an operational understanding of solvent distillation.
   - Learn the principles of solvent distillation.
   - Know how to manage still bottoms (distillation residues) properly.
   - Know how to figure cost-benefit/payback period when purchasing a solvent distillation unit.

Petroleum-Based Solvent Used to Clean Parts

Currently, petroleum-based solvents are widely used to remove grease and dirt from parts. Once the solvent becomes spent, it must be managed and disposed as hazardous waste because of ignitability or toxicity. Since most vehicle maintenance facilities operate one or more parts washing basins containing a petroleum-based solvent, a significant portion of hazardous waste generated at these facilities may consist of waste parts washing solvent.

Solvents can be hazardous because they are ignitable or because they are listed by the EPA as hazardous due to their negative health and environmental effects. Some solvents are “halogenated.” Halogenated solvents are those that contain a halogen element, such as chlorine or fluorine. One of the most common halogenated vehicle maintenance degreasing solvents is methylene chloride, used in carburetor

cleaner. There is evidence that halogenated solvents cause holes in the ozone layer, which is linked to increased cases of skin cancer in humans.
Many proven options exist to reduce the toxicity and/or volume of waste generated from parts washing activities. These options range from good housekeeping practices to product, equipment or technology changes.

Use Less Hazardous Petroleum-based Solvents

Both listed and halogenated solvents should be avoided. If petroleum-based solvents are desired for the job, use the ones that are less hazardous in terms of environmental or human harm such as petroleum naphtha, mineral spirits and stoddard solvent. Keep in mind that these solvents can still cause adverse health affects and will be considered hazardous wastes if the flashpoint is below 140°F, and/or if the solvent has leached heavy metals from the parts or contains benzene.

Some newer petroleum-based solvents are formulated to have flashpoints above 140°F. While these solvents are not hazardous because of ignitability, they may contain toxic amounts of lead (and other heavy metals) or benzene. They require a hazardous waste determination before disposal. Petroleum-based products may not be discharged to the city sewer.

Improving Management of Petroleum-based Parts Washers

Many solvent waste management companies offer a service where they lease and service parts washers. Servicing includes removing and recycling dirty solvent, cleaning the parts washer, and refilling with new solvent. The servicing is usually provided on a contract basis. First, the shop should determine if the current number of parts washers are adequate. If some parts washers are rarely used, consider eliminating those washers. Then the shop should negotiate the service schedule so that the parts washers are serviced only when the solvent can no longer be used. For example, if parts washers are serviced every month, but the solvent still has cleaning power left after one month, the service schedule should be extended to every two or three months or longer.

Another option for reducing solvent waste is to use dirty solvent to preclean dirty parts. When several parts washers are used, skip a servicing session for one of the washers, while replacing solvent for the remaining washers as usual. Designate the parts washer with the dirtiest solvent "for dirty parts only." Reserve parts washers with new solvent for final cleaning. This extends the life of the solvent in all of the washers.

Because solvent in parts washers evaporate easily, keep the lids closed and the nozzle turned off when not in use. Post a sign at each parts washer to remember to close the lid and turn off the solvent nozzle.

Install drain racks on parts washers so that wet parts can drain before being removed from the wash basin. Dripping solvents are wasteful and can contaminate the floors and other materials it comes in contact with.

Improving the Technology of Petroleum-based Solvent Parts Washers

Filtering Parts Washers

Newer parts washers have filter units that make solvent last longer by filtering out contaminants. Filtering parts washers require less frequent servicing than traditional parts washers and reduce the amount of waste solvent generated. There are different kinds of filters. Some examples are:

A series of filters (fabric and metal) mounted on the side of the parts washer that filters the solvent as the parts washer is used.

A "cyclonic" filter that spins the solvent causing the grease and dirt to fall out.

Disposable filters and captured grease and dirt are potentially hazardous. They must be determined hazardous/nonhazardous before disposal. Hazardous waste must be managed by a hazardous waste management company.

Review of Steps to Reduce Petroleum-based Solvent Waste in Parts Washing

1. Clean parts in a parts washer with a lid. Cleaning them in an open bucket or pan often results in unnecessary evaporation and spills of hazardous solvent.
2. Keep parts washer lids closed and spray nozzles turned off when not in use to reduce evaporation.
3. Locate the units away from heat sources and drafts to minimize evaporation of solvent.
4. Drain parts thoroughly before removing them from the parts washer to prevent solvent drips. Install a shelf in the parts washer to make draining easier. The shelf should not interfere with closing the lid.
5. Use only the size and number of parts washers necessary. Eliminate parts washers that are not used very often.
6. Replace solvent only when it is too dirty to be used. Use dirty solvent to pre-clean dirty parts.

Alternatives to Petroleum-based Solvent Parts Washing

Hot Soap Washers

Hot soap or jet spray washers are like "dishwashers" for parts – they use non-toxic detergent and hot water to remove oil, grease and dirt. Parts are put inside the washer and the lid is closed during cleaning. Hot soapy water circulates around the parts to remove dirt. Some washers spray strong jets of water on the parts to remove dirt. Hot soap washers are available in different sizes and designs. Some hot soap washers load from the top, while others load from the side.

Aqueous Cleaners

Aqueous cleaners are less toxic, water-based alternatives to petroleum-based solvents. They are composed of cleaning agents such as detergents, alkaline chemicals, microbes, or any combination of cleaning agents. Aqueous cleaners can be used in traditional cold parts washers. Because waste aqueous cleaners

are not ignitable, they can potentially be discharged to the city sewer with prior approval. Waste aqueous cleaners should not be disposed of in a septic system because they may contain ingredients that will interfere with the functioning of the septic tank, causing costly system failure. In addition, waste aqueous cleaners may contain hazardous ingredients that could pollute surface and groundwater.

Drawbacks to hot soap washers and aqueous cleaners include inadequate cleaning in some applications, the risk of parts rusting, and the need for final rinsing with water. Cleaners that contain a rust inhibitor may be hazardous because of the chemical used to stop rusting. Separate rust inhibitors can be purchased.

Microbial Cleaners

Microbial cleaners are water-based cleaners that contain soaps and microbes. The soap loosens the grease from parts, and the microbes "eat" the grease, turning it into water and carbon dioxide. Microbial cleaners can be used for parts cleaning, and for cleanup of small oil spills. Microbial cleaners are sold with the microbes and nutrient source packaged separately. The mixed solution has a shelf life of about 60 days. These cleaners can be used in traditional parts washers. Spent microbial cleaners may also be discharged to the city sewer with prior approval. Disadvantages of microbial cleaners include foul odors and limited solution life after mixing.

Exercise #1: Hot Soap Payback

Payback Period

Payback period is the time it takes to pay for a piece of equipment with the money saved by using the new equipment.

Iowa Farm Implement wants to replace its solvent parts washers with a $6,000 hot soap washer. Iowa Farm Implement estimates a yearly cost savings of $2,500.

What is the payback period for the hot soap washer in this case?

Exercise #2: Hot Soap Washer Cost Savings Estimate

Given the following information, determine the payback period for an auto repair shop that purchases a hot soap degreaser.

Joe's Auto Repair shop has two parts washers. Joe pays $100 per month to have each tank serviced (this includes disposing of the old solvent and replacing it with new solvent). Joe's employee's earn $10 per hour and they spend a total of 8 hours per month washing parts.

Cost Savings Estimate Worksheet
Hot Soap Degreaser

Please note this worksheet uses one hot soap degreaser replacing two solvent parts washing sinks.

1. Parts Cleaning Expenses	Example	Your Shop
A. Number of parts washer stations	2	
B. Cost of each tank per month	$100	
C. Time spent cleaning parts per month	8 hrs.	
D. Cost of labor per hour	$10	
E. Total cost of labor per month (CxD)	$80	
F. Parts wash expenses per month [(AxB) + E]	$280	
2. Hot soap Degreaser Expenses		
G. Biodegradable soap expense per month (Buying bulk is cheaper)	$20	
H. Operating costs per month (utilities)	$42	
I. Total expenses per month (G+H)	$62	
* J. Sludge testing ($350) and disposal ($400)	$750	
3. Cost Savings		
K. Expense per year using solvent (Fx12)	$3,360	
L. Hot soap unit expenses/year [(Ix12) + J]	$1,494	
M. Total cost savings per year (K-L)	$1,866	
4. Payback Period		
N. Cost of equipment	$2,500	
O. Payback period (N/M)	1.34 yrs	

*** Assumes approximately one fifty-five gallon drum of potentially hazardous sludge will result per year. This sludge must be tested to determine whether it is hazardous. If hazardous, it must be disposed through a hazardous waste management company.**

1. How much does Joe pay his employees each month to wash parts?

2. How much does Joe pay for all expenses of parts washing per month?

3. Per year?

Joe decides to switch to a hot soap washer. He now spends $20 per month on biodegradable soap and $42 on utilities per month. He also spends $400 per year on disposal of sludge from the degreaser. Joe's employees now spend a total of one hour per month washing parts.

4. How much does Joe spend per month to run the hot soap washer (including soap, utilities)?

5. Per year (don't forget sludge disposal)?

6. How much does Joe save per year by switching to a hot soap washer?

7. Joe spent $3,000 to buy the hot soap washer. He had a one-time hazardous waste test (sludge) cost of $350. How long will it take for his savings to pay for the equipment and the hazardous waste test cost?

Proper Management of Wastes From Water-based Parts Cleaning

Sludge

Dirt and grease from the parts will accumulate in the bottom of the washer as sludge. This sludge should be cleaned out frequently. The sludge is potentially hazardous and should be classified as hazardous or nonhazardous before disposal. Hazardous waste must be disposed of by a hazardous waste management company. Contact your local hazardous waste regulatory authority or assistance program for more information.

Wastewater

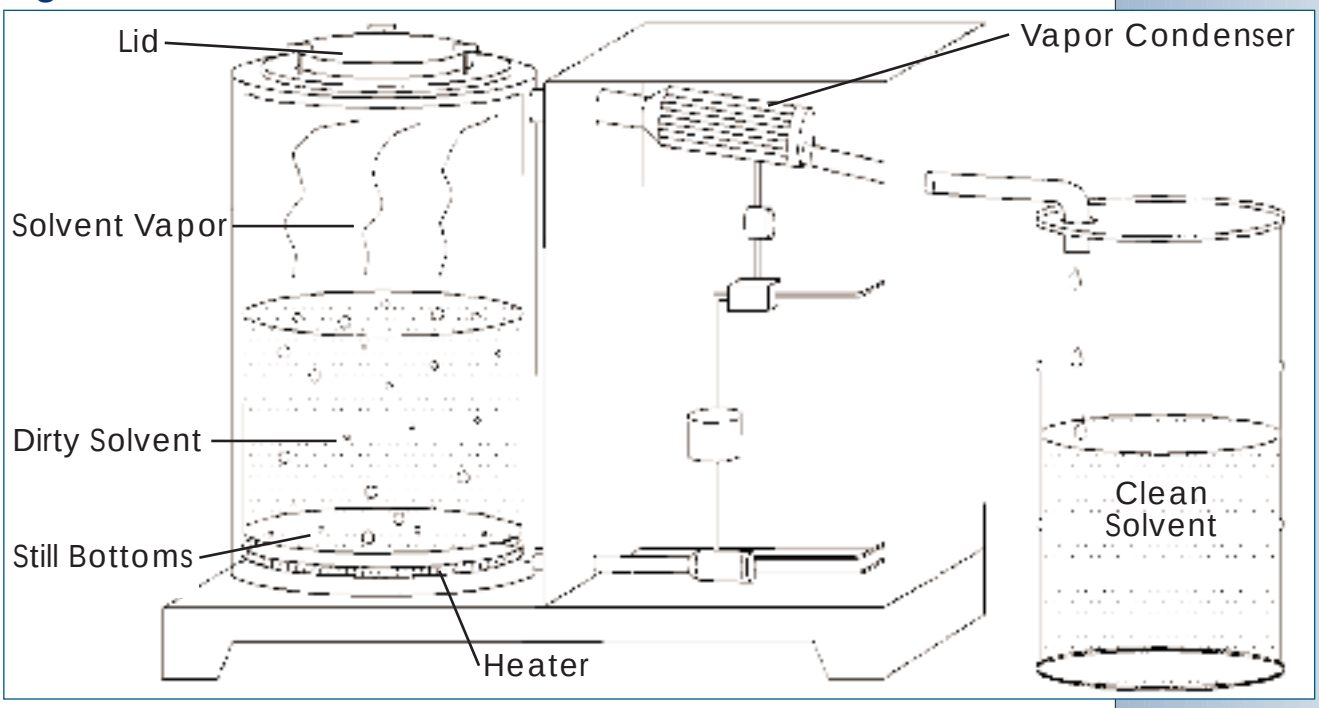
Some hot soap washers evaporate water during use – more water has to be added, and no wastewater is generated. Other washers generate wastewater that needs to be disposed. This wastewater should not be discharged outdoors or to a septic system. Contact the local wastewater treatment plant supervisor to determine if this wastewater can be discharged to the city sewer. Wastewater should be tested for pH to protect pipes. If the pH is too low, the wastewater may have to be neutralized before being discharged. Before discharge, oil and large dirt particles must be removed from the wastewater. Oil skimmers are available as an option on the washers, or can be purchased separately.

