

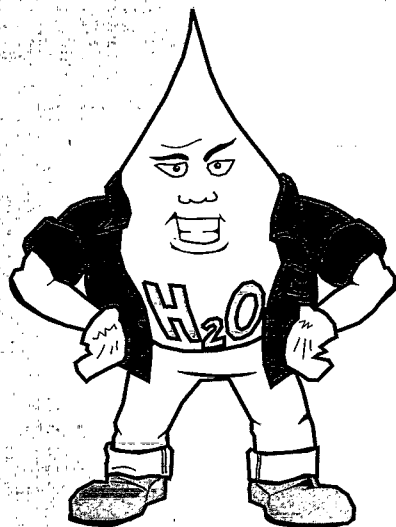


THE POLLUTION PREVENTION TOOLKIT

Best Environmental Practices for Fleet Maintenance

**Cost-effective strategies to improve
environmental performance
and worker safety.**

**Complete with diagrams, examples
and additional help contacts.**

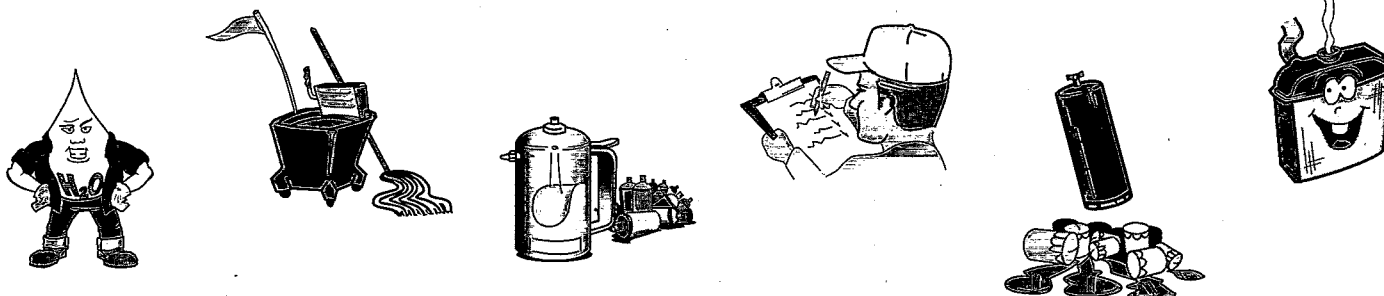




November 1999

PROFIT THROUGH PREVENTION

Best Environmental Practices for Auto Repair and Fleet Maintenance



Getting Started

The step-by-step instructions in this fact sheet can help you reduce waste, avoid regulatory problems, and save money! This fact sheet is the first in the "Pollution Prevention Tool Kit," a series of fact sheets highlighting the Best Environmental Practices for auto repair shops and fleet maintenance facilities. This fact sheet contains the following information:

- Step-by-step instructions for reducing your waste generation
- Tables to help you assess your waste stream volumes and costs before and after implementing the recommended practices
- References to other fact sheets in the series that contain detailed information on recommended practices
- Specific guidance on how common auto repair and fleet maintenance shop wastes are regulated.

How to Minimize Your Waste Generation Now

Use the table on page 2 to inventory your current practices and waste streams. Then refer to the recommended Best Environmental Practices described in the fact sheets cited on page 3. Test and implement as many recommended practices as possible, and then re-inventory your waste streams on page 3.

If you reduce your total monthly volume of hazardous waste to less than 220 pounds or 27 gallons, you will have significantly fewer hazardous waste regulations to comply with.

Remember that a hazardous waste may never be discharged into a sanitary sewer, storm drain, ditch, dry well, or septic system!

Is your waste hazardous?

You are ultimately responsible for determining whether the wastes generated in your shop are regulated as hazardous wastes. You can apply your knowledge of shop operations and of the materials you use to determine whether a waste is regulated as a hazardous waste. If you suspect that a waste may be hazardous but are not sure, either assume that it is hazardous and pay for proper waste disposal or recycling, or have the waste tested to get a definitive determination.

Local laboratories and hazardous waste disposal companies can sample and test a waste for you using approved methods. The test results will tell you whether the waste is hazardous or not. If it is not hazardous, and if both the chemicals and process you use to generate that waste do not change, you can rely on the test results for that one sample as proof that the waste is not hazardous in the future. That is, the waste generated by the process in the future will be assumed to have characteristics similar to the current waste. Make sure to keep a copy of each test result in your files in case a hazardous waste inspector ever questions your waste determination.

Your air emissions and sanitary sewer discharges are regulated by your local air district and sewer agency, respectively. You should consult them about air and sewer discharge requirements.

REDUCING YOUR WASTE = FEWER HAZARDOUS WASTE REGULATIONS

Large Quantity Generator (LQG)	→	Small Quantity Generator (SQG)	→	Conditionally Exempt Small Quantity Generator (CESQG)
2,200 lbs or 275 gallons or more per month		220 to 2,200 lbs or 27 to 275 gallons per month		220 lbs or 27 gallons or less per month
5 drums or more per mo.		1/2 drum to 5 drums		Less than 1/2 drum
At least 78 regulations		At least 67 regulations		Just 3 regulations! (see back page for details)

STEP 1: Calculate your current generator status

Complete the worksheet below to identify and quantify hazardous wastes now leaving your shop.

Process	Traditional Practice	Waste Stream	Is Waste Hazardous? (use notes below)	Amount per Month Quantity of Hazardous Waste	Disposal Cost
Parts Washing	Solvent Service	Waste Solvent ^A			
Coolant Changing	Off-site Recycling or Disposal	Waste Antifreeze ^B			
Brake Washing	Aerosol Spray Cans	Waste Cans ^C			
	Solvent Service	Waste Solvent ^D			
Lubricating and Spot Cleaning	Aerosol Spray Cans	Waste Cans ^C			
		Used Rags or Paper Towels ^E			
Floor Cleaning	Disposable Rags or Paper Towels	Used Rags or Paper Towels ^E			
	Dry Absorbents	Used Absorbent ^F			
	Hosing With Water ^H	Trap or Separator Sludges ^G			
	Cleaning Service	Wash or Mop Water ^I			
Other Processes		Waste Gasoline, etc.			
Determine your generator status by adding up the quantity of all hazardous wastes (Multiply gallons by 8 to convert to pounds)					
Determine your monthly waste management costs for all waste streams					

Waste Stream Regulatory Guidance for "Traditional" Practices

- ^A Waste solvents and solvent sludges are generally hazardous unless testing demonstrates otherwise.
- ^B Waste antifreeze may be hazardous depending on its metal concentration. In a 1999 federal survey of sampling studies, about half the waste antifreeze samples proved to be hazardous wastes. If waste antifreeze is hazardous, you may not discharge it into a sanitary sewer, storm drain, ditch, dry well, or septic system. Some states exempt recycled waste antifreeze from hazardous waste regulations. If you recycle waste antifreeze in such a state, do not count it as a hazardous waste. Otherwise, test your waste antifreeze or count it as a hazardous waste.
- ^C Used aerosol cans should be disposed of in trash or recycled as scrap metal if they are completely empty. Dispose of used aerosol cans as hazardous waste if they are not empty and their contents are hazardous. Do not count empties as hazardous waste.
- ^D Spent brake washing solvent is very likely to be a hazardous waste.
- ^E Used rags and paper towels are very likely to be a hazardous waste if they are contaminated with gasoline or solvent. If the solvent product used contained an F-listed chemical at a 10 % or greater concentration, the contaminated rags or towels will be a hazardous waste (See "What is an F-listed Chemical" on page 4). If solvent on rags or towels is not an F-listed chemical, use your knowledge or test the rags or towels to determine whether they are hazardous. If they are hazardous, it is illegal to dispose of them in trash. Have used rags laundered (recycled) by an industrial laundry, or dispose of them as a hazardous waste.
- ^F Used absorbents soaked with waste oil are not federally regulated, unless they are also contaminated with hazardous wastes. Some states regulate oily wastes and may count oil-soaked absorbents as hazardous waste, unless recycled in accordance with state law.
- ^G Sludges from traps and oil/water separators may contain heavy metals or solvents. Test sludges at least once to determine whether they contain heavy metals or solvents.
- ^H Wash water or mop water is generally not counted as a hazardous waste. However, if wash or mop water meets the criteria for a hazardous waste, it may not be placed in a sanitary sewer. For example, washing gasoline into the drain would be illegal disposal of a hazardous waste (waste gasoline is hazardous because of its ignitability and benzene content). Even if it is not hazardous waste, wash or mop water must meet sewer discharge requirements limiting its oil and grease content, etc. Check with your sewerage agency for requirements.

Note: Used oil; brake, transmission, and hydraulic fluids; oil filters; refrigerant from air conditioning systems; and batteries are not addressed here because if they are recycled in accordance with state and federal laws, they are not counted as hazardous wastes when determining generator status. If your shop does not recycle these materials, follow state laws.

STEP 2: Implement as many best practices as you can

Refer to the enclosed fact sheets.

**STEP 3: Calculate your new generator status**

After implementing as many Best Practices as possible, recalculate your waste volumes and costs.

Process	Best Practice	Waste Stream	Is Waste Hazardous? (use notes below)	Amount per Month Quantity of Hazardous Waste	Disposal Cost
Parts Washing	Aqueous Spray Cabinet, Ultrasonic unit, Microbial Sink-top, or Immersion unit	Waste Filters ¹ Waste Aqueous Solution ¹			
Coolant Changing	On-site or Off-site Recycling	Sludges or Resins ^k Waste Filters ^l			
Brake Washing	Aqueous Brake Washing	Waste Solution ¹			
Lubricating and Spot Cleaning	Refillable Spray Bottles	Used Rags or Paper Towels ^e			
Floor Cleaning	Spill Prevention and Dry Cleanup Methods	Used Rags or Paper Towels ^e Mop Water ^m Used Absorbent ⁿ			
Other Processes		Waste Gasoline, etc.			
Determine your new generator status by adding the monthly quantities of all hazardous wastes. (Multiply gallons by 8 to convert to pounds) Compare the total quantity to the Step 1 total.					
Estimate your new monthly waste disposal costs for all waste streams. Compare the total cost to Step 1 total.					

Waste Stream Regulatory Guidance for Best Practices

¹ Waste metal filters should be recycled with oil filters as a "hazardous waste-exempt scrap metal waste"; other waste filters should be disposed of as a hazardous waste or tested. In one study, one out of two filters tested positive as a hazardous waste because of the presence of lead.

¹ Waste aqueous solution should be shipped off site as a hazardous waste or tested. In two studies, 75 percent of waste aqueous solutions tested positive as hazardous wastes because of their lead and cadmium concentrations. Microbial solutions may last for years. Extend solution life by pre-cleaning parts with a rag, filtering, and removing oil.

^k Antifreeze recycling sludges or resins should be shipped off site as a hazardous waste or tested. In a 1999 federal survey of sampling studies, about half the waste antifreeze samples proved to be hazardous wastes due to metals content. Antifreeze recycling sludges and resins are likely to contain even higher concentrations of metals than waste antifreeze.

^l Antifreeze recycling filters made of metal should be recycled with oil filters as a "hazardous waste-exempt scrap metal waste"; for nonmetal filters, make your own determination based on your process knowledge or testing.

^m Mop water should be nonhazardous and can be disposed of in a sanitary sewer, provided that all floor spills are first cleaned up using dry cleanup methods. If the floor drain is capped, pour the mop water into a sink or flush it down a toilet (local sewer agency approval is required). Mop water and other waste material should never be discharged to a storm drain, ditch, dry well, or septic system.