Principles of Solvent Distillation

On-site solvent recycling reduces solvent waste. Distillation is one type of solvent recycling. Distillation equipment, called a "still," is used to distill solvent.

To recycle the solvent in a still, pour the used solvent in the process vessel. (See Figure 1). The solvent is heated to boiling. The liquid solvent changes to a vapor when it boils. This vapor goes through a chiller or condenser where it is cooled back to the liquid state. A container is attached to the condenser to collect the recycled solvent which can be reused. Recycled solvent may be 99 percent pure solvent. Solvent stills are available in many different sizes. Which size to use depends on how much waste solvent a shop generates. Some solvents will not boil except at very high temperatures and require a vacuum assist attachment to assist with boiling. Liquids boil at lower temperatures as the air pressure is lowered. Vacuum assists reduce the pressure in the heating chamber, allowing the solvent

Figure 1



to boil at a lower temperature. Solvents that require the use of a vacuum assist are more costly to recycle.

When solvents with varied boiling points are mixed together for distilling, the still will produce a lower percentage of reusable product. For this reason, solvents with different boiling points should be stored and recycled separately.

Waste from Distillation

Dirt, grease or paint that was in the used solvent before it was recycled will collect in the bottom of the heating chamber of the still after recycling. They are called "still bottoms." Still bottoms must be removed and disposed of properly, usually as hazardous waste. To make cleaning easier, some stills have a heat-resistant plastic bag that can be put in the heating chamber before the solvent is added. After distillation, the still bottoms will be inside the bag, and the whole bag can be taken out and put into a hazardous waste storage container.

Precautions

As with any equipment in the shop, safety precautions must be followed when operating a still. Always follow manufacturers directions completely. Never try to distill liquids that are not recommended for use in the equipment. Explosion and fire may result with improper use of a still. The operator of the still should wear protective clothing - such as a respirator, eye protection and gloves.

Exercise #3: Solvent Distillation Cost Savings Estimate

Using the following information, estimate the annual cost savings for the purchase of a solvent still.

Cost Savings Estimate Worksheet
Solvent Distillation Unit

	Example	Your Shop
1. Weekly Generation Rate		
A. Amount of solvent generated per week	10 gal	
2. Cost of Off-Site Recycling Per Week		
B. Off-site disposal cost per gallon	$5	
C. Cost of virgin solvent	$4	
D. Total cost per gallon (B+C)	$9	
E. Total weekly off-site disposal cost (AxD)	$90	
3. Amount of Solvent Recovered During On-Site Distillation		
F. Average percentage recovered (90%)	.90	
G. Amount of solvent recovered (AxF)	9 gal	
4. Cost of On-Site Recycling Per Week		
H. Average still bottoms per week (A-G)	1 gal	
I. Off-site disposal cost of still bottoms	$10/gal	
J. Weekly cost of still bottom disposal (HxI)	$10	
K. New solvent needed (A-G)	1 gal	
L. Weekly cost of new solvent (KxC)	$4	
M. Cost of on-site recycling per week (L+J)	$14	
5. Cost Savings Per Week for On-Site Recycling		
N. Total cost savings per week (E-M)	$76	
6. Payback Period		
O. Average cost of distillation unit	$7,000	
P. Yearly savings by recycling on site (Nx52)	$3,952	
Q. Payback period in terms of years (O/P)	1.8 yrs	

Note: Still bottoms are generally more costly to dispose per gallon than spent solvent, but the quantity of still bottom is considerably less than solvent. Also, recycling your solvent will reduce the amount of hazardous waste you generate. Thus, your regulatory status is reduced.

Nancy's Auto body Shop uses 10 gallons of solvent per week. Nancy pays $5 per gallon to buy new solvent and $5 per gallon to dispose of used solvent.

1. How much (total) does Nancy spend on solvent per gallon?

2. How much does Nancy spend on solvent per week?

Per year?

Nancy adds a distillation unit to her shop at a cost of $3,500. She recovers 90 percent of her used solvents. What Nancy does not recover is left as still bottoms. It costs $10 per gallon to dispose of still bottoms.

3. How much solvent does Nancy recover per week?

4. How much does Nancy spend to dispose of still bottoms per week?

5. How much does Nancy pay per week for new solvent?

6. What is the weekly cost of on-site solvent recycling (including still bottom disposal and new solvent purchase)?

7. What is the yearly cost of on-site solvent recycling?

8. How much does Nancy save per year by recycling solvent on site?

9. How long will it take for the savings of on-site solvent recycling to pay for the distillation unit?

Module 3 Review

1. What are the benefits of replacing hazardous solvents?

Reduced employee exposure to hazardous solvents.
Costs savings: detergents cost less than solvents.
Less hazardous waste to handle on site and dispose of off site.
Improved or "green" public image.

2. What factors should be considered when deciding whether to replace solvent parts washers with a hot soap washer?

Number of solvent parts washers, may be able to eliminate one or more.
Cost of servicing solvent parts washers.
Cost of the hot soap washer.
Cost of soap.
Wastewater disposal – is the facility connected to the city sewer?
Disposal of sludge from the hot soap washer - testing costs.
Regulations a business is subject to because of hazardous waste solvent.
Employee exposure to hazardous solvents.
Time spent cleaning parts vs. time saved using a hot soap washer.

Pollution Prevention Questionnaire — Parts Washing

1. Are you using a hazardous solvent for parts washing?
(examples: mineral spirits, petroleum naphtha, stoddard solvent, any solvent with a flashpoint over 140°F).

____ Yes____ No

2. Are you using your solvent in a parts washer or in an open bucket?

Using solvent in a covered parts washer reduces evaporation, therefore saving solvent. A parts washer has a sink where the parts are cleaned. Solvent is pumped up from the reservoir to the sink through a nozzle that is usually equipped with a brush.

3. How are you managing your used solvent?

____ Hazardous waste management company ____ On-site recycling
____ Other

Used hazardous solvent should be managed through a hazardous waste management company or recycled on site. Dumping hazardous solvents on the ground or into a drain is illegal and may cause harm to human health and the environment.

4. Is the solvent able to clean parts when it is changed out? ____ Yes ____ No

If YES, consider extending the service schedule so that the solvent is only changed out when it can no longer be used.

5. Is the parts washer located away from drains? ____ Yes ____ No

Solvent parts washers, along with other hazardous materials, should be kept away from drains to avoid an accidental spill. If the parts washer cannot be moved to a location without a drain, seal the drain.

6. Does your parts washer(s) have drain shelves? ____ Yes ____ No

Allowing parts to drain on drain shelves before removing them from the parts washer reduces the amount of solvent wasted from dripping parts. Drain shelves are often available as an option from parts washer suppliers.

7. What type of alternative cleaner or cleaning process would you recommend? Be ready to discuss the pros and cons of your choice in class.
See "Alternatives to Petroleum Parts Washing" for more information.

8. Identify and list methods that the shop could implement to improve on its waste management. Are these pollution prevention methods?

Student Handout

Module 4

— Used Oil and Oil Wastes

The purpose of Module 4 is to teach students how to manage used oil and oil-contaminated waste in a manner that reduces waste and protects human health and the environment.

Module 4 Objectives:

When students have completed this module, they should be able to understand and implement pollution prevention methods for managing used oil and oil-contaminated wastes in the shop. This includes the following:

1. Proper used oil management options.
   - Off-site recycling or burning for energy recovery.
   - On-site burning for energy recovery in an approved space heater.

2. Proper and safe storage of used oil containers.
   - Store on an impermeable barrier (such as concrete).
   - Inspect all oil storage containers regularly.
   - Store away from drains.
   - Store in a secured area.
   - Always keep all used oil containers labeled and closed.

3. Stop and/or minimize oil spills.
   - Use mobile oil drainers during oil changes to reduce chance of spillage.
   - Use funnels when filling used oil containers.

4. Minimize oil-contaminated waste.
   - Understand why oil-contaminated wastes are a liability and an expense.
   - Prevent spills.
   - Use reusable absorbents or cleaning materials such as mops or cloth rags.

5. Understand used oil filter pollution prevention options.
   - Remove residual oil from used oil filters.
   - Recycle the metal casings from used oil filters.
   - Crush used filters for volume reduction and to remove excess oil.
   - Identify resources for pollution prevention and waste management assistance.

Activities that Produce Used Oil

Used Oil Management – Recycling

Because used oil is a valuable resource it should be recycled. Used oil is also a potentially hazardous material capable of contaminating soil and water. One gallon of oil can contaminate one million gallons of drinking water.

Special Note:

Used oil is exempted by the Federal government from management as a hazardous waste only when it is recycled or burned for energy recovery.

Activities that Produce Used Oil:
- Routine oil changes or repairs
- Puddles from oily parts placed on the floor or carried across the room
- Spills when filling storage containers
- When storage containers leak or overflow

Summary of Used Oil Management Guidelines

Off-Site Used Oil Management

Used Oil Marketers/Transporters – A used oil marketer provides oil to a used oil burner or a recycler. If the oil is going to a burner, the marketer is responsible for testing the used oil to make sure it meets EPA burning specifications. Used oil marketers and transporters are required to follow EPA regulations.

Used Oil Burner – A commercial used oil burner burns used oil in a cement kiln or other large industrial furnace. The burner must meet all federal guidelines and have an EPA identification number.

On-Site Used Oil Management

Burning used oil in an oil-fired space heater – Shops may burn their own used oil and used oil from do-it-yourselfers such as private citizens and some farmers, in EPA-approved used oil space heaters.

This is good management because used oil is burned for fuel instead of new oil or gas. When used oil stays on site, there is less liability from potential accidents during transportation or improper management.

Never burn oil mixed with hazardous waste, such as parts wash solvent or carburetor cleaner.

Shops must not burn oil from other businesses without first testing the used oil and meeting all other applicable EPA regulations.

What You Should Not Do with Used Oil

The following are practices that should not take place at the shop. They are either in violation of environmental laws and/or cause environmental pollution.

- Do not dump oil on the ground.
- Do not spread used oil as a weed killer or dust suppressant.
- Do not dump oil into rivers, streams, lakes or any body of water.
- Do not add hazardous waste or other materials to used oil.
- Do not give or sell used oil to another business for burning in their furnace (Illegal unless you meet the federal guidelines as a Used Oil Marketer).
- Do not give or sell used oil to another business for road oiling (Illegal disposal).