ⁿ Used absorbent should be used only to clean up gasoline or solvent spills; in emergency situations; or for cleanup of old, pitted shop floors. Test the used absorbent or use your knowledge of what was spilled to determine whether the used absorbent is hazardous. Absorbent saturated with gasoline or solvents will very likely be a hazardous waste.

Note: Used oil; brake, transmission, and hydraulic fluids; oil filters; refrigerants from air conditioning systems; and batteries are not addressed here because if they are recycled in accordance with state and federal laws, they are not counted as hazardous wastes when determining generator status. If your shop does not recycle these materials, follow state laws.

What "CESQG" Means to Your Shop

If you generate less than 220 pounds per month of hazardous wastes (about 27 gallons of a liquid with the same weight as water), you officially become a CESQG. CESQGs have significantly fewer hazardous waste requirements to comply with and many more waste management options. In addition to local air pollution regulations and wastewater discharge rules, a CESQG need comply with only three basic hazardous waste management requirements:

- 1) Identify all hazardous waste you generate;
- 2) Do not store more than 2,200 pounds (275 gallons) of hazardous waste on site at any one time;
- 3) Legitimately use, reuse, or recycle your waste on site, or ensure delivery of your hazardous waste to one of the following:
 - A state or federally regulated hazardous waste treatment, storage, or disposal facility (TSDF)
 - A facility permitted, licensed, or registered by the state to manage municipal or industrial solid waste
 - A facility that legitimately uses, reuses, or recycles the waste or treats the waste prior to its use, reuse, or recycling
 - A household hazardous waste collection center run by your state or local government, if available.

Note: Some states require CESQGs to meet other requirements, such as obtaining an EPA identification number or further restricting disposal options. Call your state hazardous waste agency for CESQG information.

What is an F-Listed Chemical?

An F-Listed chemical is a chemical that makes each waste it contaminates a hazardous waste no matter what its concentration in the waste is. Even one drop of an F-listed chemical on a shop rag, in absorbent, or in used oil or antifreeze is enough to make a regulated hazardous waste.

Find out which products in your shop contain F-listed chemicals, and be very careful not to contaminate your wastes with them. Check the Material Safety Data Sheet (MSDS) for each product you use. If the product is an aerosol or liquid solvent (parts cleaner, brake cleaner, etc.) and has any of the following chemicals in it at a concentration of 10 percent or more, all waste streams contaminated by the product must be properly managed as hazardous wastes: acetone; methanol; 1,1,1-trichloroethane; methyl ethyl ketone; methyl isobutyl ketone; xylenes; benzene; ethyl benzene; toluene; perchloroethylene; trichloroethylene; and dichloromethane (methylene chloride).

"The Pollution Prevention Tool Kit is a great resource for our industry. Repair shops can realize significant compliance benefits and cost savings by following the sound recommendations provided."

—Larry Moore, Past President, Automotive Service Councils of California

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).

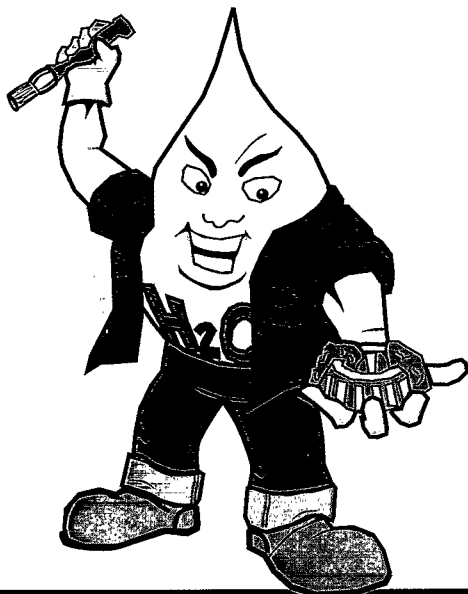


These fact sheets were produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program.



AQUEOUS PARTS CLEANING

Best Environmental Practices for Fleet Maintenance • November 1999



DISSOLVING THE MYTHS ABOUT AQUEOUS CLEANING

Myth

1 Aqueous cleaning units do not clean parts as well as solvent units.

2 Aqueous cleaning units cannot clean transmissions or carburetors.

3 Part rusting is a problem.

4 Aqueous cleaning is expensive.

5 Aqueous cleaning wastes are a hassle to manage.

Fact

Aqueous spray cabinets and ultrasonic units can clean even difficult-to-clean parts such as wheel bearings.

Ultrasonic units can effectively clean transmissions and carburetors, including hidden areas.

Rust inhibitors in aqueous cleaners decrease the chances of rusting. Rusting can be further minimized by drying parts immediately after cleaning.

Most facilities can save money by 1) implementing aqueous spray cabinets to reduce cleaning labor and 2) maximizing aqueous solution life.

Waste aqueous solution with sludge typically requires disposal less than three times per year. Skimmed oil can be recycled along with used oil. Spent filters can be disposed of off site or sometimes recycled along with used oil filters.

What's wrong with solvents?

Mineral spirits is a solvent commonly used for part cleaning because of its ability to quickly dissolve oil, grease, dirt, grime, burnt-on carbon, and heavy lubricants. Although it is effective for cleaning, mineral spirits raises significant environmental and human health concerns:

- Mineral spirits contains volatile organic compounds (VOC) that contribute to smog formation and may be toxic when inhaled.
- Mineral spirits evaporates quickly, making worker exposure difficult to control.
- Solvent cleaning units are usually a facility's greatest source of hazardous waste.
- Some areas of the country have already restricted use of solvents in parts cleaning operations.

Using solvents creates unnecessary environmental, worker health, and fire liabilities for your organization. Minimize your costs and regulatory liabilities by switching to aqueous solutions.

What is an aqueous cleaner and how does it work?

Aqueous cleaners are water-based solutions that, unlike petroleum-based solvents, are typically nonflammable and contain little or no VOCs. Instead of dissolving grease and solids, aqueous cleaners rely on heat, agitation, and soap action to break dirt into smaller particles. Although they clean differently, aqueous cleaners perform as well as solvents.

For this fact sheet, aqueous cleaners are defined as water-based cleaners that contain less than 5% (50 grams per liter) of VOCs. Hundreds of aqueous cleaner formulations are commercially available. The California South Coast Air Quality Management District maintains a list of aqueous solutions that are certified to contain less than 5% of VOCs; this list is available on the Internet at www.aqmd.gov/tao/cas/prolist.html. Information presented in this fact sheet is derived from studies of more than 20 aqueous cleaning units in use at over 30 vehicle maintenance facilities in California.

Types of aqueous cleaning units

The cleaning equipment used is critical to successful aqueous cleaning because it applies two important mechanisms to the cleaning process: mechanical force and heat. Four types of aqueous cleaning units—microbial sink-top, spray, immersion, and ultrasonics—are described below. Each type of unit is designed for specific cleaning applications; therefore, most facilities will likely meet all their cleaning needs by implementing more than one type of unit.

Microbial sink-top units: Best for quick, light-duty cleaning

Aqueous sink-top units are used for manual cleaning of parts in the same way as conventional solvent sink-top units. Microbes present in the aqueous solution degrade oils and organic contaminants, significantly extending solution life. In addition, microbes are safe and pose no risk to technicians. Non-microbial aqueous sink-top units are also available; these units generally require more frequent solution changes, which may increase operating costs relative to microbial units.

Applications

- Preventive maintenance and light-duty cleaning
- Parts with light to moderate soil buildup
- Small quantities of parts
- Parts for immediate replacement on a vehicle

Key Features

- Solution heated to 110 to 120°F
- Filtering available to remove solids
- Microbes degrade oily contaminants

Advantages

- Low capital cost relative to other aqueous cleaning units
- Little or no waste solution
- Does not dry or chap technician's hands

Disadvantages

- May require more scrubbing effort than solvent
- Difficult to clean heavy or stubborn soils
- Keeping microbes alive requires proper worker training

Unit Selection Considerations

- Make sure the unit is at a comfortable height for your workers
- Greater sink-top size allows larger parts to be cleaned
- Higher pump pressure improves cleaning action
- Workers may react negatively to certain odors

Cost: \$1,000 to \$1,500

Spray cabinets: For heavily soiled or large volumes of parts

Aqueous spray cabinets clean parts by spraying high-temperature solution at high pressures within an enclosed cabinet. Spray cabinets are available in a full range of capacities from small to extremely large.

Applications

- Parts with heavy or difficult-to-remove soils
- Moderate to very large quantities of parts
- Medium to large sized parts
- Heavy-duty repairs and rebuilding

Key Features

- Solution heated to 130 to 190°F
- Spray pressures of 40 to 60 pounds per square inch
- Oil skimming options
- Solution concentration typically maintained between 10 and 15%

Advantages

- Significant reduction in cleaning labor
- High level of cleaning performance
- Large cleaning capacities available
- Lower waste management costs compared to solvent units

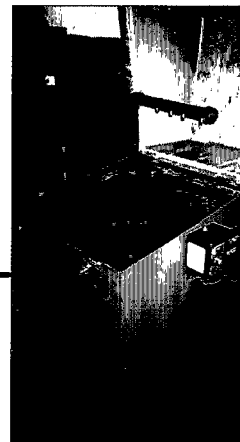
Disadvantages

- Moderate to high cost

Unit Selection Considerations

- Pump power, spray pressure, flow rate, and number of nozzles (higher spray pressures and greater coverage result in better cleaning performance)
- A 220-volt outlet is often required
- Temperature adjuster helps to optimize cleaning performance
- Insulated units are more energy efficient

Cost: \$1,700 to \$11,500



Selecting the right type of unit for your facility

Most fleet maintenance facilities require more than one type of aqueous unit to meet their cleaning needs. For example, a facility may maintain walk-up sink-top cleaning stations for clean-and-replace operations, as well as a centrally-located spray cabinet for cleaning heavily soiled or large parts. If the facility services transmissions or carburetors and does not subcontract the cleaning of these parts, the facility may also require an ultrasonic unit. After converting to aqueous cleaning, most facilities have fewer cleaning units because spray cabinets and ultrasonic units typically can handle a large number of parts.

Immersion units:

When soak option is needed

Immersion units consist of a rectangular tank filled with aqueous solution and a removable false bottom. Immersion units give technicians the option of soaking parts in the aqueous solution below the false bottom to loosen soils on the parts or manually scrubbing parts on top of the false bottom, as performed in a sink-top unit.

Applications

- Parts with light to moderate soil buildup
- Small to moderate quantities of parts
- Light- to medium-duty repairs

Key Features

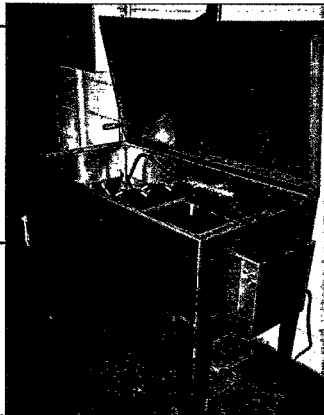
- Allows soaking of parts
- Solution heated to 110 to 120°F
- Filter and oil skimming options
- Solution concentration typically maintained between 25 to 30%

Advantages

- Soaking can improve cleaning and reduce scrubbing time

Disadvantages

- More expensive than sink-top units
- May be difficult to clean heavy or stubborn soils



Unit Selection Considerations

- Make sure unit is at a comfortable height for your workers
- Greater size allows larger parts to be cleaned
- Workers may react negatively to certain odors
- Unit available in stainless steel or plastic construction

Cost: \$1,700 to \$3,500

Ultrasonic units:

Clean blind areas

Ultrasonic units consist of a steel tank filled with an aqueous solution and are equipped with transducers along the bottom or sides of the tank. The transducers generate high frequency sound waves that produce an intense microscopic scrubbing action on parts surfaces, including blind holes and interior surface areas.