Adding hazardous solvents such as parts washing or carburetor cleaner to used oil can contaminate the entire batch of used oil. The resulting mixture may be considered hazardous and have to be disposed of as a hazardous waste.

Contaminated used oil may be unsafe or illegal to burn on site in a used oil space heater. Before adding any nonhazardous fluid other than used oil, contact the used oil space heater manufacturer or used oil marketer/collection center to make sure the used oil will still be recyclable.

What You Should Do with Used Oil

The following are considered the most desirable methods or options to properly manage used oil. Many are pollution prevention options and will assure compliance with federal requirements for used oil.

- Store used oil in leak-proof containers on an impermeable surface. Label as "USED OIL."
- Make provisions for spill containment and cleanup in the event of an accidental spill.
- Keep used oil separate from other wastes to avoid accidental contamination.
- Make arrangements for an EPA permitted used oil recycler to recycle your used oil off site.
- Burn used oil on site for energy recovery in an EPA-approved used oil space heater.

Oil-contaminated Wastes

Oil-contaminated wastes include:

Shop towels
Disposable oil absorbent

Shop towels

Disposable shop rags that are contaminated with oil, solvent, paint and other chemicals cannot be recycled. This creates a potential disposal problem when rags are contaminated with a hazardous waste. Costly testing is the only way to determine the proper disposal method (Module 1). If paper shop towels must be used, try cutting them in half or in quarters before using them to reduce waste. Hazardous disposable shop rags must be disposed of by a hazardous waste management company.

Reusable cloth shop towels are a good pollution prevention alternative. The soiled towels can be sent to a laundry service where they are laundered and sent back to the shop for reuse. A potential hazardous waste disposal problems (and costs and liability associated with disposal) can be eliminated by using a commercial laundry towel service.

Disposable oil absorbent

When disposable oil absorbent (such as clay or "kitty litter") is used to soak up spills, the resulting waste is usually thrown away. This means that the oil is not recycled, and ends up in the landfill where it can leach into surface or groundwater and cause contamination. It is better to prevent spills from occurring (Module 2).

Review of Preventing Spills

- Use drip pans underneath leaking vehicles and work areas whenever possible.
- Make sure the drip pans are big enough and won't tip over.
- Put dripping parts in a drip pan instead of on the floor.
- Use funnels when emptying used oil into storage containers.
- Used oil in the drip pans should be drained into a used oil container. Store drip pans carefully so they do not leak on the floor. Designate drip pans for specific use, for example, do not use an oil drip pan to collect antifreeze or solvent.
- When purchasing disposable oil absorbent materials, be sure to consider their reusability. Absorbent "socks" for example, may be reused about 10 times before disposal. Roller-wringers are available to remove the maximum amount of oil from the socks but the socks cannot be laundered and must eventually be disposed.

Disposal of Oil-Contaminated Wastes

Spills are Bound to Occur

Some oil spills are bound to occur. To make clean-up easier, shop floors can be sealed or painted to make the surface impermeable and to allow spills to "pool." A launderable rag or a mop and bucket can then be used to soak up the spill. Special oil-absorbing mops are available. Once the spill has been absorbed into the mop wring the oil from the mop head and place the oil into a used oil container for recycling. Mop heads and cloth rags should be sent to a commercial laundry for laundering and returned to the shop for reuse.

Once most of the spill is cleaned up, a mild soap and water solution may be used to clean the residual oil sheen. This wastewater may be discharged to the local wastewater treatment plant if all local sewer codes are met. Do not discharge this water directly outdoors since even non-toxic soaps can pollute soil and streams.

Disposal of Oil-Contaminated Wastes

Oil-contaminated waste such as used oil absorbent and shop rags are potentially hazardous because they may contain:

Lead and other heavy metals
Solvents
Fuel
Used oil
Paint
Antifreeze

If these wastes are landfilled, hazardous materials may leach out of the waste into the groundwater causing a pollution problem. According to federal regulations, all industrial wastes must be classified as hazardous or nonhazardous before choosing a disposal option. For wastes that are contaminated with unknown quantities of hazardous materials, laboratory testing is usually the only way to determine if the

waste is hazardous or not. Wastes determined to be hazardous must be disposed of by a hazardous waste management company. (Module 1) Nonhazardous wastes can be landfilled with permission from the landfill. Keep in mind that landfills do not accept industrial wastes that contain free-flowing liquids.

Pollution Prevention for Used Oil Filters

When removing oil filters during an oil change, put a drip pan underneath the vehicle to catch any oil that may spill. There are drip pans mounted on a roller stand with adjustable height to catch the oil from a vehicle on a lift. These drip pans drain into a container at the bottom and are often on wheels for easier transportation. Pour collected oil into the used oil storage container.

Remove and recycle as much oil as possible from the used filters. After the filter has been removed from the vehicle, place it in a drip pan immediately. Be careful not to let oil drip on the floor when transferring the filter to the drip pan. Drain oil trapped inside the filter by one of the suggested methods:

1. Draining and crushing (the filter may need to be punctured for better draining)
2. Hot-draining (near engine operating temperature) for a minimum of 12 hours
3. Dismantling and draining

Draining and crushing is the preferred method since it removes considerably more oil than draining alone and reduces the volume of the filter so the filter takes up less space in a landfill. A commercial filter crusher is used to crush the oil filter. Generally, the filter is placed inside the crusher and the door is closed. Closing the door or pulling a level will activate the ram. The filter cartridge is ruptured and oil drains into a collection container. To prevent spills during crushing, use a container large enough to catch all oil from the filter, and empty the oil collection drum regularly.

Recycle metal filter casings

Oil filter casings are made of good quality metal that should be recycled. Check with scrap metal recyclers to see if they will accept used oil filters. There are companies that specialize in oil filter recycling. Oil filter recyclers often provide a drum to collect the filters. They either shred the filters or crush them together into large briquettes. The used oil is recovered and recycled and the metal is sent to a scrap dealer for recycling.

Pollution Prevention Questionnaire

Used Oil and Oily Wastes

1. What happens to your used oil?

____ Burned on site in a used oil space heater
____ Recycled or burned for energy recovery off site
____ Other

According to federal regulations, used oil should be burned on site in an EPA-approved used oil space heater, or recycled or burned off site in an EPA-approved boiler or space heater.

2. Where is your used oil stored?

_____

New and used oil containers should be stored away from floor drains, or seal floor drains in the oil storage areas. Used oil containers should be stored on an impermeable surface in secondary containment. Secondary containment is a structure that can contain spills from the primary used oil container.

3. Are your used oil containers in good condition?____ Yes____ No

Used oil containers should be inspected regularly for leaks. Damaged, leaking containers should be fixed or replaced immediately.

4. Is your used oil container labeled "Used Oil?"____ Yes____ No

This is required by law, and will help to prevent used oil from accidentally being contaminated with other wastes.

5. Do you mix any other wastes with your used oil?____ Yes____ No

If yes, what other wastes do you mix?

____ Non-chlorinated solvents (such as mineral spirits)
____ Chlorinated solvents (such as methylene chloride carburetor cleaner)
____ Brake fluid
____ Other _____

Spent solvents and other hazardous waste should not be added to used oil because this could make the whole mixture hazardous. Adding some wastes to the used oil will make recycling for energy recovery difficult or impossible. Check with your local regulatory agency and used oil recycler before adding anything to your used oil.

Student Handout

Module 5

— Used Antifreeze

The purpose of Module 5 is to teach students pollution prevention management options for used antifreeze. Antifreeze reuse and recycling are discussed.

Module 5 Objectives:

When students have completed this Module they should be able to:

1. Identify pollution prevention methods to minimize or eliminate antifreeze waste and protect the environment.
2. Explain why antifreeze should not be discharged to a septic system or bodies of water.
   - Adverse effect on microbial activities of septic systems.
   - Adverse effect on humans, fish and animals.
3. Identify two antifreeze pollution prevention management options.
   - On-site Recycling:
     - Distillation
     - Filtration
     - Reuse
     - Recycling Service
   - Off-site Recycling:
     - Recycling Service
4. Calculate an estimated yearly cost savings and payback period for purchase and use of antifreeze recycling equipment on-site.

Managing Used Antifreeze

Minimize Waste Antifreeze

Antifreeze must be replaced when it becomes corrosive or contaminated and no longer provides adequate protection against freezing. Replace antifreeze only when necessary. Visually check antifreeze for contaminants, and test for freeze point and pH. Freeze point can be tested with a hand-held refractometer, and pH can be tested using pH test paper or a pH meter. Fresh ethylene glycol or corrosion inhibitors can be added to adjust these parameters without disposing of the antifreeze.

When usable antifreeze must be removed for repairs, save it in a clean container and reuse it after the repairs have been completed. This avoids unnecessary disposal of good antifreeze.

Separate used antifreeze from other wastes such as used parts wash solvent or used oil. Contaminated antifreeze cannot be reused unless it is recycled first.

Used antifreeze may be hazardous because is contains lead or other metals from contact with engine parts. It can also be contaminated with fuel or solvents. Some states regulate antifreeze as a hazardous waste.

"Safer" Antifreeze

Most antifreeze is composed of ethylene glycol and water. Propylene glycol has been introduced as a "non-toxic antifreeze" because it is less toxic to humans and animals than ethylene glycol. Used propylene glycol is potentially hazardous if it is contaminated with fuel, solvents or lead – the same contaminants found in used ethylene glycol.

Proper Disposal

Used antifreeze should be recycled. Although some state and local regulations allow discharge of small amounts of used antifreeze to the city sewer (with prior permission from the wastewater treatment plant), this is not considered pollution prevention or good management practice. If recycling or reuse is not feasible, you must check with the local sewer authority for state and local regulations prior to discharge. Contaminated or unusable antifreeze should be managed by a hazardous waste management company.

Improper Disposal

Never dump antifreeze on the ground, to a storm sewer or to a body of water. Children and animals are attracted to the sweet taste of antifreeze. Eating or drinking antifreeze can result in sickness or even death. Dumping antifreeze into bodies of water can also kill fish.

Never discharge antifreeze to a septic system.
Antifreeze may interfere with the normal functioning of a septic system. If the antifreeze is hazardous, discharge into a septic system is illegal disposal of hazardous waste, subject to fines and clean-up costs.

Antifreeze Recycling Alternatives

On-vehicle Recycling

Some on-vehicle recycling units are equipped with hoses that attach directly to the vehicle, forming a closed-loop recycling system. The old antifreeze is removed from the vehicle and circulated through the recycling unit where the contaminants are removed from the antifreeze using filters. Additives are then replenished, and the recycled antifreeze is returned to the vehicle through the attached hoses.

Off-vehicle Recycling

Off-vehicle recycling requires that used antifreeze be removed from the vehicle and placed in a recycling unit where contaminants are removed by filtration or distillation. Again, additives are replenished, and the coolant can then be reused.

Note: Check manufacturers' warranties before putting recycled antifreeze into any vehicle to ensure that the use of recycled antifreeze will not invalidate the warranty.

Off-Site or On-Site Recycling by an Antifreeze Recycling Service

Off-site: An antifreeze recycling service will pick up your antifreeze and transport it off-site for recycling. The recycled antifreeze is either returned to the company or resold.

On-site: An antifreeze recycling service comes on site with their recycling equipment, recycles the antifreeze at the place of business. Antifreeze that has been recycled is reused by the business. Dirty filters may or may not be left at the business for proper disposal (most likely will contain high levels of hazardous materials such as lead).

Antifreeze Recycling Technologies

Antifreeze Distillation

In distillation, used antifreeze is removed from the vehicle and placed in the heating unit of the antifreeze "still," where it is heated to the boiling point. A vapor forms and passes through a cooling unit, where it is returned to the liquid state. The recovered liquid will be nearly pure ethylene glycol, and will require anti-corrosion and other additives (in addition to distilled water) before reuse. Recycling equipment vendors provide additive packages.

Antifreeze Filtration

Two types of filtration commonly used to recycle antifreeze in vehicle maintenance shops are chemical filtration and ultra filtration. In chemical filtration, chemicals are added to used antifreeze to precipitate (cause to settle out) dissolved solids before mechanical filtration. Ultra-filtration involves passing used antifreeze through a series of successively finer filters to remove contaminants suspended in the antifreeze. After filtration, additives must be replenished. Recycling equipment vendors provide additive packages.

Antifreeze Recycling Wastes

After recycling, contaminants removed from the antifreeze will remain in the equipment. In a distillation unit, a sludge called "still bottoms" is left at the bottom of the heating unit. In the filtration unit, there will be used filters. These wastes are potentially hazardous because they may contain high levels of lead, solvents, fuel, etc. Recycling wastes must be classified hazardous or nonhazardous before disposal. (Module 1) Hazardous still bottoms and used filters must be stored in sealed, labeled containers, and disposed of by a permitted hazardous waste management company. Nonhazardous still bottoms and used filters containing no free liquids may be landfilled with permission from the landfill operator in accordance with state and local regulations.

Cost Saving Estimate Worksheet

The following worksheets can illustrate the parameters and steps involved in determining a cost savings estimate.

Cost Savings Estimate Worksheet

Antifreeze Distillation Unit

a. Based on 2 jobs per week.

	Example	Your Shop
1. Antifreeze Used Per Week		
A. Amount of antifreeze used [a]	5 gal	
2. Cost of Antifreeze Per Week		
B. Off-site disposal cost per gallon[b]	$3	
C. Cost of virgin antifreeze	$5	
D. Total cost per gallon per week (B+C)	$8	
E. Total cost of antifreeze per week (AxD)	$40	
3. Amount of Antifreeze Recoverable Per Week		
F. Average percentage recovered (%90)	.90	
G. Amount of antifreeze recovered (AxF)	4.5 gal	
4. Weekly Operating Cost of On-Site Distillation Unit		
H. Cost of additives per week	$3.50	
I. Still bottom disposal per week[c]	$2.90	
J. New antifreeze needed per week (A-G)	0.5 gal	
K. Weekly cost of new antifreeze (JxC)	$2.50	
L. Total operating cost per week (H+I+K)	$8.90	
5. Cost Savings Per Week		
M. Cost savings per week (E-L)	$31.10	
N. Service charge for recycling per week[d]	$10	
O. Total cost savings per week (M+N)	$41.10	
6. Payback Period		
P. Cost of antifreeze distillation unit	$7,500	
Q. Total savings per year (Ox52)	$2,137	
R. Payback period in terms of years (P/Q)	3.5 yrs	

b. Estimated on $165/55 gallons of hazardous antifreeze.
c. Estimated on $300/55-gallon drum of still bottoms; 1 drum generated every 2 years.
d. Based on a $5 added recycling charger per job.

Cost Savings Estimate Worksheet
Antifreeze Distillation Unit

	Example	Your Shop
1. Antifreeze Used Per Week		
A. Amount of antifreeze used [a]	5 gal	
2. Cost of Antifreeze Per Week		
B. Off-site disposal cost per gallon[b]	$3	
C. Cost of virgin antifreeze	$5	
D. Total cost per gallon per week (B+C)	$8	
E. Total cost of antifreeze per week (AxD)	$40	
3. Operating Cost of Filtration Unit Per Week		
F. Cost of additives per week	$3.50	
G. Resin tank recharge cost per week[c]	$2	
H. Filter disposal[d]	$3	
I. Total operating cost per week (F+G+H)	$8.50	
4. Cost Savings Per Week		
J. Cost savings per week (E-I)	$31.50	
K. Service charge for recycling per week[e]	$10	
L. Total cost savings per week (J+K)	$41.50	
5. Payback Period		
M. Cost of antifreeze filtration unit	$7,000	
N. Total savings per year (Lx52)	$2,158	
O. Payback period in terms of years (M/N)	3.2 yrs	

a. Based on 2 jobs per week
b. Estimated on $165/55 gallons of hazardous antifreeze.
c. Estimated on $100 per recharge and 100 jobs prior to recharge.
d. Estimated on $310/55-gallon drum of used filters; 1 drum generated every 2 years.
e. Based on a $5 added recycling charge per job.

Antifreeze Distillation Cost Savings Exercise

Payback period is the amount of time it takes to pay for a piece of equipment with the money saved by using the equipment minus purchase and operating costs.

Using the following information, determine how long it would take for a shop to recover money spent for the purchase of on-site antifreeze recycling equipment. In other words, how long will it take before the amount of money saved from on-site recycling is equal to the cost of the equipment.

1. Friendlys Service Station performs two antifreeze flush and fills and uses 5 gallons of antifreeze per week. New antifreeze costs $5 per gallon. Friendly pays $3 per gallon to dispose of used antifreeze off site.

a. What is Friendlys cost per gallon of antifreeze?

b. What is Friendlys total weekly cost of antifreeze?

c. Yearly?

2. Friendlys is thinking of purchasing an antifreeze distillation unit (still) to help cut costs and protect the environment. With this unit they will be able to recover 90 percent of the antifreeze used each week. Antifreeze additives will cost $3.50 each week. Still bottoms (waste from the distillation process) will cost $2.90 per week to dispose. Friendlys will add a $5.00 service charge per flush and fill for waste disposal.

a. How much usable antifreeze will be recovered each week?

b. How much new antifreeze will have to be added each week to replace what is lost to still bottoms?

c. What is the cost of the antifreeze that must be replaced?

d. What would be the cost per week of operating an antifreeze still?

e. Per year?

f. What is the revenue from operating an antifreeze still per year?

g. What is the total cost savings per year from having on-site distillation?

3. Friendlys paid $7,500 for the antifreeze still. How many years would it take to pay for the unit from the cost savings accumulated from using it?

Pollution Prevention Questionnaire — Used Antifreeze

1. Do you recycle used antifreeze?____ Yes____ No

Recycling used antifreeze is the best pollution prevention management option. Equipment can be purchased to recycle used antifreeze on site, or there are companies that provide off-site recycling services. Use a cost-benefit analysis worksheet to help determine whether purchasing on-site recycling equipment is cost effective.

2. Do you discharge used antifreeze to a drain?____ Yes____ No

The best pollution prevention option for antifreeze is to recycle it. It is legal in some areas to discharge used antifreeze to the city sewer. Contact your regulatory agencies to determine whether discharging antifreeze to the city sewer is legal in your area. Used antifreeze should never be discharged to a septic tank or directly outdoors (as through a storm sewer).

3. Do you store used antifreeze on site?____ Yes____ No

If used antifreeze is stored on site, it must be classified as hazardous or nonhazardous according to EPA regulations. Make sure used antifreeze storage containers are in good condition, and located in an area that provides secondary containment in case of an accidental leak. Hazardous waste antifreeze must be labeled "Hazardous Waste."

4. If you store antifreeze on site, where do you store it?

_____

New and used antifreeze containers should be stored away from drains, or drains in the storage areas should be sealed. Used antifreeze containers should be stored on an impermeable surface in secondary containment. Secondary containment could be an area with a concrete floor and walls, or another structure to contain spills from the used antifreeze container.

5. What do you store your antifreeze in?_____

Used antifreeze containers should be in good shape and inspected regularly for leaks. Damaged, leaking containers should be fixed or replaced immediately.

6. Is your used antifreeze container labeled "Used Antifreeze?"____ Yes____ No

Proper labeling will help to prevent used antifreeze from accidentally being contaminated with other wastes.

Student Handout

Module 6

—Wastewater and Floor Drain Sludge

The purpose of Module 6 is to introduce students to pollution prevention options for shop wastewater and floor drain sludge.

Module 6 Objectives:

When students have completed this module they should be able to:

1. Identify good management practices and pollution prevention options for managing wastewater and floor drain sludge.
2. Identify options for wastewater management in the absence of a sanitary sewer connection.
   - Arrange for connection to city sewer when possible.
   - Use a holding tank to save and reuse water.
   - Use a water recycling system.
   - Use only dry floor cleaning methods.
   - Clean vehicles at a commercial car wash.
3. Identify the potential contaminants found in shop wastewater and floor drain sludge.

Wastewater From Vehicle Maintenance Facilities

Wastewater from vehicle maintenance facilities is generated from washing vehicles and from floor washing. This wastewater contains soaps, grease and oil, and possibly solvents, fuel and antifreeze. Floor drain wastewater should not be discharged directly to a ditch, stream, river or any other body of water. Untreated wastewater that goes directly to a stream or river can cause the water to be unsuitable for drinking or recreational purposes, and can kill fish and other aquatic life.

Know Your Drains

Know where all of the drains in the shop empty.

Type of Drain	Where Drain Discharges
City Sewer	Local wastewater treatment plant
Storm Drain	A ditch, nearby stream or other body of water
Septic Drain	On-site septic tank

Wastewater Disposal

Wastewater should be discharged to the city sewer. Wastewater discharged to the city sewer goes to the local wastewater treatment plant where it is treated before being discharged to surface water. Industrial discharges (including vehicle maintenance-related wastewater) should be approved by the local wastewater treatment plant authority. It is illegal to discharge ignitable solvents, petroleum products and certain solids to the city sewer.

Before discharging wastewater, solids and oil have to be removed. Wastewater should go to a sump where the solids settle to the bottom and the oil separates by floating to the top. Oil can be removed by using an oil skimmer. Most oil skimmers operate by using an oil-attracting material that is put in or run over the top of the water to absorb oil only. Once separated, the oil should be put into the used oil storage container. Solids settling to the bottom of the sump or drain area are called sump sludge or floor drain sludge. The sludge can be contaminated with oil, lubricants, antifreeze, fuel, cleaners and solvents. Floor drain sludge may be hazardous.

Never discharge industrial wastewater (even vehicle washwater) to storm drains or directly outdoors. Such discharges may cause environmental harm such as surface water and groundwater contamination and is in violation of federal and state law.

Do not discharge industrial wastewater to a septic system. Septic systems are designed for domestic sewage. Industrial discharges may kill necessary bacteria in the septic tank and/or cause overloading.

Never discharge hazardous waste to a septic system. This is illegal disposal and could result in expensive groundwater contamination and regulatory problems.

Wastewater Pollution Prevention

Helpful Tips to Prevent Water Pollution

- Use only mild soaps to clean floors and vehicles instead of hazardous solvents.
- Read MSDS sheets (Module 1) for cleaners prior to purchasing to eliminate corrosive or toxic cleaners.
- Prevent drips and spills from reaching the floor (Module 2).
- Clean spills immediately, preferably using a dedicated mop and bucket or launderable rags (Module 2).

Never clean spills by hosing them down with water.

Perform vehicle maintenance work in areas with no floor drains, or seal drains during work temporarily or permanently to prevent spills from contaminating wastewater. Store hazardous wastes and hazardous materials away from drains. If this is not possible, cover drains in hazardous material storage areas.

Water Conservation

Save water. Use as little water as possible for floor or vehicle cleaning by:

- Using dry floor cleaning methods such as sweeping and vacuuming.
- Using water efficiently. Use only as much water as is absolutely necessary.
- Shut the faucet off when you are not using the water. Consider installing pressure-reducing, water-saving devices on faucets.
- Collect water in a holding tank and reuse it for preliminary cleaning.
- Wastewater goes to a sump where solids settle out. Collect this water in a holding tank where it can be pumped out and used for the preliminary cleaning of vehicles.

Options to manage wastewater if your shop is not connected to the city sewer

- Collect water in a holding tank, reuse the water to its fullest extent, and haul to the local wastewater plant for disposal (if the water is nonhazardous and the wastewater plant will accept it).
- Treat water on site with a water recycling unit. Treated water should be reused for vehicle cleaning. Even treated wastewater requires a permit for outdoor discharge.
- If the water is nonhazardous, evaporate water on site using evaporating equipment. The resulting sludge will require a hazardous waste determination.