Applications

- Transmissions, carburetors and other hard-to-clean parts
- Parts with blind holes and hidden surface areas
- Heavy-duty repairs and rebuilding

Key Features

- Transducers generate ultrasonic waves
- Solution heated to 140 to 185°F
- Filter and oil skimming options

Advantages

- Very high performance cleaning
- Ability to clean hidden areas on parts
- Significant reductions in cleaning labor

Disadvantages

- High cost
- Some units make a "hissing" noise



Unit Selection Considerations

- Greater ultrasonics power provides better cleaning ability
- A 220-volt outlet is required for some units
- Greater unit size provides more cleaning capacity

Cost: \$5,000 to \$12,000

Maximizing aqueous solution life

Aqueous cleaning solutions last longer than solvents. Further extending the life of an aqueous solution will save you money by reducing your chemical purchase and waste disposal costs. To maximize aqueous solution life, you should:

Use microbe technology for sink-top units. Solutions for these units have very long lives and with proper use rarely require disposal.

Filter the solution. Filters, typically cartridge filters, are used to remove solids as small as 50 microns in size.

Perform oil skimming. Oil skimmers remove free-floating oil from the solution, reducing the amount of oil residuals left on parts and significantly extending solution life. Microbial units do not need oil skimming because microbes degrade the oil.

Accept solution discoloration. Many aqueous solutions turn gray or brown during use, but this discoloration does not affect its cleaning ability. Do not change your cleaning solution just because it looks dirty.

Change the solution only when necessary. Change the solution only when its cleaning performance declines. Do not change the solution on a scheduled basis. Always dispose of cleaning solution appropriately.

Maintain solution concentration. Perform chemical additions as needed to maintain the cleaning strength of your solution. Some vendors offer easy-to-use test kits to measure the concentration of your solution and determine when chemical additions are necessary.

Recycle your solution using microfiltration. Some vendors offer an on-site microfiltration recycling service that removes contaminants from the solution, eliminating waste solution generation and disposal.

Did You Know?

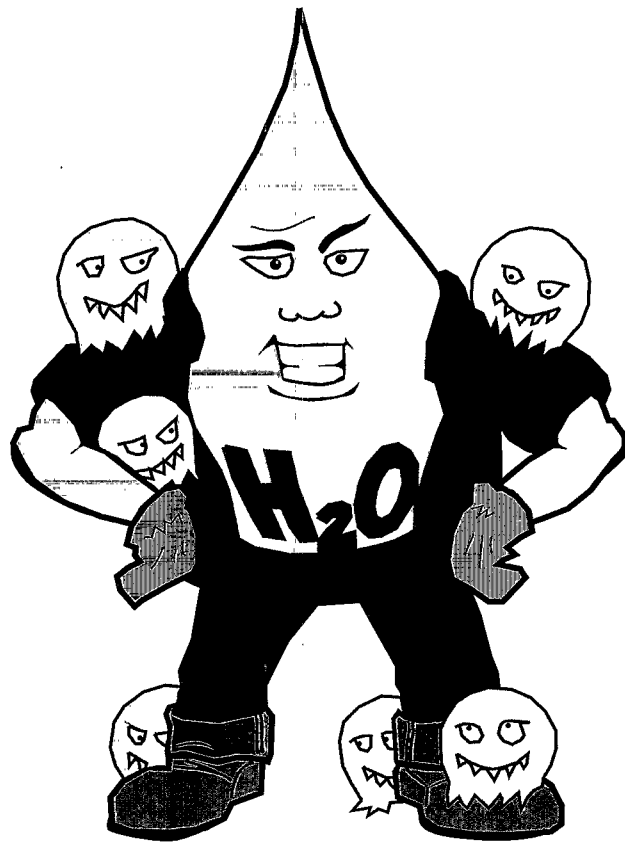
Your greatest cost for parts cleaning is labor. The time your workers spend cleaning parts is time they could otherwise use for servicing vehicles. Spray cabinets reduce cleaning labor by as much as 75 percent.

convenience

"I can put wheel bearings covered in heavy grease in the spray cabinet, turn on the machine, and go back to work. When I come back and pull out the bearings, they're all clean."

—Mark Foti

MUNI technician, San Francisco, California



Killing your microbes will result in an unpleasant odor, oil accumulation in your solution, or loss of cleaning performance.

Be sure to keep your microbes alive and happy!

Keeping your microbes alive and well

Maintain solution temperature: Don't unplug your microbial sink-top unit, even overnight. Most microbes require a heated environment to survive.

Don't use aerosols above unit: Solvents from aerosols and other sources may harm microbe populations and contaminate the solution.

Allow time for microbes to adjust to new soils: Microbes will adapt to the type of soils you are cleaning. If the microbe solution does not clean effectively at first, cleaning performance will improve after the microbes adapt and digest the new soils.

Don't overload the unit: Do not pour oils or dump soils into the unit. Sudden loading of concentrated oils and grease may harm the microbes. Very heavily soiled parts should be precleaned by wiping with a rag.

Monitor sludge and oil accumulation: Solids will gradually accumulate at the bottom of the solution, decreasing cleaning performance, and therefore may require removal every several years. Also, an oil layer may accumulate on top of some solutions. If the unit does not have aeration, significant oil accumulation may suffocate the microbes and should be skimmed off.

Aqueous cleaning cost worksheet for fleet maintenance facilities

Complete this worksheet to calculate the costs of replacing solvent cleaning units with one or more types of aqueous cleaning units. Although many facilities may choose to lease aqueous cleaning units, this worksheet uses purchase prices to calculate a payback period.

The sample calculations provided are for a facility with four solvent units that converts to one microbial sink-top, one spray cabinet and one immersion unit. The microbial sink-top handles 30% of the original workload, the spray cabinet handles 50% and the immersion unit 20%.

The values provided in the sample column serve only as an example, as actual cost and savings will vary according to specific conditions.

Start here by determining your current costs for solvent cleaning.

SOLVENT CLEANING (leased units with servicing)	your facility	sample
A Number of solvent units leased		4
B Current cost per service visit per unit		\$90
C Number of times unit serviced per year		26
D Total annual solvent service cost (A x B x C)		\$9,360
E Loaded hourly labor rate of shop worker		\$50
F Total number of cleaning labor hours per week		20
G Total labor cost (E x F x 52)		\$52,000
H Total annual cost for solvent cleaning (D + G)		\$61,360

If you want to implement one or more microbial sink-top units, continue below. If not, skip to the next section.

CONVERSION TO AQUEOUS MICROBIAL SINK-TOP CLEANING (units purchased)	your facility	sample
I Number of microbial sink-top units to be purchased		1
J Purchase price plus installation costs per unit		\$1,400
K Total capital cost of sink-top units (I x J)		\$1,400
L Cost per gallon of aqueous cleaner		\$6
M Estimated aqueous cleaner use per unit per year in gallons		60
N Aqueous cleaner purchase cost per unit per year (L x M)		\$360
O Cost per replacement filter		\$10
P Number of replacement filters per unit per year		12
Q Total cost for replacement filters per unit (O x P)		\$120
R Total number of cleaning labor hours per week		6
S Total annual labor cost (E x R x 52)		\$15,600
T Total sink-top unit operation and maintenance (O&M) cost ((N + Q) x I) + S		\$16,080

If you want to implement one or more aqueous spray cabinets, continue below. If not, skip ahead to the next table.

CONVERSION TO SPRAY CABINET CLEANING (units purchased)	your facility	example
U Number of spray cabinets to be purchased		1
V Purchase price plus installation cost per spray cabinet		\$3,500
W Total capital cost of spray cabinets = U x V		\$3,500
X Cost per gallon of aqueous cleaner		\$6
Y Estimated aqueous cleaner use per unit per year in gallons		240
Z Aqueous cleaner purchase cost per unit per year = X x Y		\$1,440
AA Disposal cost per gallon of spent solution (including sludge)		\$5
BB Gallons of solution per spray cabinet		65
CC Number of solution changes per unit per year		6
DD Total cost for spent solution disposal per unit = AA x BB x CC		\$1,950
EE Number of cleaning labor hours per week (typically reduced up to 80%)		2
FF Total annual labor cost = E x EE x 52		\$5,200
GG Total spray cabinet O&M cost = [(Z + DD) x U] + FF		\$8,590

Proceed to side two to calculate costs for converting to immersion, or ultrasonic units, as well as to calculate your potential cost savings. ➔

Aqueous cleaning cost worksheet for fleet maintenance facilities, continued

If you want to implement one or more immersion or ultrasonic units, continue below. If not, skip to the last table.

CONVERSION TO IMMERSION/ULTRASONICS (units purchased)	your facility	sample
HH Number of immersion/ultrasonic units to be purchased		1
II Purchase price plus installation cost per immersion/ultrasonic unit		\$2,200
JJ Total capital cost of immersion/ultrasonic units (HH x II)		\$2,200
KK Cost per gallon of aqueous cleaner		\$6
LL Estimated aqueous cleaner use per unit per year in gallons		80
MM Aqueous cleaner purchase cost per unit per year (KK x LL)		\$480
NN Disposal cost per gallon of spent solution (including sludge)		\$5
OO Gallons of solution per immersion/ultrasonic unit		30
PP Number of solution changes per unit per year		4
QQ Total cost for spent solution disposal (NN x OO x PP)		\$600
RR Number of cleaning labor hours per week (typically reduced)		4
SS Total annual labor cost (E x RR x 52)		\$10,400
TT Total unit O&M cost = (MM + QQ x HH) + SS)		\$11,480

Summarize your calculations below to determine your potential cost savings and payback period.

RESULTS	your facility	sample
UU Total capital cost of all units purchased (K + W + JJ)		\$7,100
VV Total annual cost savings (including labor costs) (H—T—GG—TT)		\$25,210
WW Payback period (year) (UU/VV)		0.3

Sample parts cleaning cost comparisons

The tables below compare the cost of using an aqueous microbial sink-top unit and a spray cabinet to solvent units.

These costs are based on actual demonstration results at two fleet maintenance facilities.

SOLVENT UNIT VS. MICROBIAL SINK-TOP UNIT	
<u>One Solvent Unit</u>	<u>One Microbial Sink-Top Unit</u>
Annual costs	Annual costs
Leasing, waste management\$1,908	Purchase price (annualized) ¹\$266
Electricity (est.)\$120	Chemicals\$365
Cleaning labor (239 hrs)\$11,950	Filters\$60
<hr/> Total costs\$13,978	Electricity (estimated) ..\$360
	Solution disposal ²\$125
	Cleaning labor (239 hrs)\$11,950
	<hr/> Total costs\$13,126
<hr/>	
Annual Savings: \$852	
¹ Annualized over a 7 year period at 10 percent interest	
² Assumes off-site disposal of 25 gallons of waste solution once per year	

TWO SOLVENT UNITS VS. ONE SPRAY CABINET			
<u>Two Solvent Units</u>		<u>One Spray Cabinet</u>	
Annual costs		Annual costs	
Leasing, waste management	\$3,816	Purchase price (annualized) ¹	\$776
Electricity (estimated) .	\$369	Chemicals	\$510
Cleaning labor (738 hrs)	\$36,900	Solution and sludge disposal ²	\$3,672
Total costs	\$41,085	Electricity (estimated)	\$3,100
		Cleaning labor (221 hrs)	\$11,050
		Total costs	\$19,108
Annual Savings: \$21,977			
¹ Annualized over a 7 year period at 10 percent interest			
² Assumes off-site disposal of 64 gallons of waste solution 6 times per year			

Managing aqueous cleaning wastes

The wastes generated from aqueous cleaning should be managed as described below.