Floor Drain Sludge Management

Floor drain sludge is made up of dirt, grit and road grim that collects at the bottom of floor drains, sumps and settling tanks. This sludge may accumulate in the service area, the car wash bay area, or wherever wastewater is discharged. Floor drain sludge is potentially hazardous because it may contain oil, solvents or other chemicals present in vehicle maintenance shops. The only way to know for sure if sludge is hazardous is to send a sample to a laboratory for hazardous waste testing (Module 1).

Hazardous sludge must be disposed of by a hazardous waste management company.

Nonhazardous sludge can be managed in one of the following ways:

- Dried until no free liquids remain and sent to a landfill with the proper permits. Sludge can be dried by spreading it on an impermeable surface, such as concrete, or by placing it in a drum and periodically mixing.
- Disposed of by a sump cleaning company. Be sure to know what the sump service is doing with the sludge.
- Spreading sump sludge directly on the ground (land spreading) should be avoided as it may cause environmental contamination. Local or state agencies may require testing and monitoring for land spreading wastes.

Floor Drain Sludge Pollution Prevention

- Use only mild soaps to clean floors and vehicles instead of hazardous solvents.
- Prevent drips and spills from reaching the floor.
- Clean spills immediately, preferably using a dedicated mop and bucket or launderable rags.
- Never clean spills by hosing them down with water.
- Perform vehicle maintenance work in areas with no floor drains, or seal off the drains during work temporarily or permanently to prevent spills from contaminating wastewater.
- Store hazardous wastes and hazardous materials, such as parts wash solvent, away from drains. If this is not possible, seal drains in hazardous material storage areas.

Pollution Prevention Questionnaire

Wastewater and Floor Drain Sludge

1. Are the drains in your shop area connected to:
____ The city sewer
____ A septic system
____ The storm sewer
____ A combination of the above
____ Other (cistern, cesspool, discharge to a leach field, ditch or stream, etc.)

You should identify where all your drains lead. Many things that are acceptable for discharge to the city sewer are not acceptable for discharge to a septic tank or storm sewer. Confer with your school plant services or other personnel. Review blueprints or city sewer maps. You may need to contact the local wastewater treatment plant authority for assistance in tracing drain discharge points.

2. What types of activities generate wastewater at your facility?
____ Floor washing
____ Vehicle washing
____ Other

3. What type of cleaner do you use for floor and vehicle cleaning?
____ Petroleum-based solvent
____ Non-toxic soaps
____ Water alone

Only non-toxic cleaners should be used to wash floors and the exterior of vehicles. Petroleum-based solvents should never be discharged to a drain. Refer to the MSDS sheet for the cleaner.

4. Do you discharge wastewater from the shop area to a septic tank or storm sewer?
____ Yes____ No

Untreated wastewater from the shop area may contain oil, solvents, antifreeze and other hazardous materials and should not be discharged to a septic tank or outdoors (either directly or through a storm sewer).

5. How do you dispose of sludge that collects in the floor drain(s)?
____ Septic tank cleaning company hauls it to a wastewater treatment plant
____ Dried and landfilled
____ Land applied
____ Other method

Sludge from shop area drains may contain oil, solvents, antifreeze and other hazardous materials. It is subject to a hazardous waste determination prior to disposal. Hazardous sludge should only be managed by a hazardous waste management company. Land application of hazardous sludge is illegal. Land application of nonhazardous sludge should follow all applicable regulations. (If you are using a septic tank cleaning company, make sure they follow these regulations for disposal of your sludge).

Student Handout

Module 7

— Automotive Air Conditioning Repair

The purpose of Module 7 is to instruct students on proper methods for performing service to automotive air conditioning units. The goals of pollution prevention for refrigerant usage are to:

Minimize refrigerant vented to the atmosphere, and
Use effective alternatives to R-12.

Module 7 Objectives:

When students have completed this module they should be able to:

1. List the negative environmental effects of ozone depletion.
2. Manage refrigerant properly when servicing air conditioners.
   - Evacuate refrigerant from the AC system before servicing to avoid accidental releases.
   - Avoid topping off leaking systems.
   - Visually inspect hoses, connections and condensers.

Goals of Pollution Prevention for Automotive Air Conditioning Repair

Refrigerants containing chlorofluorocarbons are suspected of contributing to the depletion of the stratospheric ozone layer. This ozone layer protects humans against skin cancer by blocking harmful ultraviolet light. For this reason, refrigerants such as R-12, which is commonly used in vehicles, have been phased out of production. This includes R-12, which is commonly used in vehicles. The venting of refrigerants is banned by federal regulations. Most service shops are using refrigerant recycling equipment which is required by law to service vehicle air conditioners.

Minimize Refrigerant Venting

Refrigerant should not be vented to the atmosphere. Refrigerant reclaiming units must be used during air conditioning (AC) servicing to decrease the possibility of refrigerant loss. Use independently approved equipment certified to the SAE standard J-1990 to evacuate and recharge AC systems. EPA notification and certifications are required. Consult the local environmental assistance agency or the state environmental agency for details of regulations and requirements for your state.

To prevent refrigerant loss during service, evacuate all refrigerant prior to maintenance or repair of air conditioning systems. Manifold hoses must have a shutoff valve located at the end of each line to prevent leakage. If an air conditioning system comes into the shop leaking refrigerant, evacuate the system immediately.

Make it a policy to encourage customers to repair rather than "top off" leaking systems. Note that topping off a leaking system will result in unnecessary refrigerant loss. Repairing a system will protect the environment and lessen the need to purchase R-12, which is rising in cost. Instead, find the leak and take corrective measures prior to recharging the system.

Avoid using products containing R-12 designed to be used in-system to find leaks. Use such products only as a last resort. Many air conditioning system leaks can be detected with a simple visual inspection of the hoses, connections and condenser. If visual inspection does not expose the problem, use an electronic sniffer to detect the leaks. Do not use R-12 or leak detection products containing R-12 to find leaks in an R-34a system.

When recharging, do not use small (12 ounce) disposable containers of refrigerant. The cans cannot be reused, and are not equipped with a shutoff valve. Any unused refrigerant remaining in the can will be lost as waste. In addition, the price per pound of refrigerant is much less when purchased in bulk.

Storage of Refrigerants

To help avoid leaking of stored refrigerant, use only DOT or UL approved containers. Label containers to indicate the type of refrigerant stored. Avoid mixing storage containers for different types of recycled refrigerants, since this could cause cross contamination. Segregate any refrigerant that has been contaminated and store it in a specifically labeled container. Send mixed refrigerants to a reclamation center to be separated and purified.

Alternative Refrigerants

The phase out of R-12 has brought an influx of alternative refrigerants and refrigerant blends. Prior to using an alternative, make sure it is acceptable according to the regulations and the manufacturer of the vehicle.

Since many new refrigerants and blends are not compatible with the R-12 or R-134a, it is important to ensure that the system being serviced does not contain a mix of refrigerants. If a system contaminated with another refrigerant is evacuated into the reclaimer, all refrigerant contained in the unit will be contaminated and must be sent to a refrigerant reclamation facility.

Determine which type of refrigerant is used in a vehicle prior to servicing. A label under the hood should identify refrigerant type. Otherwise, a device is available on the market to identify refrigerant in a system as R-12, R-134a, or unknown.

Some alternative refrigerants on the market today contain liquefied petroleum (LP) gas. The refrigerants can cause contamination and pose a significant explosion risk. Air conditioning technicians should be aware of these dangers and take precautionary measures. It is best to avoid the uses of such refrigerants.

Retrofitting

By the end of 1995, all major manufacturers stopped production of R-12. Although there should be enough R-12 to keep current systems operating for several years, as supplies of R-12 diminish, some of these systems will need to be retrofitted to use alternative refrigerants such as R-134a or MP52. When retrofitting, it is important to remember that new refrigerants have characteristics and compatibilities with other products that must be addressed.

The lubricants used in R-12 (mineral oils) are not compatible, and should not be used in retrofitted system. Some lubricants used with R-134a and MP52 are highly hygroscopic (soak up moisture), and should have limited exposure to the atmosphere. Be sure to check manufacturer's instructions for use and storage of lubricants.

Make sure all system O-rings are compatible and functional with the replacement refrigerant. R-134a runs at a higher pressure and temperature range and may exceed the range of some O-rings. Some compressor shaft seals may also need to be replaced when retrofitting. Contact the compressor manufacturer to make this determination. If the seals do need to be replaced, use only seals made of compatible materials that will withstand the operations temperature of the replacement refrigerant.

Always Check with Air Conditioning Manufacturers

When in doubt as to proper retrofitting procedures, always consult the air conditioner manufacturer. Retrofitted systems should be relabeled and proper fittings installed to prevent the accidental contamination of the system with other refrigerants. If proper retrofitting procedures are not followed, loss of refrigerant, personal injury or a poor operating system may result.

Pollution Prevention Questionnaire

Automotive Air Conditionng Repair

1. Do you perform air conditioning repair at your shop?____ Yes____ No

2. Do you use refrigerant recovery equipment when performing all air conditioning repairs?

____ Yes____ No

It is illegal to vent R12 and R134a refrigerant. All air conditioning repairs must be performed using approved equipment that removes refrigerant from the system for recycling.

3. Are the service technicians who perform air conditioning repairs certified to do so?

____ Yes____ No

According to federal law, all air conditioning repair work must be performed by technicians who are certified to use refrigerant recovery equipment.

4. Do you commonly "top off" leaking air conditioning systems for customers?

____ Yes____ No

It is not a good pollution prevention practice to top off leaking air conditioning systems. Customers should be made aware of the environmental hazards and rising cost of refrigerant, and encouraged to consider repairing the air conditioning system instead.

Student Handout

Module 8

— Batteries

The purpose of Module 8 is to instruct students on the proper management for batteries and will introduce the student to the environmental problems related to mismanagement of batteries.

Module 8 Objectives:

When students have completed this module they should be able to:

1. Describe the potential environmental and health problems associated with improper management of lead acid batteries.
2. Store and recycle batteries properly.

Contaminants from Batteries

Lead acid batteries contain lead and corrosive acid. If batteries are not handled properly, these hazardous wastes can leak out and contaminate the environment. Lead will accumulate in soils, and in surface and groundwater. Fish and wildlife can be harmed and even killed. When levels of lead accumulate in human tissue, brain damage and other developmental problems may result.

Good Battery Storage

Store new and used batteries safely to prevent contamination from leaks. The storage area should have secondary containment made from an acid-resistant material (plastic or concrete, for example) and be indoors if possible. Secondary containment is a structure that will contain waste (lead and acid) if the batteries leak. Batteries stored outdoors should be protected from the rain, either by having a roof overhead, or by covering the batteries with plastic or another waterproof material.

Do not stack batteries since they may fall and crack. Store batteries and battery acid away from flammable liquids, ignition sources and drains.

Used Battery Recycling

Used batteries should be recycled through a reputable recycling company. Most battery suppliers have an exchange program where they pick up used batteries when dropping off new ones.

Shops that generate used lead acid batteries are responsible for pollution caused by batteries off site as well as on site. As with any other hazardous material recycling, the shop should question the battery collector it is using and know that the batteries are being safely transported and recycled.

Pollution Prevention Questionnaire — Batteries

1. Where are used batteries stored?

_____

Used batteries should be stored on an acid-resistant surface that provides secondary containment in case of accidental leaks. Indoor storage is preferable to protect batteries from the weather. Freezing and thawing can cause batteries to crack, and rainwater can spread contaminants from a spill.

2. Are batteries stacked on top of each other?____ Yes____ No

Stacking batteries should be avoided since this can cause them to fall over and crack, or crack under the weight of other batteries.