Waste Solution. Aqueous cleaning solutions may qualify as hazardous waste after extended use because concentrations of metals such as cadmium, copper, lead, and zinc may exceed state or federal limits. Therefore, fleet maintenance facilities should always use a licensed waste disposal company to manage waste solution. Many waste disposal companies will analyze the waste solution for you to determine whether it is hazardous. The cost of disposal will vary according to the characteristics of the waste and the volume generated, but will generally be \$2 to \$4 for a gallon if it is a hazardous waste and \$1 to \$2 for nonhazardous waste. Unless you obtain permission from your local sewage treatment agency, do not discharge waste solution to the sewer or septic system.

Used Filters. Used filters may be recycled along with spent engine oil filters with the permission of the recycler. Contact your oil recycler to determine if they will take your filters. Some recyclers will only accept used filters if they are encased in metal shells like engine oil filters, and some states prohibit recycling aqueous filters with engine oil filters. If they are not recycled with engine oil filters, used filters should be managed as hazardous waste and disposed of by a licensed waste disposal company. Contact your state environmental agency to learn if any special rules apply to used filters.

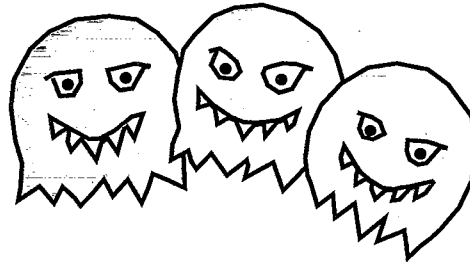
Skimmed Oil. Oil skimmed from an aqueous cleaning solution can be managed as used oil and recycled. Most recyclers will accept skimmed oil with used motor oil as long as it is not contaminated with solvent.

Simple sludge management

Little or no sludge will accumulate in aqueous cleaning units with filtration, but units without filtration may accumulate sludge at the bottom. This sludge may be disposed of along with waste solution. Most waste disposal companies will accept a certain percentage of solids in the waste solution. If the sludge is separated from the solution, the sludge may not be disposed of as solid waste unless tested to determine if it is nonhazardous. To eliminate waste solution disposal, some spray cabinets are available that evaporate the solution, leaving behind a sludge that requires proper disposal. Check with state and local regulators for potential permitting issues associated with evaporation.

Full service lease agreements

Convenience at a cost. Most fleet maintenance facilities enjoy the hassle-free arrangement of full servicing and waste management provided by a solvent management company. Although some aqueous cleaning vendors offer similar servicing and waste management arrangements, most do not, usually because it's not necessary. Here's why:



- Aqueous solutions can last significantly longer than solvents and therefore do not need to be changed as frequently. Even with heavy use, a spray cabinet can clean effectively for as long as 3 months between solution changes. With proper use, microbial sink-top units may clean effectively for several years before requiring solution change.
- Servicing aqueous units requires minimal time and effort. Servicing requirements are shown below.

SERVICING REQUIREMENTS	TIME TO PERFORM AND FREQUENCY
Add water and chemical	For 10 minutes, daily to every 2 weeks
Skim oil (not on microbial units)	For 5 minutes, every 2 weeks to every 2 months
Replace filter	For 5 minutes, every 2 weeks to every 2 months
Drain and replace solution	1 hour, every 2 months to every few years

Self servicing aqueous cleaning units may be easier than you think!

Did You Know?

Numerous vendors offer aqueous cleaning equipment. Before purchasing a unit, always:

Obtain and check references from vendors to learn about unit performance at other facilities and the servicing support provided by the vendors. Cleaning performance and maintenance requirements can vary significantly among different vendors and units.

Demonstrate aqueous cleaning units and solution before making a purchase. Most vendors allow facilities to demonstrate units for two to four weeks.

Case study:

MUNI converts to aqueous cleaning

The City and County of San Francisco Hazardous Waste Management Program is helping Municipal Railway (MUNI) repair and maintenance facilities identify cost-effective alternatives to solvent part cleaners. Between February and December 1998, 14 different aqueous cleaning units were demonstrated at three MUNI fleet maintenance facilities. Based on the demonstrations, the following conclusions were drawn:

- All MUNI facilities can convert entirely to aqueous cleaning without compromising their cleaning performance.
- Facility cleaning requirements are best met by implementing two or more types of aqueous cleaning units.
- Significant cost savings can be realized with aqueous spray cabinets and ultrasonic units because of reduced cleaning labor and larger cleaning capacities. These cost savings can offset unit capital costs and result in short payback periods.
- MUNI can reduce the total number of cleaning units used by implementing spray cabinets and ultrasonic units because these units have large cleaning capacities.

MUNI is considering the following vendors for full implementation of aqueous cleaning:

- | | |
|---------------------|------------------------|
| • Ultrasonic Units: | • Immersion Units: |
| - Alpha | - KleenTec |
| - GlobalSonics | - Mirachem |
| • Spray Cabinets: | • Microbial Sink-Tops: |
| - EMC | - EcoClean |
| - Landa | - ForBest |
| - Safety-Kleen | |

Electric bus facility

Operations: Light-duty repair, preventive maintenance

Number of Solvent Sink-Top Units: 4

Average Daily Cleaning Labor: 3.7 hours

The electric bus facility used a microbial sink-top unit and a spray cabinet for a 3-month demonstration period.

- The sink-top unit met most of the facility's cleaning needs for small parts.
- The spray cabinet was used to clean large parts.
- Facility workers responded positively to both units.

**Electric bus facility conversion to aqueous**

From (Solvent Units)	To (Aqueous Units)
2	2 microbial sink-top (cost: \$1,300 per unit)
2	1 spray cabinet (cost: \$11,4300 per unit)

Total: 4 solvents 3 aqueous

Total capital cost: \$14,030 Annual savings: \$13,250

Payback period: 1.1 years

The estimated cost savings is largely from the reduced labor from the spray cabinet and reduced servicing and waste management costs of the microbial sink-top units.

Diesel bus facility

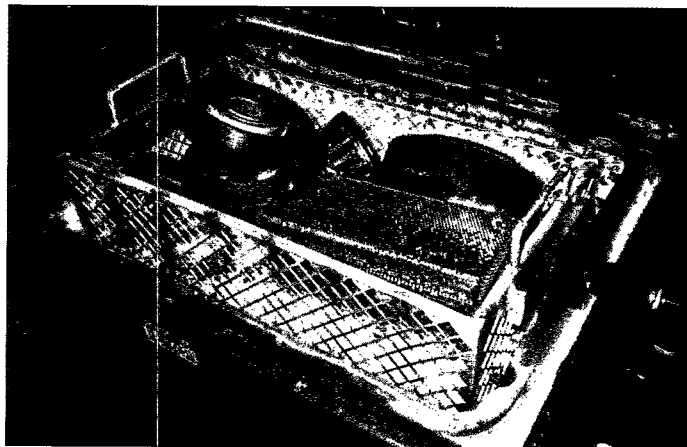
Operations: Heavy-duty rebuilding and repair

Number of Solvent Sink-Top Units: 13

Average Daily Cleaning Labor: 18 hours

The diesel bus facility demonstrated three spray cabinets, two ultrasonic units, one immersion unit, and four sink-top units.

- Facility workers favored the spray cabinets and ultrasonic units because these types of units were able to clean almost all parts, including heavily soiled parts, while significantly reducing cleaning labor.
- One spray cabinet received an extremely positive response because of its 1) exceptional cleaning performance, 2) automatic water fill feature to make up for evaporative losses, and 3) timer that automatically reduces solution temperature overnight and returns it to the optimal level in the morning.
- The ultrasonic units impressed workers with their ability to clean interior surfaces and hidden areas on complex parts, including transmissions. However, some workers objected to a constant hissing noise made by some units.
- The sink-top and immersion units were used for quick, light-duty cleaning of small parts.
- Three of the sink-top units were disliked by facility workers inadequate height and sink-top capacity, and poor cleaning performance.



Diesel bus facility conversion to aqueous

From (Solvent Units)	To (Aqueous Units)
8	3 spray cabinets (cost: \$3,500 per unit)
2	1 ultrasonic (cost: \$12,000 per unit)
2	3 microbial sink-top (cost: \$1,300 per unit)
1	2 immersion (cost: \$3,500 per unit)

Total: 13 solvent **9 aqueous**

— Total capital cost: \$33,400 Annual savings: \$134,810
Payback period: 3 months

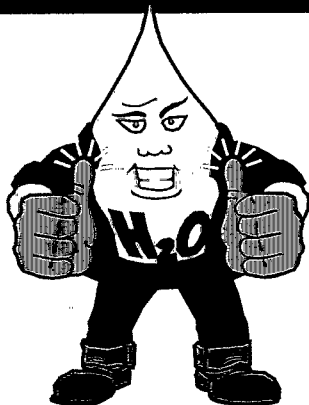
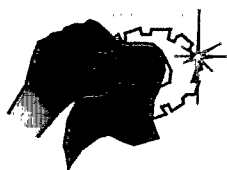
The estimated cost savings is largely from significant reductions in cleaning labor from the spray cabinets and ultrasonic unit.

less harmful

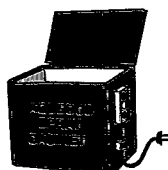
"I like our microbial sink-top unit because I don't have to breath the heavy solvent vapors and its less aggressive on my skin."

—Daron Gee
MUNI technician, San Francisco, California

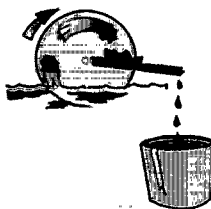
THE DO'S AND DON'TS OF AQUEOUS CLEANING

**Do**

**Dry parts
immediately after
cleaning to
prevent rusting**



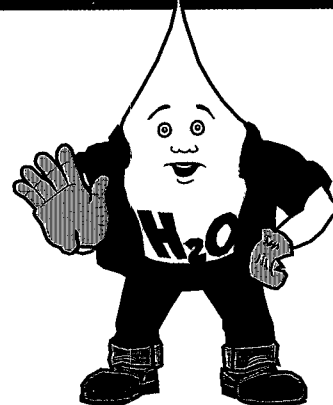
**Demonstrate
units before
purchasing**



**Use oil skimming
to extend
solution life**



**Use filtration to
extend solution life**

**Don't**

**Don't discharge
waste solution
into sewers**



**Don't contaminate
aqueous solution with
aerosol solvents**



**Don't use solutions with
greater than 5% VOCs**

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).



Case Studies in AQUEOUS PARTS CLEANING



Best Environmental Practices for Fleet Maintenance • November 1999

Aqueous Cleaning Works!