3. Are batteries recycled?____ Yes____ No

Used lead acid batteries are exempt from most hazardous waste regulations if they are recycled. Most battery suppliers offer a battery exchange program where used lead batteries are accepted when new ones are purchased. Batteries can also be recycled directly through a recycler.

Student Handout

Module 9

— Collision Repair - Surface Preparation

The purpose of Module 9 is to introduce alternatives to using hazardous, high-VOC (volatile organic compound) solvents to clean vehicles in preparation for painting.

Module 9 Objectives:

When students have completed this module they should be able to:

1. Reduce hazardous waste during surface preparation.
   - Pre-wash dirt and grime from vehicles using water or a soap and water mixture.
   - Use water-based cleaners whenever possible for subsequent cleaning to remove tar, grease, wax, etc.
   - Only when necessary, use low-VOC solvent-based cleaners sparingly to remove excess silicone, tar and grease.
2. List the wastes generated from vehicle surface preparation.
3. Properly dispose of vehicle washing wastewater.

Pollution Prevention in Surface Preparation

The surface of a vehicle must be clean prior to refinishing so that undercoats and/or topcoats will adhere to it. Many cleaners commonly used to remove surface contamination contain toluene, which is an EPA-listed hazardous waste and a volatile organic compound (VOC). The use of hazardous solvents should be avoided whenever possible. Here are three basic tips to reduce solvent waste in surface preparation.

1. Prewash dirt and grime from vehicles with water or a soap and water mixture.
2. Use water-based cleaners when possible for subsequent cleaning to remove tar, grease, wax, etc.
3. If necessary, use solvent-based cleaners as a last resort to remove stubborn silicone, tar and grease. Additional cleaning operations should be performed using water-based cleaners.

1. Prewash using soap and water

Much of the contamination on the surface of a vehicle is dirt that should be washed off using water alone, or a mild soap and water mixture. Not only are soap and water safer for the environment than hazardous solvents, they are also less expensive.

Don't forget to conserve water when washing vehicles – use only the amount of water necessary. And remember, don’t discharge untreated wastewater outdoors. Discharge wastewater to the city sewer.

2. Use water-based cleaners

After washing with mild soap and water, there may be grease, tar, wax or other contaminants remaining on the vehicle. Use water-based cleaners whenever possible for subsequent cleaning to remove stubborn contaminants. Water-based cleaning products have been developed as a substitute for hazardous solvents. These water-based cleaners are stronger than traditional car wash soap, but not as toxic as petroleum-based solvents.

Prior to cleaning, make sure that the cleaning product is compatible with the surface to be cleaned.

Note that many water-based cleaners are not recommended for use on water-based or acrylic lacquer finishes. Consult the product manufacturer for specific information.

3. Use solvent-based cleaners as a last resort

If waterborne cleaners prove unsatisfactory, solvent-based cleaners may be necessary to remove heavy silicon and grease contamination. When solvent-based cleaners must be used, do so sparingly. Don't use more solvent than is necessary. Replace the lid on the solvent containers when not in use. Keep solvent-laden dirty rags in a closed container prior to disposing of them properly (through a hazardous waste management company if necessary). If possible, avoid painting sequences that would require multiple pre-paint cleaning operations. For example, apply the undercoat after performing operations that could contaminate the surface with grease or oil. A contaminated undercoat will have to be washed again.

Wastes Generated in Surface Preparation

Wastewater

Wastewater generated from vehicle cleaning operations may contain oil, dirt, soaps and solvents. This wastewater can pollute soil, groundwater, lakes and streams, and should not be discharged outdoors, to a septic system, or to a storm sewer. Avoid washing vehicles outdoors where wastewater can run off onto soil or into a storm sewer. Instead, discharge the wastewater to a wastewater system with a sump that removes oil and solids before releasing the wastewater to the city sewer. Oil should be removed from the wastewater and put in the used oil container. Oil removal can be accomplished when the wastewater settles in a sump - solids will settle to the bottom, oil will float to the top, and water will be discharged to the sanitary sewer. If an oil/solids separating sump is not present, oil skimming equipment can be purchased.

Sludge

The solids that settle out from wastewater form a sludge. This sludge may be hazardous if hazardous wastes (such as solvents) have been put down the drain. This is one reason not to use hazardous solvents for vehicle cleaning. Hazardous sludge should be disposed of by a hazardous waste management company.

Rags

Rags used for surface preparation are potentially hazardous because they may be contaminated with grease, paint and solvents. All rags (disposable and launderable ones) that are contaminated with hazardous solvents should be stored in sealed containers to prevent evaporation of solvent vapors into the air. If possible for your application, reduce waste by using launderable cloth rags instead of disposable ones for surface cleaning. Launderable rags are not considered a waste if they are cleaned through a contractual agreement with a commercial laundry and reused.

If it is not possible to use cloth rags, and disposable rags must be used, they should be classified as hazardous or nonhazardous prior to disposal. Hazardous used rags should be stored in sealed containers and disposed of by a hazardous waste management company. Nonhazardous rags can be landfilled. Make sure rags are appropriately sized for the job – cutting rags in half or in quarters can reduce waste.

Pollution Prevention Questionnaire — Collision Repair - Surface Preparation

1. What type of cleaners are used to wash vehicles? Refer to MSDS sheets for information.

General Vehicle Cleaning_____

Surface Preparation_____

Vehicles should be prewashed with water alone or with water and mild soap. Water-based cleaners should be used whenever possible. If petroleum solvents are necessary for cleaning, use them sparingly.

2. Where are vehicles washed?_____ indoors_____outdoors

Do not discharge vehicle wash wastewater outdoors or to storm sewers. Wash vehicles in an area where wastewater is discharged to the city sewer - but be sure to remove oil and solids from the wastewater first.

3. What type of rags are used for cleaning?

_____launderable rags_____disposable rags

Use launderable cloth rags for cleaning if possible. If disposable rags are used, cut them in half or quarters to reduce waste. (Note: Laundered shop rags may contain contaminants that make them unsuitable for vehicle washing and surface preparation.)

Student Handout

Module 10

—Spray Equipment Cleaning

The purpose of this module is to introduce pollution prevention and waste management technologies to reduce solvent use and reduce VOC emissions during paint gun cleaning operations.

Module 10 Objectives:

When students have completed this module they should be able to:

1. Reduce waste during spray equipment cleaning.
2. Understand the pollution prevention advantages of using an enclosed mechanical gun wash system.
3. Minimize solvent used during manual gun cleaning.

Manual Gun Cleaning Processes

Equipment cleaning generates a great deal of unnecessary waste if not done properly. In manual gun cleaning, solvent is exposed to the air during most of the cleaning operation, and much of it evaporates. Approximately 20 percent of VOC's (volatile organic compounds) released from auto refinishing occurs during equipment cleaning operations. This figure reflects the volume of organic solvents emitted to the atmosphere during conventional equipment cleaning (purging) procedures. The majority of commercial spray equipment cleaners found on the market today are made entirely of organic solvents.

Proper cleaning and maintenance of spray equipment has always been an essential part of achieving a quality finish. This is especially true with newer high transfer efficiency spray technologies. These new spray guns are machined to very close tolerances and are highly susceptible to dried paint or other obstructions that can affect the performance of the gun.

Manual Cleaning Processes

Prior to the introduction of paint gun cleaning systems, all spray equipment was cleaned by hand using the following basic steps:

- All paint is removed from the cup.
- The air hose and cup is removed, the gun is triggered to remove all remaining paint from the siphon tube.
- The cup is rinsed with a small amount of thinner.
- Clean thinner is poured into the cup and reattached to the gun.
- With the air supply reattached, the thinner is sprayed through the gun to

remove any paint remaining in the interior orifices. During this process, the operators finger is place over the fluid tip several times while spraying to backwash the gun.

- The cup is removed and thinner poured out.
- The outside of the gun and the inside and outside of the cup is wiped down using a rag or paper towel.
- The air cap is removed and cleaned with a cleaning brush. A cleaning brush is also used to clean other external moving parts and behind the trigger.
- The gun is reassembled and returned to the storage area. Many painters remove the air cap from the gun and place it in the cup. A small amount of thinner is left in the cup so the cap can soak during storage.
- A metal object is used to clean the small passageways and often results in severe damage which greatly reduces the efficiency of the spray gun.

From this description, it is easy to understand how 20 percent of VOC's are generated during the manual cleaning process.

Mechanical Enclosed Gun Cleaning System

Within the last few years the mechanical gun wash system has gained popularity in the refinishing industry. Mechanical gun washers provide a safe, quick way to effectively clean paint equipment, including HVLP and LPLV spray guns. In general, the mechanical cleaning process follows these basic steps:

- Remove all the remaining paint from the cup.
- With the air hose removed, pull the trigger of the gun to remove all remaining paint from the siphon tube and/or from the fluid passages inside the gun.
- Rinse the cup with a small amount of thinner.
- When cleaning pressure cup systems, place a small amount of solvent in the cup and connect to the air line to pressure the cup. Disconnect the air line from the gun, purge the gun, and drain the solvent into the hazardous waste storage drum.
- Place the disassembled gun (with all pressure gauges removed) in the gun washer. For siphon or pressure cup-type guns, the siphon tube is placed on the cleaning jet, and the gun trigger is locked open using a locking plate. For gravity-feed guns, the gun is placed upside down with the fluid orifice on the cleaning jet.
- Close the lid and turn the washer on.
- Let the washer run for the manufacturer's recommended amount of time (often only 1 - 3 minutes). Then the gun and parts are ready to be removed and used again. Don't forget to shut the lid after using the gun washer to prevent solvent evaporation.

- With proper use and maintenance, these systems can reduce the amount of thinner used during the cleaning process by more than 50 percent (some manufacturers boast a 75-90 percent reduction). Mechanical systems also reduce the labor time needed for equipment cleaning by over 60 percent.
- VOC emissions from enclosed gun washing systems have yet to be accurately measured, but the reduction should be substantial.
- To further reduce air emissions, use cleaning solvents that are low in volatile organic compounds (VOCs). In high volume shops, two gun wash systems can be used. Use the first system for initial cleaning, and the second for final cleaning. When the final cleaning solvent becomes too dirty, switch it to use for pre-cleaning. When the pre-cleaning solvent becomes too dirty, it should be recycled.

Wastes from Mechanical Cleaning Systems

Paint sludge from the dirty equipment will collect in the gun washer and must be removed on a regular basis to keep the washer in good working order. This sludge is hazardous and thus should be stored in a closed container that is labeled "hazardous waste," and disposed of through a hazardous waste management company. Cleaning solvent that becomes laden with paint can be recycled either on site or off site and be reused (Module 3).

A summary of the advantages of mechanical gun wash systems are:

- Reduced employee exposure to hazardous solvents
- A reduction in the amount of thinner necessary for cleaning by 50 percent or more
- Save time spent gun cleaning by up to 60 percent over manual cleaning
- Reduced VOC emissions

Improved Manual Gun Cleaning

Manual gun cleaning processes can use up to three times the solvent as the same operation performed in an enclosed gun wash system. However, if an enclosed gun cleaning system is not available, guns must be cleaned manually. When spraying solvent through the gun, spray into an enclosed backdrop or container to catch solvent for reuse or recycling. Take precautions to avoid solvent spraying back onto the person cleaning the gun. To reuse dirty solvent, store the solvent in a closed container to let the solids settle to the bottom. Then pour off the clear solvent and save it to use it again for cleaning. Be sure to properly store and dispose of the paint waste that settles to the bottom.

If passageways are clogged, use a broom straw or a soft wood toothpick to clear them. Do not use metal objects to clear passageways as this can enlarge the spray orifices, reducing spray efficiency.

Pollution Prevention Questionnaire — Spray Equipment Cleaning

1. How are guns cleaned?

____Manually____ Enclosed gun cleaner____ Open gun wash system

Enclosed gun cleaners are recommended over manual gun cleaning to reduce waste, reduce employee exposure to hazardous solvents, and save time spent cleaning guns.

If guns must be cleaned manually, do so against an enclosed backdrop or onto an enclosed container to catch solvent waste. Collect solvent and let solids settle to the bottom. Pour off clean solvent and reuse. Store and dispose of paint solids using a hazardous waste management company.

Student Handout

Module 11

— Solvent and Paint-Related Wastes

The purpose of Module 11 is to teach students how to reduce solvent and paint-related wastes during automotive spray painting.

Module 11 Objectives:

When students have completed this module they should be able to:

1. Identify paint-related (contaminated) waste.
2. Reduce solvent waste, paint waste and paint-related waste in auto collision repair activities.
   - Eliminate evaporation.
   - Use proper spray techniques.
   - Define transfer efficiency (TE).
   - Demonstrate knowledge of spray techniques that improve transfer efficiency (TE).
   - Understand how mixing systems can reduce paint waste.
3. List methods to recycle or reuse solvent.

Wastes Associated with Automotive Painting

Wastes from painting operations include waste paint and solvent and all materials contaminated with paint including:

Used paint booth arrestors (also called exhaust filters)
Disposable rags
Masking tape and paper
Floor sweepings
Disposable mixing cups and sticks
Disposable paint strainers

Minimize the Amount of Painting Waste:

- Use reusable mixing cups and sticks and wash them in a mechanical gun wash system.
- Where possible, use cloth rags that are cleaned by a laundry service and returned.
- Improve transfer efficiency. When transfer efficiency is improved, more of the coating is applied to the vehicle, and less paint and solvent are lost into the air and/or onto booth arrestors or as overspray on masking.
- Recycle solvent on site with a solvent distillation unit.
- When a solvent distillation unit is not available, let waste solvent sit in a drum until the paint solids settle to the bottom. Pour the solvent off of the top and reuse it for precleaning equipment.
- Keep all solvent container lids tightly closed except when adding or removing material.

- Use a mechanical gun wash system to reduce solvent waste.
- Keep track of the type and quantity of materials used on different types of vehicles to better estimate future jobs.
- Use a material usage tracking form.

Minimize the Hazardous Nature of Paint-related Wastes

- Use undercoats and topcoats that contain no heavy metals. (Heavy metals = arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver.)
- Use low-VOC paint and solvent products.
- Use water-based coatings when practical.

Disposal of Paint-related Wastes

Liquid paint and solvent waste should be managed as a hazardous waste. This means it should be stored in sealed containers labeled "Hazardous Waste " and disposed of through a hazardous waste management company.

Dry paint-related wastes (such as used paint booth arrestors, disposable rags, floor sweepings, etc.) are potentially hazardous because they may contain heavy metals (lead, chromium, etc.) and solvents. If these wastes are landfilled, hazardous materials may leach out of the waste into the groundwater. According to federal regulations, all industrial wastes must be determined hazardous or non-hazardous before disposal. Wastes determined to be hazardous must be managed as a hazardous waste.

Transfer Efficiency

A common reason for excessive paint and solvent waste is poor transfer efficiency. Transfer Efficiency (TE) is the ratio of the mass of solids (in the paint) reaching the surface being coated to the mass of solids sprayed. The higher the transfer efficiency, the less paint that is wasted in overspray.

$$\text{Transfer Efficiency} = \frac{\text{Mass of Coating (Solids) Sprayed}}{\text{Mass of Coating (Solids) Applied}}$$

Factors Affecting Transfer Efficiency

Many factors affect transfer efficiency. Some are under the control of the spray operator and some are not. For example, the operator has no control over the size and shape of the parts sprayed, atmospheric conditions, or the finish quality requirements. The following factors can be controlled by the spray operator:

- Spray equipment type
- Gun set up
- Spray angle
- Spray distance
- Spray techniques
- Spray equipment maintenance and practices

Improving Spray Technique

Studies have shown that operator spray technique is the most important element in achieving a good transfer efficiency. A skilled operator should be able to adjust spraying style and gun set up with each job according to the type of coating sprayed, the weather conditions (heat and humidity), the size and shape of object being coated, and the spray equipment used. Following are some suggestions to improve spray technique for better transfer efficiency:

Spray Equipment Type

Consider spray equipment that provides a better transfer efficiency.

Newer spray equipment has been developed that has the capability to achieve a higher transfer efficiency than conventional siphon feed spray guns. One type of spray gun that can provide improved transfer efficiency is the high-volume/low pressure (HVLP). Low pressure/low volume (LPLV) guns also provide good transfer efficiency. LPLV guns require a lower volume of air, and thus a smaller air compressor than HVLP guns.

In order to choose the best spray equipment for your application, you need to first determine how much you can afford to spend and what types of coatings you will be spraying. Next, consult your paint representative to determine which type of gun will work best with the product(s) you will be using. Choose the spray equipment that will achieve the highest transfer efficiency while providing the required atomization properties within your price range. Be sure to use the proper fluid tip/air cap combination and gun settings for the material being sprayed. Consult your paint or spray gun representative for assistance.

Always remember that a paint gun is only as good as the operator using it. Even if a particular spray gun has the potential to have a high transfer efficiency, this will only be achieved if the operator sets up the gun properly and uses proper spray techniques.

Gun Set-up

Choose the correct size of fluid tip-air cap combination. The fluid tip size is determined by the viscosity of the coating. Viscosity is measured using a Zahn cup measuring system.

Choice of air cap depends of the fluid tip size. Generally, spray gun manufacturers will give recommendations for what air cap should be used with a fluid tip.

Set the air pressure at the lowest possible setting that will provide the required degree of atomization. Never exceed the coating manufacturer's recommended air pressure settings.
Keep records of gun set ups used with each type of coating to reduce set up time and material wasted during set up.

Spray Angle

Always hold gun perpendicular to the surface being sprayed, using parallel strokes. Do not arc the gun except when performing blending operations or panel spotting.

Study your spray pattern. Make sure the pattern is uniform and the coating is atomized properly.

Spray Distance

Hold the spray gun at an appropriate distance from the surface being sprayed. Usually this distance is between 6 and 8 inches, but some gun and coating combinations may require a distance as close as 4 inches.

Make sure gun distance is kept constant throughout the coating operation.

Use a 50 percent overlap for each pass, feathering the trigger at the beginning and end of each pass. Note: This technique may need to be altered slightly when applying high metallic, high solids base coats and some three stage systems.

Spray Techniques

When painting small and medium sized panels, make each pass the full length of the panel. If possible spray larger panels in the same way, walking the length of the panel. If the panel cannot be done using this method, use a comfortable stroke, with a 4 - 5 " overlap of the strokes.

If blending is necessary, keep the blend area as small as possible without jeopardizing appearance.

Spray the border edges of the substrate first (banding). This will assure all edges are covered without extending the spray pattern well beyond the borders of the object.

Have a “plan of attack”:

> Before you start spraying, know how you are going to perform the operation. Do a “dry run” before you spray to practice your spraying strategy.

Spray Equipment Maintenance and Practices

Maintain equipment in clean and good working order to ensure proper atomization and a full, consistent spray pattern.

Mixing Systems

The addition of an in-house paint mixing system can greatly reduce the material costs of topcoat applications while increasing productivity. Payback times on such systems will depend mainly on the refinishing production rate of the facility. Paint mixing systems have the following benefits:

- Lower material costs of the topcoat per volume
- The ability to mix only the amount of topcoat required for the specific job

- The ability to track the amount of coating each technician mixes per job
- The ability to add mixing colors as needed to assure color match (increases the ability to accurately duplicate the pigmentation of the original finish)
- Reduces the dependency on the paint supplier, i.e. mixing or tinting coatings as needed

Proper use and maintenance of these systems is very important. If mixing colors are not properly sealed, or if the colors are not agitated adequately, cost and productivity benefits could be lost. The following precautions should be taken when operating these systems:

- Always agitate the mixing colors for an adequate time period prior to removing material from any container in the mixing system.
- Make sure all the agitators are operating properly.
- Make sure the mixing container covers are properly sealed at all times.
- Keep a good inventory of the tinting colors on hand to reduce over or understocking of materials.
- Regularly calibrate the scale to insure accuracy.
- Double check the paint code on the vehicle and the code in the mixing formulation prior to beginning the mixing operation.
- Carefully add mixing colors, verifying the tint and amount to be added.
- Only mix the amount of color needed for that specific job.
- Use spray out panels as a tool to insure proper match of the next job with the same color code.
- If the option is available, monitor the amount each technician is mixing for each job.

Pollution Prevention Questionnaire — Solvent and Paint-Related Wastes

1. What type of paint-related waste do you generate?

_____ used paint booth arrestors
_____ floor sweepings
_____ masking
_____ disposable rags
_____ mixing cups
_____ other

2. How do you dispose of paint-related wastes?

_____ sanitary landfill _____hazardous waste management company
_____ other

Only nonhazardous paint-related wastes may be disposed of in a sanitary landfill. Hazardous paint-related wastes must be disposed of by a hazardous waste management company. Contact your local regulatory agency for information on determining whether a waste is hazardous or nonhazardous.

3. What type of spray gun(s) do you use?_____

Using high volume, low pressure (HVLP) guns properly may increase transfer efficiency. Consult your paint manufacturer.

Student Handout

Module 12

— Reducing Air Emissions

The purpose of Module 12 is to introduce methods to reduce air emissions in automotive collision repair.

Module 12 Objectives:

When students have completed this module they should be able to:

1. List the factors that affect air emissions from auto body refinishing operations.
2. Explain how transfer efficiency affects air emissions.
3. Understand why a paint booth equipped with paint arrestors reduces emissions.
4. Identify and select low VOC materials.
5. Be familiar with dust collection systems.

Air Emissions from Auto body Repair Activities

There are two basic kinds of air emissions from auto body repair painting activities:

Volatile Organic Compounds (VOCs) and
Particulate (solids)

Volatile Organic Compounds (VOCs) – Volatile means the compounds "evaporate rapidly at a low temperature." VOCs are chemicals such as paint thinner that evaporate rapidly and can contribute to the formation of smog in the lower atmosphere. A Material Safety Data Sheet (Module 1) is an excellent source of information for VOC content of any chemical product.

Particulate make up the solid part of paint that contains the binder, pigments and other additives. Some paint particulate are easy to see in the air, while others are not. Nonetheless, all particulate decrease the air quality of our environment.

Factors Affecting Air Emissions

1. Paint Booths

To control particulate, painting should be performed inside a paint booth that is equipped with paint arrestors and a ventilation system sufficient to draw the air from the booth through the arrestors. Paint arrestors are filters that remove paint particles from the air before exhausting the air outside. Painting inside a booth is also important since the incoming air can be filtered to remove dust that can ruin a finish.

2. Transfer Efficiency

Improved transfer efficiency means that less paint is wasted to overspray or air emissions. Transfer efficiency can be improved by improving spraying techniques,

and by using equipment that is capable of a higher transfer efficiency for certain applications (Module 11).

3. Closed Solvent Storage Containers

Reduce evaporation by keeping all solvent containers (both new and waste) sealed shut when not adding or removing material. Keep used solvent-soaked rags in closed fire-proof waste containers.

4. Sanding/Blasting

Waste from sanding and blasting is potentially hazardous because it is contaminated with paint. One way to control these emissions is to use portable sandblasters with a vacuum attachment. Vacuum attachments collect dust and keep the air in the shop cleaner. Not only is the worker's exposure to dust reduced, but less dust reaches the outdoor air where it can potentially cause pollution problems.

5. Choice of Coating Materials

Air emissions from painting can be reduced by choosing low VOC, high solids surface coating materials. VOC content is normally listed on Material Safety Data Sheets (MSDSs).

Recommendations to Reduce Air Emissions from Auto Body Repair Activities

Following are some recommendations to reduce air emissions and waste for each phase of auto body surface coating:

Prep Coats

Use versatile products such as epoxy primers or self-etching primers. These may alleviate the need for additional surface coating operations such as primer-surfacing or primer-sealing.