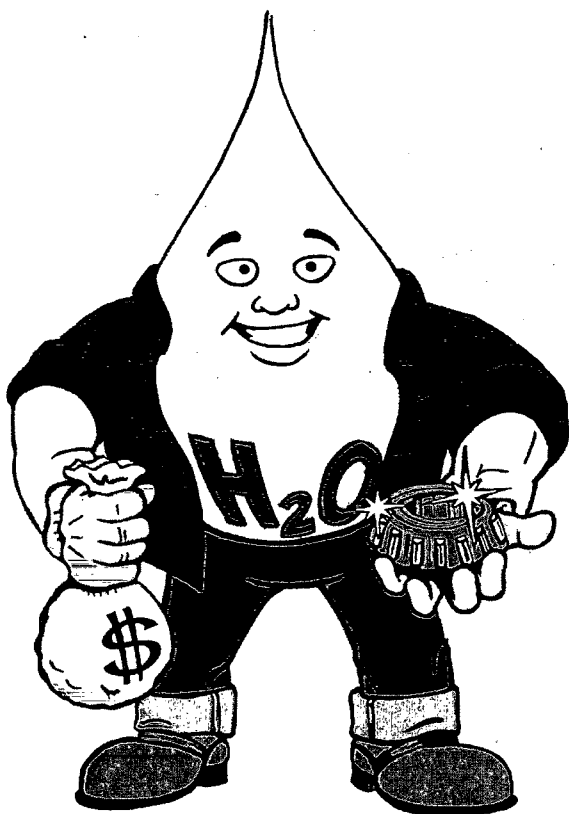
The case studies featured in this document are from studies conducted in California between 1997 and 1999. Each of the operations featured in these case studies successfully switched from solvent to aqueous (water-based) parts cleaning, or from one brand of aqueous cleaner to another. These case studies prove that aqueous cleaners are capable of meeting or exceeding the many parts cleaning challenges encountered in a wide variety of fleet maintenance operations.

New Environmental Regulations Lead to Improved Aqueous Cleaners

The emergence of a new generation of highly effective cleaning units and solutions is the direct result of environmental regulations recently passed in two California air districts. To protect human health and reduce smog, aqueous parts cleaning solutions are favored or required over solvent cleaners. These new rules opened the parts cleaning market to new vendors and spurred innovation. Shop owners, facility managers and technicians benefit the most from the new rules, because compared to solvents, aqueous cleaners:

COST LESS • ARE SAFER TO USE • CLEAN EQUALLY WELL

The public also benefits from the overall reduction in volatile organic compounds (VOC) emitted to the air as facilities switch from high VOC solvents to aqueous cleaners. The estimated VOC reductions as a direct result of enacting these new rules are 10 tons per day in the Los Angeles area and 2.1 tons per day in the San Francisco Bay Area! Widespread use of these new aqueous cleaners will hopefully bring about similar benefits nationally.



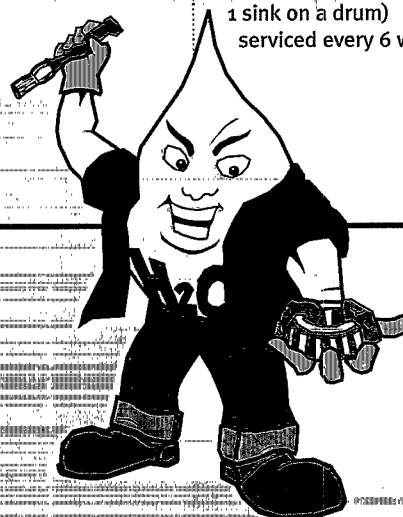
Tips for Successful Conversion

In selecting an aqueous cleaner for your operation, you should test more than one model to identify the model that works best for you. As the case studies show, often more than one type of unit is needed to fulfill all cleaning needs in a fleet (e.g: spray cabinet in combination with microbial sink-top). The good news is; in all but one case featured here, fleets are saving significant money by switching to aqueous cleaning systems. Reduced labor spent cleaning parts account for most of these savings (as with automated spray cabinets and ultrasonic systems). Savings are also achieved through lower waste disposal costs, because aqueous cleaning solutions generally last longer than solvent. For more tips on making aqueous cleaning work for you, see the Best Environmental Practices fact sheet entitled "Aqueous Parts Cleaning, Best Environmental Practices for Fleet Maintenance". It can be obtained by calling (800) 490-9198 or viewed and downloaded at www.epa.gov/region09/p2/autofleet.

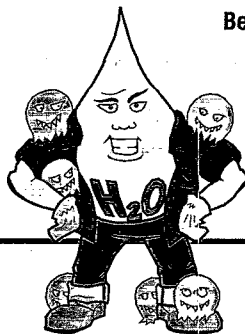
Testing the waters—aqueous parts cleaning case studies from California vehicles

CASE STUDIES IN AQUEOUS PARTS CLEANING, BEST ENVIRONMENTAL PRACTICES FOR FLEET MAINTENANCE OPERATIONS

Facility	Size	Operations	"Before"	"After"
'San Francisco Municipal Railway (MUN) Diesel Bus Facility—Woods Heavy Duty Section	32 technicians (16 per shift)	Full service— diesel buses. 18 hours/day cleaning parts	13 solvent sinks	4 spray cabinets 1 ultrasonic 2 microbial sink-top 1 immersion
*City of Los Angeles General Services Department 7th Street Facility	40 technicians	Full service— construction equipment, light trucks, heavy trucks. 140 hours/week cleaning parts	16 aqueous units: (All Safety Kleen Units; 3 Model 90 sink-top units, 10 Model 91 immersion units, 2 Model 11C carburetor cleaners, 1 Model 81.8 large agitator)	3 spray cabinets 7 immersion units
*City of Los Angeles World Airport Fleet Maintenance Facility	40 technicians	Full service— automobiles, light trucks, heavy trucks. 6 hours/week cleaning parts	10 aqueous units: (All Safety Kleen Units; 6 Model 90 sink-tops, 4 Model 91 immersion units)	1 spray cabinet 4 microbial sink-tops
'Los Angeles Dept of Water and Power	85 fleet vehicles 2 mechanics 2 machinists 7 electricians	Full service— automobiles, light trucks, heavy trucks. 5 hours/week cleaning parts	3 solvent sinks; (2 immersion, 1 sink on a drum) serviced every 6 weeks	2 non-microbial sink-top units



Maintenance facilities



New Unit Types	Unit Cost	Annual Savings*	Payback Period	Testimonial
EMC Jetsink, ALO Jet solution	\$1,695	\$134,810	3 months	"The spray cabinets reduced our cleaning labor by 80%"
Landa SJ-10, Hotsy Tubmate solution	\$3,900			
Safety Kleen TLW-2, Aqua Works solution	\$3,850			
Global Sonics Grease Monkey Senior, Brulin 815GD solution	\$11,000			"The ultrasonic unit is good for parts with blind passageways"
EcoClean Bioflow 20, PC solution	\$1,295			
ForBest IPC360, Seawash 700 solution	\$1,000			
Mirachem PW-40S (w/skimmer), Mirachem 500 solution	\$1,867			"The immersion unit was good for parts with baked-on carbon that could soak for 30 minutes"
Landa SJ-15, AX-IT solution	\$8,190			
Mirachem PW-40S, Mirachem 500 solution	\$3,000			
Hydroblast Model 50, PowerClean solution	\$14,600	\$16,900	1 year	"I'm impressed"
Mirachem PW-20, Mirachem 500 solution	\$725			
Kleentec Model 4000 Unit, Green Unikleen/IPAX solution	\$2,200	\$4,050	6 months	"It's a good all around cleaner for our shops. We now use less than one can of aerosol cleaner per month"
Gray Mills Model R35037A, Green Unikleen/IPAX solution	\$2,200			

*Annual savings includes cleaning labor, waste disposal, servicing, chemical purchase, and electricity costs.

References

We gratefully acknowledge the contributions of the following individuals and organizations whose referenced publications contain the original source material for this fact sheet:

*Water-Based Parts Washer Systems: Case Study Conversions prepared for U.S. EPA and Santa Barbara County Air Pollution Control District by Michael Morris and Katy Wolf, Institute for Research and Technical Assistance, Pollution Prevention Center, December 11, 1998, available at <http://home.earthlink.net/~irta/rprt0002.htm>

*Water-Based Repair and Maintenance Cleaning: Case Study Conversions prepared for Southern California Edison by Michael Morris and Katy Wolf, Institute for Research and Technical Assistance, Pollution Prevention Center, March 12, 1999, available at <http://home.earthlink.net/~irta/rprt0003.htm>

*Final Report: Aqueous Cleaning Demonstration Project, City and County of San Francisco prepared for the City and County of San Francisco Hazardous Waste Management Program, Administrative Service Department, by Tetra Tech EM Inc., February, 1999. The executive summary of the report is available at www.epa.gov/region09/p2/autofleet. The full copy is at www.p2pays.org/ref/03/02197.pdf.

*Final Report: Aqueous Cleaning Demonstration Project, City and County of Los Angeles prepared for the City of Los Angeles Environmental Affairs Department Hazardous and Toxic Materials Office, by Tetra Tech EM Inc., August, 1999. An executive summary of the report is available at www.epa.gov/region09/p2/autofleet.

*Aqueous Parts Cleaning, Best Environmental Practices for Fleet Maintenance, part of this publication series.

CASE STUDIES VENDOR CONTACTS

Alpha Cleaning Systems	(805) 520-8057, (800) 729-2828	KleenTec	(800) 435-5336
EcoClean Corporation	(510) 797-4050	Landa, Inc.	(408) 998-3051, (800) 547-8672
EMC	(408) 292-9289, (562) 908-7696	Mirachem	(602) 966-3030, (800) 847-3527
For Best Cleaning Solutions, Inc.	(225) 334-6990	Safety-Kleen Corporation	(800) 344-5191
Global Sonics	(800) 437-7117	UniKleen	(310) 532-0353, (800) 930-4729
Graymills Corporation	(773) 248-6825	W.R. Grace	(708) 458-6811, (800) 854-1623

These vendors were featured in these case studies. Other vendors may provide similar or identical products and services.

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet.

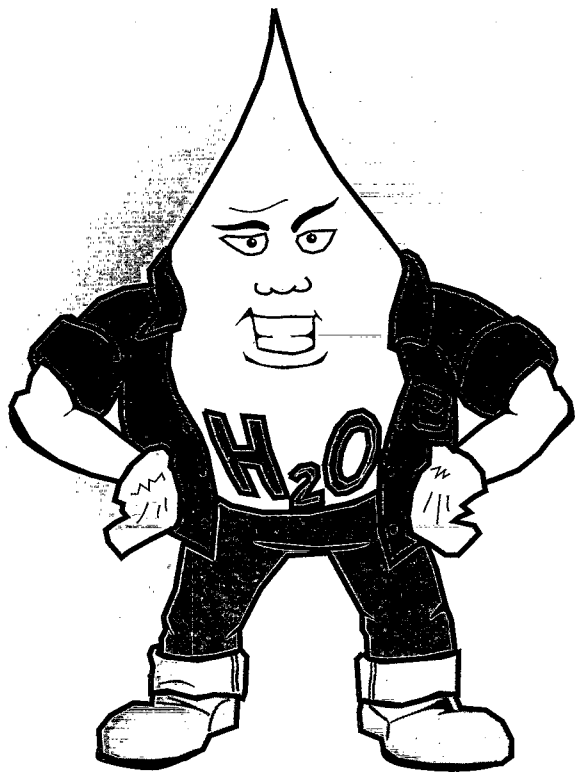
This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).





AQUEOUS BRAKE WASHERS

Best Environmental Practices for Auto Repair and Fleet Maintenance • November 1999



Which brake washing method is best for the environment?

Washing brakes before inspection and repair helps create a clean work area. It also removes dust and debris that prevent the brakes from functioning properly and cause squeaking and grinding. Brake washing can be performed using three devices: 1) aerosol cans of solvent-based brake cleaner, 2) solvent brake washing units, or 3) aqueous brake washing units. The best environmental practice is to use aqueous brake washing units.

Aqueous brake washing units use water-based cleaning solutions. These solutions are nonflammable and generally less toxic than petroleum-based solvents. Furthermore, aqueous cleaners contain little or no volatile organic compounds (VOCs) that can harm the environment and shop employees. Aqueous brake washing units are widely available and perform as well as solvent-based equipment; however, aqueous brake washers have the following advantages:

Advantages of using aqueous brake washers

- Little or no solvent vapors or aerosol mists that can be harmful to your workers' health.
- Nonflammable.
- Do not contribute to smog formation, climate change, or ozone depletion.
- No empty aerosol cans discarded as bulky, nonbiodegradable trash.
- Reduces overall environmental and safety liabilities for your shop.
- Can save you hundreds of dollars per year after payback period.

WHAT ARE YOU WAITING FOR?

If you perform 20 or more brake jobs per month, you can purchase and operate an aqueous brake washer and achieve payback in less than 2 years. This payback threshold was estimated assuming the following:

- | | |
|---------------------------------------|--------------------------------|
| • Aerosol brake cleaner = \$2 per can | • Aqueous solution = \$10/year |
| • Aqueous brake washing unit = \$800 | • Filters = \$20/year |
| • 1 can used per brake job | |

Costs include purchase only.

How aqueous units work

Most aqueous brake washing units function much like sink-top parts cleaners. Aqueous brake washers feature a portable basin that can be adjusted to fit under the wheel assembly. Units with adjustable sink height are preferred by most technicians. Compressed air pumps the aqueous solution through a hose and a flow-through brush. A filter is often used to collect debris and keep the solution clean. Aqueous units range in cost from \$500 to \$1,200 to purchase, or \$45 to \$85 per month to lease (lease cost includes waste management).



Managing wastes

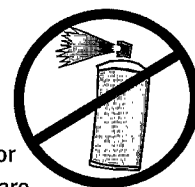
When purchased, aqueous brake washing solutions contain proprietary compounds that are either nonhazardous or considerably less hazardous than solvents. With proper filtration and regular addition of fresh solution to make up for evaporative losses, many shops can go for years without requiring solution disposal. Over time however, contaminants build up creating sludge and making the solution less effective. Waste solution, sludge and filters may contain metals washed off the brake assembly, or solvents that mistakenly dripped into the sink and contaminated the solution. Waste solution, sludge and filters should be shipped off-site as either hazardous or non-hazardous wastes. Get data, or test the waste stream at least once to make this determination, and dispose of the waste solution and filters accordingly. Some unit vendors will dispose of the spent solution for you and include the cost of this service in the unit's rental price.

Did You Know?

An informal survey of San Francisco Bay area shops revealed that aqueous solution is changed about once every 3 years, on average.

Keeping aerosol products away from aqueous brake washers

If you use aerosol brake cleaners to spot clean or dry brakes after aqueous brake washing, be aware that many aerosol products contain F-listed chemicals. An F-listed chemical is a chemical that makes each waste it contaminates a hazardous waste, no matter what its concentration in the waste is. Even one drop of an F-listed aerosol solvent that drips into your brake washing solution is enough to make it a regulated hazardous waste! If you must use aerosol products to spot clean, always move the aqueous brake washing unit away from the brake area first. To save time and avoid potential regulatory problems altogether, use compressed air to dry brakes rather than aerosol brake cleaner.



Ask the vendor

How often will I need to change the solution?

How much will it cost to refill the unit?

How often will I need to change the filters?

How should I dispose of solution and filters?

If the vendor recommends dumping solution down the drain or filters into the trash, ask them to pay for testing the waste solution and filters to determine proper disposal methods. Aqueous brake washing wastes (solution and filters) must be disposed of according to state and local regulations governing sewage treatment and solid and hazardous waste. In some states, the filters can be recycled.

VENDOR CONTACTS FOR AQUEOUS BRAKE WASHERS

Clayton Associates	(800) 248-8650
Kleer-Flo	(800) 328-7942
Mirachem	(800) 847-3527
Raybestos	(800) 407-9263
Safety-Kleen	(800) 669-5840
KleenTec	(800) 435-5336
Safe CleanUp Solutions	(888) 848-0879

These vendors provided information for this fact sheet. This list is not complete: other vendors may provide similar or identical products and services.

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).

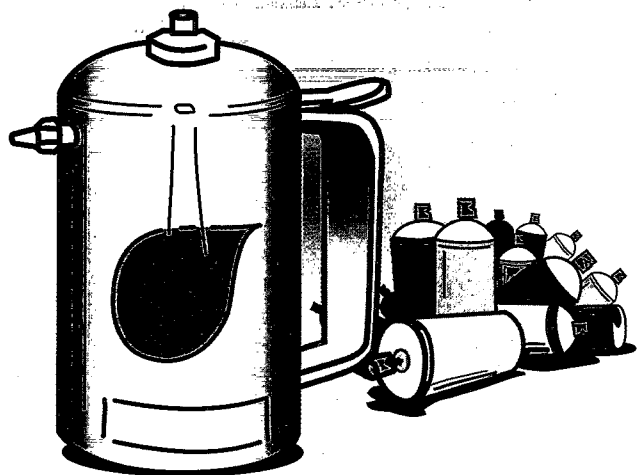


This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



REFILLABLE SPRAY BOTTLES

Best Environmental Practices for Auto Repair and Fleet Maintenance • November 1999



REFILLABLE SPRAY BOTTLES: PERCEIVED PROBLEMS AND REAL SOLUTIONS

Perceived problem

- ① Refillable spray bottles require more labor time because they must be refilled.

Real solution

The time needed to refill a bottle (1 to 3 minutes) is comparable to the time needed to dispose of an aerosol can and obtain a new one.

- ② Spray nozzles clog.

Clogs rarely occur, but when they do, they can usually be eliminated by blowing compressed air through both sides of the spray nozzle. As a preventative measure, technicians should clear spray nozzles with compressed air weekly, and keep dirt and grime out of the bottles when filling by using funnels with filters or screens.

- ③ Refillable spray bottles are cumbersome.

Bottles the size of typical aerosol cans are available, and nozzle extensions can be attached to larger bottles.

What's wrong with aerosol cans?

When compared to refillable spray bottles, they are expensive and have greater environmental consequences:

- Ounce for ounce, spray-on product sold in aerosol cans is roughly twice the cost of bulk product.
- You pay for propellants in every aerosol can you purchase. Most aerosol cans contain 10-15% propellant by weight.
- Carbon dioxide, propane, and butane are commonly used aerosol propellants. These are "greenhouse gases" that contribute to global warming and smog formation.
- Every year, individual auto repair and fleet maintenance facilities discard hundreds, and sometimes thousands, of aerosol cans used to dispense brake cleaners, carburetor cleaners, lubricants and penetrants, engine degreasers, and numerous other products as trash, taking up valuable landfill space.
- Used aerosol cans that are not empty may be considered hazardous waste by US EPA and many states.

Shops and facilities that switch to refillable spray bottles are saving money by avoiding the high cost of aerosol cans and are helping to protect the environment by eliminating the solid and potentially hazardous waste stream they produce. This fact sheet is designed to help auto repair shop owners and fleet managers make informed decisions about implementing refillable spray bottles.

What are refillable spray bottles?

There are two basic types of refillable spray bottles: 1) metal bottles that spray product using compressed air and 2) plastic bottles that use a hand pump to spray product. Refillable metal bottles more closely resemble aerosol cans in terms of their design and performance. These bottles are filled with product (for example, brake cleaner) from a bulk container and are pressurized with air at 80 to 200 pounds per square inch using a compressed-air hose. Plastic bottles are also filled from bulk containers but do not require compressed air. Instead, they are operated by pumping a trigger to create a mist or stream of product.

What to consider when selecting refillable spray bottles

Capacity. The capacity of air-pressurized, refillable spray bottles varies from 7 fluid ounces to 1 quart. Smaller bottles are useful for spraying hard-to-reach areas. Larger bottles are more convenient because they require less frequent filling and therefore less technician time.

Construction material. Refillable spray bottles are available in different materials and with different finishes (aluminum, stainless-steel, brass, and steel) for use with different types of bulk product. Ask the spray bottle manufacturer whether the bottle is compatible with the product you intend to use.

Nozzle type. 1-quart, refillable spray bottles come with standard spray and stream nozzles. A nozzle that can be adjusted from stream to spray is also available. Smaller bottles (16- and 8-fluid ounce) are available that closely resemble the size and shape of aerosol cans and have a spray pattern similar to an aerosol can spray.

Nozzle extensions. Nozzle extensions up to 12 inches long are available for spraying areas that are otherwise difficult or impossible to reach.

Cost. Air-pressurized, refillable spray bottles cost from \$25 to \$60 each, depending on the construction material. Chemically resistant plastic bottles and hand pumps cost from \$1 to \$6 each. Be sure to check with the product vendor about plastics that are compatible with their chemical product.

Economy. Ounce for ounce, bulk product is cheaper than aerosol cans. Most common spray-on products are available in containers ranging in size from 1 to 55 gallons. You may be able to obtain free refillable spray bottles from your vendor when you purchase their product.

Maximizing benefits

Refillable spray bottles do work and can reduce costs—if they are used correctly. Therefore, be sure to:

- Avoid product losses due to spills during refilling. Use funnels and pumps to minimize spills (see next page for details).
- Keep replacement parts on hand. Small, inexpensive parts such as nozzle seals, filler caps, valves, and nozzles may deteriorate with repeated use and pressurization.
- Refillable spray bottles will be used if they are as convenient for workers as aerosol cans; therefore, provide every technician with a refillable spray bottle for each type of frequently used aerosol product.
- Water in the shop air lines may cause corrosion in some steel refillable spray bottles. Ensure that your shop air supply has a water removal device.

Recycle used aerosol cans

- Under the federal Resource Conservation and Recovery Act (RCRA), aerosol cans may be recycled if they have been emptied through normal use or punctured and drained to remove significant liquids.
- Some states such as California have more stringent regulations than RCRA. Be sure to investigate state regulations before recycling aerosol cans.
- Shops are responsible for properly managing any captured wastes recovered from puncturing and draining.

WHAT'S WRONG WITH THIS PICTURE?

Many shops stock and use more types and brands of aerosol products than necessary. Use of refillable spray bottles helps reduce excess inventory.



Case studies:

Cost-effective aerosol can reduction

Three auto repair shops (Nielsen Automotive in San Carlos, CA; Glenmoor Auto Repair in Fremont, CA; and Salem Boys Auto in Tempe, AZ) and one fleet maintenance facility (City of Sunnyvale, CA) contributed information regarding their use of pressurized, refillable spray bottles. This information is summarized below.

Very few implementation problems occurred at the shops. One shop had problems with minor spills during bottle refilling. To prevent such spills, the shop modified a \$2.00 hand pump to fit a 1-gallon bulk product container. While the pump eliminated spills; it increased the refilling time from about 1 minute to 3 minutes per bottle. Another shop also had a nozzle clog, which was corrected by blowing compressed air through both sides of the nozzle.

Shop owners and fleet managers noted the following refillable spray bottle advantages:

Cost Savings. "We reduced our aerosol product costs by 84 percent for the same brake cleaner by switching to refillable spray bottles and eliminating aerosol can disposal costs."

Efficiency. "Technician efficiency is improved!

A technician requires about 1 minute to refill and pressurize a spray bottle, which is much less time than it took to walk to the storeroom to get a new aerosol can. In addition, we realized a cost savings by reducing the time needed to order and stock aerosol cans."

Ease of Use. "Our technicians find the refillable spray bottles easier to use than aerosol cans because the bottles give a more predictable shot of product."

Preferred by Technicians. "Refillable spray bottles work as well as or better than aerosol cans."

Tip. "I use a part-time student worker to top off bottles two to three times per week, which further saves technician time."