If a self-etching primer or epoxy primer is not an acceptable alternative, use a wash-primer or metal conditioner conversion coating system.

Primer-Surfacer

Minimize the number of coats applied.

Ensure that all major body imperfections are removed prior to priming operations (i.e. do not use a primer as a body filler).

Use a primer gun with the correct fluid tip/air cap combination for each particular type of primer-surfacer.

If the curing time of waterborne products is too long, consider using versatile urethane primers.

Perform body work using a minimal amount of primer-surfacer.

If a clear sealer is used, make sure the primer-surfacer is a color that is easily covered with the desired topcoat. (Be aware that with transparent topcoats, the color of the undercoat may affect the color match of the topcoat).

Primer-Sealers

Use low VOC urethane primer-sealers as an alternative when possible.

Choose primer-sealer in a color that is easily covered with the desired topcoat, or choose a tintable primer-sealer and tint it to an easily-covered color shade.

Sealers

Choose a sealer appropriate for each specific job.

If filling capabilities are required, use a primer-sealer in place of a sealer.

Choose a primer-sealer of a color that can be easily covered with the coating to be sprayed, or choose a tintable primer-sealer.

Topcoats

Mix color coats in-house, making certain the formula for the proper shade of the specific color code is used. This will help avoid the need for blending the finish to achieve a satisfactory color match.

Keep good records of paint match information, including spray-out cards and detailed notes. Use record keeping to help determine how much material should be mixed for the job.

Avoid the use of lacquer-based topcoats.

Choose low VOC topcoats that require fewer than three coats to achieve adequate coverage (polyurethane or urethane).

Apply only the number of coats needed to achieve a quality finish.

Use high solids/low VOC clears to topcoat color coats.

Keep the addition of paint additives to a minimum.

Pollution Prevention Questionnaire — Reducing Air Emissions

1. Is all painting performed in a paint booth?____ Yes____ No

Painting should be performed in a paint booth so that emissions can be controlled.

2. Are solvent containers kept tightly sealed except when adding or removing material?

____ Yes____ No

Solvent and used solvent-soaked rags should be kept in air-tight containers to prevent air emissions through evaporation of solvents.

3. Is a dust collection system used for sanding/blasting operations?____ Yes____ No

Dust (vacuum) collection systems can be used to reduce worker exposure to dust and to reduce the amount that enters the outside air.

4. What is the VOC content of all paint supplies being used? Can the VOC content be reduced?_____

Products with high VOC content contribute to air emissions. Find alternative low-VOC products as replacement whenever possible. Vendors and suppliers can assist with identifying a desirable substitute.

Student Handout

Module 13

— General Pollution Prevention Practices

The purpose of Module 13 is to identify general pollution prevention opportunities in an automotive shop.

Module 13 Objectives:

When students have completed this Module they should be able to:

1. Identify general pollution prevention opportunities in the shop.
   - Buy in bulk whenever practical.
   - Buy reusable products.
   - Use inventory control.
2. Begin a recycling program for metal, plastic, cardboard and paper, and rubber waste (tires, hoses, belts, etc).
3. Complete the recycling loop by purchasing and using recycled content products.

Option for Pollution Prevention Practices

General Waste Reduction

General wastes commonly found at vehicle maintenance shops include:

- Aerosol cans
- Paper
- Cardboard
- Plastic
- Rubber
- Metal

Options for Pollution Prevention Practices

- Buy in bulk
- Buy reusable or refillable product instead of disposable
- Reuse materials
- Inventory control
- Recycle
- Buy recycled

Pollution Prevention Steps

Buy in Bulk

Buying products in bulk reduces packaging waste. Since the customer pays for packaging, products bought in bulk are usually less expensive than products packaged in small individual containers.

Examples:
Purchase antifreeze and oil in drums instead of small single-use plastic containers. Drums can be fitted with hand pumps for easy and clean dispensing. Often many different kinds of oil are used, making bulk purchasing more difficult. If this is the case, consider limiting the number of brands purchased, or purchasing the most popular kinds of oil in drums.

When refillable spray cans are purchased (see below), materials such as parts cleaners and lubricants can be purchased in bulk.

Buy Reusable or Refillable Products Instead of Disposables

Replacing disposable items with reusable ones always reduces waste and can save money.

Aerosol cans are used for many applications including on-vehicle parts washing and lubrication. Replace disposable aerosol cans with refillable spray cans. When refillable spray cans are used, product is bought in bulk and compressed air is used as the propellant.

Replace disposable oil absorbent by using drip pans to catch drips before they reach the floor. A mop and bucket can be used to clean spills. The fluid that is recovered should be recycled or disposed of properly. For example, used oil should be placed in the used oil barrel.

Use launderable cloth shop towels instead of disposable paper towels.

Use refillable tanks for welding gas instead of disposable tanks.

Reuse Materials

Reuse materials as many times as possible before throwing them out. If materials cannot be reused on site, see if a local business could use them.

Examples:
Repair broken parts and equipment when possible. For example, cracked plastic parts may be able to be welded.

Reuse cardboard boxes and other packing materials for shipping. Often local manufacturers or craft stores need extra packing materials or boxes.

Cut up waste office paper to reuse as note pads.

Control Inventory

Inventory control is important to reduce waste and to ensure that hazardous wastes are disposed of properly.

Use “just-in-time” purchasing when appropriate.
Just-in-time purchasing is buying materials just before they are needed. This can reduce waste from expired materials that have a short shelf life or are not used very often. Also, don’t forget to rotate stock and use materials on a first-in-first-out basis.

Streamline materials purchased.
Minimize the number of different types of products purchased. For example, use one type of cleaning solvent instead of two or three, and use multi-purpose materials when possible.

Each waste has its specific disposal or recycling requirements. Limiting the number of different types of materials can reduce waste and make disposal or recycling easier and less expensive. When employees or students bring in materials from home, this can create an additional waste stream that the shop will have to dispose.

Keep records of materials purchased.
Keep track of the amount of materials purchased. This will help show where there are waste reduction opportunities. It will also help measure reduced waste after pollution prevention steps have been implemented.

Keep track of materials used by each person or department. This can be accomplished by having everyone sign materials out. If one person or department is using more materials than another, this may mean that more training in waste reduction is necessary.

Return defective or outdated materials to the supplier.
Ask your suppliers to take back defective and outdated materials. Return defective materials to the supply room immediately so they can be returned to the supplier promptly.

Recycling

Wastes that cannot be reused or eliminated should be recycled. Recyclable materials include:

- Office paper
- Cardboard (not oil-soaked)
- Plastics (used oil and antifreeze bottles, etc.)
- Metal wastes (parts, empty cans, etc.)
- Rubber waste (tires, belts, hoses etc.)

Wastes can be recycled by contacting your waste hauler or a local recycling center. State and local recycling assistance programs can help you identify markets for your recyclables as well as set up a recycling program.

Office Paper – Office paper usually must be separated by color to be recycled. Staples and paper clips must be removed.

Cardboard – Cardboard usually must be baled prior to being picked up for recycling. For companies that generate very large quantities of waste cardboard, it may be economical to purchase a baler. Smaller generators can arrange to take their cardboard to a local business that has a baler, such as a grocery store or manufacturer. Note that recyclers may reject cardboard stained with oil, paint or other materials.

Plastics – Plastics must be separated by type (high density polypropylene, polyethylene, etc.). If an identification code is not stamped on the product, contact the manufacturer to determine the type of plastic. Drain all liquids from plastic bottles before recycling. Many recyclers will not accept plastic bottles that contain residues, especially oily residues.

Metal Waste – Metal waste includes parts, used oil filters (Module 4), and empty steel cans. Most metal waste can be recycled through a scrap dealer. Since many scrap dealers will not accept metal contaminated with other waste, empty cans may have to be cleaned out first. Enclosed gun washers (Module 10) can be used for quick cleaning of empty paint cans.

Rubber Waste

Tires – Approximately 275 million tires are thrown away each year in this country - that's over one tire per person. Reclaimed rubber from tires can be recycled into new products such as retread tires, floor mats, surfaces for playgrounds or running tracks, shoe soles, dock bumpers, etc. Rubber from tires can also be mixed with asphalt for paving roads or burned for energy recovery. Since used tires are such a valuable resource, look for a tire management company that recycles tires, rather than disposing of them. Note that if tires are landfilled, they must be shredded.

Other Rubber Waste – Other rubber waste includes various belts and hoses. This waste can also be recycled into new rubber products. Hoses should be completely drained of all liquids prior to recycling. If no recycling options exist in your area, hoses and belts may be landfilled as long as they are not contaminated with hazardous materials. If contaminated, the hoses and belts should be tested to determine if they are hazardous. Hazardous waste must be disposed of through a hazardous waste management company.

On-site Collection of Recyclables

Waste that will be recycled should be collected on site and separated. For example, white paper should be separated from colored paper, and different types of plastics should be kept separate. Labeled containers should be available for each type of recyclable.

Note: Specific instructions on exactly what can be recycled and how the materials must be separated depend on the requirements of your particular recycling program.

Avoid messes in recycling collection areas. Drain bottles into appropriate containers before putting them in recycling bins. For example, empty oil bottles should be drained.

Buy Recycled

Buying recycled products helps to "close the recycling loop." This means that in order to be able to make recycling possible, there must be a demand for recycled products. This demand is created when companies purchase and use recycled

products. Examples of items that can be made from recycled materials are paper (for office documents, receipts, etc.), plastics, antifreeze, oil, etc. Ask your supplier if they offer recycled products. If necessary, contact your state or local recycling assistance program for more information on companies that sell recycled goods.

The Recycling Loop
Waste Fuel and Fuel Filters

Fuel

When fuel is removed from a vehicle being repaired it should be stored in an approved fuel container. When the repairs are finished, return the fuel to the vehicle. It may be necessary to filter the fuel first. Dispose of filtered sediments as a hazardous waste unless they have been proven nonhazardous through laboratory TCLP testing.

Waste fuel that cannot be reused should be stored in approved containers labeled "Hazardous Waste" and disposed of through a hazardous waste management company.

Fuel Filters

Waste fuel filters are potentially hazardous because of ignitability or toxicity due to benzene, lead or other contaminants. Hazardous fuel filters must be recycled or disposed of as a hazardous waste by a hazardous waste management company.

To reduce waste, nonhazardous fuel filters should be recycled. Some used oil filter recycling companies also recycle fuel filters. Contact used oil filter recycling companies to find one that accept fuel filters.

Note: Do not crush fuel filters using a used oil filter crusher as this may cause a fire or explosion.

To determine whether or not used fuel filters are hazardous, send a representative sample to a laboratory to be tested for the following parameters:

- Ignitability
- Benzene and lead using the Toxicity Characteristic Leaching Procedure (TCLP) test

If the filters are not ignitable, and the results of the TCLP test are below regulatory levels, the filters are nonhazardous.

If the filters are ignitable, and/or any TCLP test result exceeds regulatory levels, the filters are hazardous.

Waste Log

The purpose of this log is to identify wastes for reduction or recycling. Include plastic, glass, metal, paper, cardboard and any other waste you find.

Type of Waste	Quantity	Options
Ex: #2 black plastic oil bottles	15/week	Buy in bulk
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Pollution Prevention Questionnaire — Solvent and Paint-Related Wastes

1. List the types of waste you throw away. Include the amounts of each waste.

Cardboard_____

Plastic (list different types)_____

Paper_____

Glass_____

Other_____

Wastes should be reduced where possible. Packaging wastes can be reduced by buying in bulk. Wastes that can not be reduced or eliminated should be recycled.

2. Do you keep records of materials purchased and used? ____ Yes____No

It is important to keep records to help track where waste is being generated, and to measure waste reduction efforts.