BEFORE

AFTER

	Nielsen Automotive	Glenmoor Auto Repair	Salem Boys Auto	City of Sunnyvale
Technicians	9	2	10 to 12	10
Service bays	6	8	20	12
Aerosol cans per year	780 (brake cleaner)	192 (brake cleaner) 288 (carb cleaner) 36 (lubricant)	1,560 (brake cleaner) 540 (carb cleaner)	260 (brake cleaner)
Aerosol can product cost per gallon	\$15.95	\$38.90 (brake cleaner) \$24.32 (carb cleaner) \$38.89 (lubricant)	\$16.54 (brake cleaner) \$15.45 (carb cleaner)	\$32.96
Pressurized, refillable spray bottles	4 (1-quart)	6 (1-quart) 3 (10-ounce)	30 (1-quart)	10 (1-quart)
Total cost for refillable bottles	\$200	\$450	\$0 (free for purchasing bulk product)	\$400
Refilling time	3 minutes	3 minutes	1 minute	1 minute
Bulk product cost per gallon	\$9.89	\$15.60 (brake cleaner) \$18.20 (carb cleaner) \$23.80 (lubricant)	\$6.36 (brake cleaner) \$7.54 (carb cleaner)	\$14.00
Annual savings	\$484	\$926 (brake cleaner) \$490 (carb cleaner) \$45 (lubricant)	\$1,570 (brake cleaner) \$465 (carb cleaner)	\$1,654
Payback period	5 months	4 months (overall)	immediate for both	3 months

Cost savings and payback

Use the worksheet below to evaluate refillable spray bottle costs and potential savings for your facility. The worksheet does not include the technician time to refill spray bottles because it is usually comparable to the time required to throw away an aerosol can and obtain a new one. This worksheet should be completed for each type of aerosol can product that might be replaced by refillable spray bottles; that is, you should make several copies of the worksheet and use one for each product type. The data in the sample column below is from an actual shop—it may not be representative of your shop's costs.

AEROSOL CAN USE	your facility	sample
A Number of aerosol cans used annually		780
B Fluid ounces per aerosol can		13
C Cost per aerosol can		\$1.62
D Gallons of liquid aerosol used annually ($A \times B \div 128$ ounces per gallon)		79
E Annual aerosol can disposal cost		Negligible
F Total annual aerosol can cost ($A \times C + E$)		\$1,264
SPRAY BOTTLE USE		
G Number of refillable spray bottles needed (assume one per mechanic)		4
H Unit capital cost for spray bottles and accessories		\$50
I Bulk product purchase cost per gallon		\$9.89
J Total annual bulk product purchase cost ($D \times I$)		\$780
RESULTS OF SPRAY BOTTLE USE		
K Capital cost ($G \times H$)		\$200
L Annual savings ($F - J$)		\$484
M Payback period (years) ($K \div L$)		0.4

Payback threshold

If you use more than 20 cans of brake cleaner or carburetor cleaner per month, you can purchase five refillable spray bottles at \$50 each with a payback of less than 1 year. This payback threshold was determined by assuming the following:

- a shop uses 13-fluid-ounce aerosol cans at a cost of \$2 per can
- no disposal costs are incurred for aerosol cans
- bulk product costs \$10 per gallon.

VENDOR CONTACT INFORMATION

Air-pressurized spray bottles	Bulk product
Milwaukee Sprayer Mfg. Co. Inc. (800) 558-7035	Zep Mfg. Company (408) 739-3656
	MOC Products Co. Inc. (818) 896-2258
Hand-pumped spray bottles	
McMaster-Carr (732) 329-3200	Tiodize Co. Inc. (714) 898-4377
Impact Products (419) 841-2891	CRC Industries Inc. (800) 272-8963
Tolco Corporation (419) 241-1113	Berryman Products Inc. (817) 640-2376
	Gold Eagle Co. (773) 376-4400

These vendors provided information for this fact sheet. This list is not complete; other vendors may provide similar or identical products and services.

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet.

This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance"

(publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).

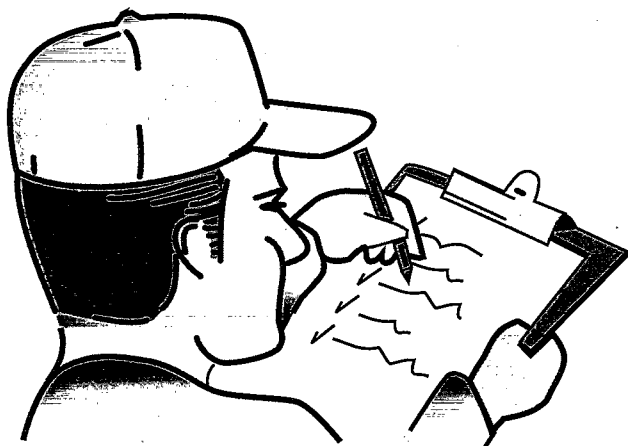


This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



OIL LIFE EXTENSION

Best Environmental Practices for Fleet Maintenance • November 1999



Why test your engine oil?

Fleet maintenance facilities generate a tremendous amount of used oil from routine engine maintenance. Engine oil changes are typically performed according to mileage or calendar schedules that are based on average data for a wide variety of vehicles. As a result, engine oil changes are often performed more frequently than necessary. If this is the case at your facility, you are purchasing and throwing away more oil than you need to. This fact sheet describes how a testing program can extend engine oil life and thus lower oil consumption, reduce used oil generation, and decrease operating costs with no risk to your vehicles.

Advantages of oil testing

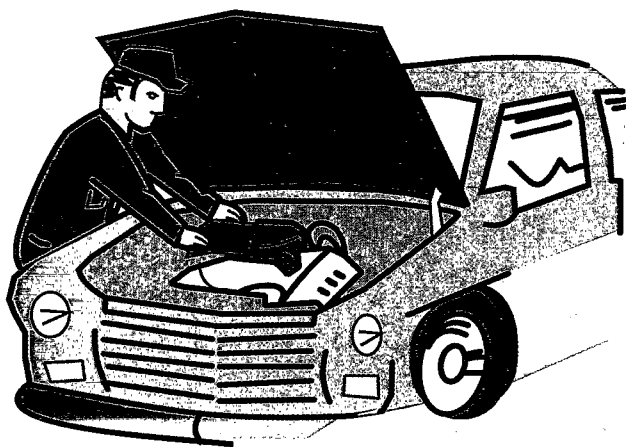
Resource Conservation. Oil is a nonrenewable resource; oil supplies are decreasing, which will drive prices higher. By extending engine oil life through testing, you can help save this nonrenewable resource!

Source Reduction. Reducing oil change frequency through testing reduces used oil generation at the source.

Cost Savings. Extending oil life reduces oil purchase and disposal costs as well as labor spent on changing oil.

Monitoring Maintenance Practices. After a few tests, you can identify trends to verify that routine maintenance is performed adequately.

Keeping Minor Repairs Minor. Testing provides early warning of engine component problems before they become serious, which will: 1) reduce repair costs, 2) help you anticipate vehicle down time, and 3) minimize "hit and miss" disassembly and inspection.



ENVIRONMENTAL ISSUES WITH USED OIL

- 1 2.7 billion gallons of oil is sold annually in the U.S.
- 2 50% of oil is consumed and 50% becomes used oil; 31% of the used oil, or about 420 million gallons, is never recycled! Much of it goes into the environment.
- 3 Used oil is recycled by being burned for energy or re-refined. Burning oil results in air pollution that includes sulfur and hydrocarbon emissions.
- 4 3 to 5% of the used oil that is re-refined ends up as hazardous waste sludge.

Create an oil life extension program at your facility

There are four aspects of a successful, cost-saving oil life extension program: 1) establishing baseline information, 2) conducting engine oil sampling, 3) testing oil, and 4) evaluating test results.

1) Establishing baseline information

Documenting the following baseline data for each of your vehicles provides information that will help you evaluate test results and make decisions about extending oil life:

- Oil change intervals
- Operating environment
- Recent maintenance or repair work
- Brand and type of oil used
- Vehicle age



2) Conducting engine oil sampling

Engine oil sampling should be performed at regular intervals. Begin your program by sending samples to an off-site laboratory for testing.

Consider this: Collecting engine oil samples does not require much extra labor, particularly if samples are collected during scheduled preventive maintenance and safety checks. Sampling labor is usually offset by reductions in oil change labor.

Sampling tips:

- Run the engine, and then sample soon after turning off the engine.
- Collect a sample by 1) installing a valve to draw off oil just before the filter, 2) withdrawing oil through a narrow hose inserted in the dipstick tube, or 3) taking a sample when the oil is changed (within 15 minutes of engine shutoff).
- Keep hands out of sample bottles and keep bottles tightly capped before and after sampling to minimize foreign contamination.
- Consult oil testing companies for sampling equipment and methods.

METAL CONTAMINATION AND ITS SOURCES

Aluminum	<ul style="list-style-type: none"> • Piston or bearing wear • Hydraulic system pumps • Transmission components
Chromium	<ul style="list-style-type: none"> • Piston rings • Roller bearings in geared compartments • Valve stem wear
Copper	<ul style="list-style-type: none"> • Thrust bearing wear • Oil cooler core "leaching" • Transmission or steering disc wear
Iron	<ul style="list-style-type: none"> • Gear, shaft, or liner wear
Lead	<ul style="list-style-type: none"> • Bearing wear

3) Testing oil

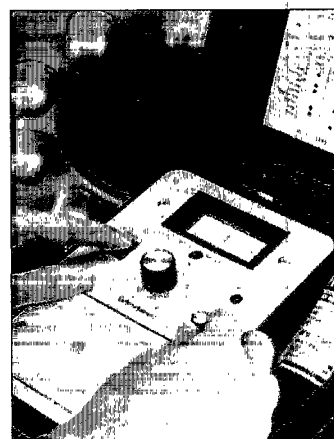
The following are sources of engine oil contaminants.

- **Antifreeze** contaminates engine oil through a coolant leak, causing bearing damage and piston, ring, and liner wear. The first sign of a coolant leak is detection of sodium, potassium, or boron in the oil.
- **Metals** from engine wear contaminate engine oil (see table below, "Metal Contamination and its Sources").
- **Fuel** contaminates engine oil as a result of faulty injectors and can reduce oil lubricating qualities, lower oil viscosity, and lead to bearing failure. As little as 1% fuel content decreases oil viscosity by 4 to 6 percent.
- **Sand and dirt (silicas)** enter engine oil from outside sources and cause abrasive wear of engine parts.
- **Water** contamination of engine oil is usually caused by condensation in the crankcase. Large amounts of water contribute to formation of metal-corroding acids that can damage pistons, rings, and the liner. Oil performance is affected when its water content exceeds 0.3 percent.

Selecting test methods: Most fleet maintenance facilities test engine oil for a variety of contaminants and therefore use more than one testing method. Common tests for oil life extension include testing for water, metals, viscosity, antifreeze, and dielectric constant (see table on next page, "Engine Oil Testing Methods at a Glance").

On-site testing: After you see how you can extend oil life based on the test results, consider purchasing on-site oil analysis equipment to lower your program costs and significantly reduce your waiting time for results.

On-site testing reduces the lag time between sampling and decision-making because test results are obtained almost immediately. On-site testing equipment ranges from small, hand held units



Hand-held oil analyzers give test results quickly.

which simply measure dielectric constant, to more complex analyzers that can identify specific contaminants and produce oil quality reports. Hickam Air Force Base in Hawaii used both a LubriSensor and a Computational Systems Inc. (CSI) Model 5100 oil analyzer to conduct their oil analysis program. They found that both provided comparable results to off-site laboratory analysis. The Lubri-Sensor costs about \$600 and the CSI 5100 costs about \$8,000.

ENGINE OIL TESTING METHODS AT A GLANCE

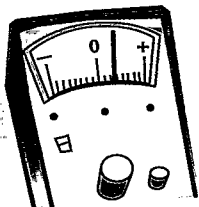
The following test methods are commonly used to evaluate contaminant levels in oil. Costs vary depending on the level of detail required.

Method	Description	Sample testing cost at an off-site laboratory
Ferrographic analysis	Measures the concentrations of particles in oil caused by engine wear. Particle type, size, and number indicate the severity of wear.	\$25
Spectrometric analysis	Measures concentrations of metal contaminants that indicate excessive engine wear.	\$8
Water detection test	Two common water detection tests are the Crackle test and the FT-IR test. The FT-IR test is more sensitive.	\$1 to \$4
Viscosity test	Determines whether oil has (1) thickened due to excessive soot, oxidation, or coolant contamination or (2) thinned due to improper combustion or the presence of fuel. Oil viscosity increases over time; however, a decrease in viscosity is considered more serious.	\$8
Dielectric constant test	Measures dielectric constant, which is altered by oil contaminants.	On-site

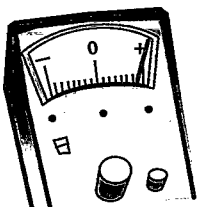
4) Evaluating test results

Most testing labs or equipment vendors will provide contaminant thresholds or action levels for specific test methods to help you decide when to change your oil. Having good baseline information is important when establishing fleet-specific action levels. The following rules of thumb apply to two common tests, the viscosity and dielectric constant tests:

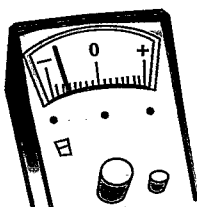
- Action is needed if viscosity increases more than 20 percent, or decreases more than 10 percent, from the baseline.
- Changes in the dielectric constant indicate potential problems as follows:
 - A moderate increase indicates the presence of contaminants such as dirt, acids, soot, and oxidation products.
 - An extreme increase indicates the presence of water, antifreeze, or metal particles: immediate action is needed to prevent engine damage.
 - A moderate decrease indicates the presence of fuel: immediate action is needed to prevent engine damage.



Moderate increase



Extreme increase



Moderate decrease

Making the change!

Extending oil change intervals safely—a step-by-step approach

- 1) Select a few vehicles that can be easily monitored.
- 2) Gather vehicle history data such as oil consumption, current oil change interval, and vehicle driving condition information. Collect and test oil samples from two consecutive oil changes to establish baseline conditions.
- 3) If the vehicle baseline data indicates no oil quality problems, increase the oil change interval by 15 to 25 percent (for example, if the engine oil is currently changed after 4,000 miles, extend the change interval to 4,800 miles).
- 4) Test oil at the new change interval (for example, 4,800 miles) for two consecutive oil changes, and compare the results with the baseline oil test data.
- 5) If test results at the change interval are favorable, consider extending the change interval further. If the results are not favorable, reduce the change interval and repeat the testing.

VENDOR CONTACT INFORMATION

LubriSensor (for measuring dielectric constant on site)	For off-site oil sampling and Probilizer sampling ports
Northern Technologies Int'l Corp.: (800) 328-2433	Titan Laboratories: (800) 848-4826
CSI 5100 (for on-site oil analysis)	Websites
CSI: (423) 675-2110	National Oil Recyclers Association: www.noraoil.com
For off-site oil analysis for various parameters	Oil Analysis.com: www.noria.com/index.html
Herguth Laboratories, Inc.: (800) 645-5227	

These vendors provided information for this fact sheet. This list is not complete: other vendors may provide similar or identical products and services.

Case studies:

Benefits of oil testing

Several fleet maintenance facilities (Eielson Air Force Base (AFB) in Alaska; Fort Lupton School District Maintenance Shop in Colorado; Hickam AFB in Hawaii; and the Idaho Engineering and Environmental Laboratory (IEEL), a Department of Energy facility) provided information about their oil testing programs for this fact sheet. As the following table indicates, each of these facilities realized environmental and cost benefits from extending engine oil life through oil testing.

	EIELSON AFB	FORT LUPTON SCHOOL DISTRICT	HICKAM AFB	IEEL
Number of vehicles	800 vehicles (heavy machinery, trucks, and vans)	23 buses	659 vehicles (trucks, vans, cars, and various other)	1,590 vehicles (buses, trucks, cars, and heavy machinery)
Oil testing	On site with CSI model 5100 Cost: \$8,000	Off site by Titan Labs Cost: \$6/sample; "Probilizer" sampling port available for fleets	On site with CSI model 5100; Cost: \$8,000	Off site with Herguth Labs Cost: variable
Number of samples per month	40 to 60	50	45	32
Time to sample per analysis	1 hour to sample and analyze	5 minutes to collect one sample	30 minutes to sample and analyze	5 to 10 minutes to collect one sample
Parameters analysis	Silicas Iron Metals Water	Silicas Metals Water Viscosity Percent fuel Percent antifreeze	Silicas Ferrous materials Metals Water	Non-metallic contaminants Heavy metals Water Viscosity Percent fuel Percent antifreeze
Oil change interval	Average oil change interval tripled	Before: 4,000 miles After: 8,000 miles	Average oil change interval doubled	Interval increased by about 1,000 miles, and labor decreased
Used oil disposal per year	Before: 26,260 gallons After: 3,400 gallons Savings: \$435	Reduced by 80 gallons Savings: \$230	Before: 2,385 gallons After: 500 gallons	Before: 10,000 gallons After: 8,500 gallons Savings: \$600
Engine oil purchased	Reduced by 13% Savings: \$26,000	Decreased but not quantified	Before: 2,255 gallons After: 495 gallons	Decreased but not quantified
Engine wear and tear	No engines lost due to oil failure in 5 years of oil testing (this is also attributed to synthetic oil use)	Not tracked	Not tracked	Saves about 3 engines per year that cost \$6,000 to \$25,000 each. Saves the most on bus engines (\$25,000 for a new engine and \$12,000 to rebuild an old engine) Net savings: at least \$40,000 per year
Estimated payback period	4 months	7 months	About 18 months	About 1 year

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).



This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



REUSABLE OIL FILTERS

Best Environmental Practices for Fleet Maintenance • November 1999

What is a reusable oil filter?

Fleet maintenance facilities generate hundreds of used oil filters every year from routine engine maintenance. In doing so, these facilities incur costs associated with maintaining filter inventory and managing and disposing of used filters. An alternative to conventional oil filters is reusable oil filters, which can last up to the life of the vehicle and eliminate the waste stream created by conventional disposable filters. Using reusable oil filters can save your facility money and reduce its impact on the environment.

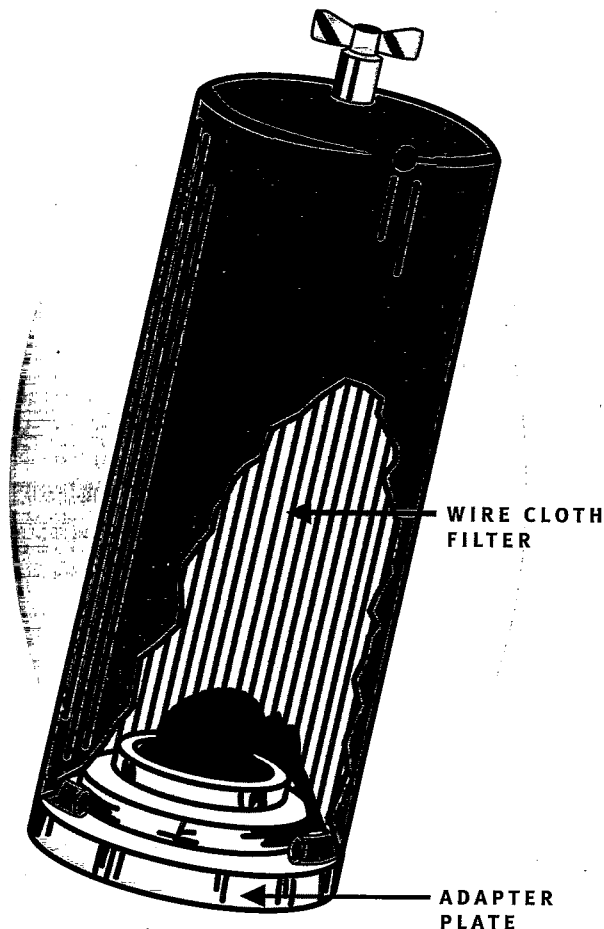
A reusable oil filter consists of an adapter plate; a canister; and a pleated, stainless-steel, wire cloth filter. The wire cloth replaces the paper elements in conventional oil filters. Most filter parts last the lifetime of the vehicle. In comparison, conventional oil filters must be drained and either landfilled or recycled.

Will the filter fit any engine? Reusable oil filters are made to fit most vehicles. The adapter plate can be changed to accommodate different engine types, while the wire cloth filter inserts are often the same for vehicles of similar size. Depending on your fleet, you can often replace multiple sizes of disposable oil filters with fewer replaceable filter inserts. This makes stocking and ordering filters easier, saving you time and money.

How is the filter cleaned? The wire cloth filter is easily removed, cleaned in a parts washer and replaced. Some vendors, such as PureCycle Filter System (PureCycle), sell machines specifically for washing reusable oil filters. The cleaning time ranges from 5 to 15 minutes, and cleaning is usually performed when the oil is changed.

How much does the filter cost? Prices for a reusable filter (including adapter plate, canister and wire cloth filter) range from \$65 to \$130 for cars and small trucks and from \$120 to \$300 for large trucks.

What will the payback period be? According to vendors and facilities using reusable oil filters, the payback period ranges from 1 to 3 years, depending on fleet size and oil change cycles. Savings are achieved by eliminating purchase and disposal costs for conventional oil filters.



ADVANTAGES OF REUSABLE OIL FILTERS

Environmental

- Conserve oil, a non-renewable resource
- Reduce potential for used oil contaminating groundwater, soil, and surface water

Operational

- Reduce on-site filter inventory
- Eliminate draining and crushing of used filters
- Eliminate used filter storage and disposal



Case studies:

Benefits of reusable oil filters

Two fleet facilities, Barton Sand and Gravel (a sand and gravel carrier in Minnesota) and the City of Walnut Creek, California, provided the following information about using reusable oil filters. As the tables show, each of these facilities realized environmental and cost benefits from reusable oil filters.

	BARTON SAND & GRAVEL, MN	CITY OF WALNUT CREEK, CA
Fleet Size	100 trucks, 40 of which use reusable oil filters	290 vehicles; reusable filters used in 10 out of 18 police cars
Filters Used	PureCycle oil filters (\$169 to \$195 each for heavy trucks)	System One Filter Systems oil filters (\$80 each for cars)
Reusable Filter Implementation	Started by using 1 reusable filter and gradually increased to 40	Started by using 1 reusable filter and gradually increased to 10
Cleaning Frequency	Clean filters during every oil change (every 6,000 to 10,000 miles or 6 to 7 weeks)	Clean filters during every oil change (every 5,000 miles)
Cleaning Methods	Use a PureCycle washing machine to clean filters; cleaning takes about 10 minutes	Use a Safety-Kleen parts washer to clean filters; cleaning takes about 5 minutes
Previous Costs for Conventional Oil Filters	6 oil changes per year x 40 trucks x \$10 per filter = \$2,400 per year Disposal: \$80 per drum x 2 drums per month x 12 months per year = \$1,920 per year	12 oil changes per year x 10 cars x \$3.75 per filter = \$450 per year Disposal: Decreased but not quantified
Reusable Oil Filter Costs	40 trucks x \$180 (average filter) + \$700 (washing machine) = \$7,900	10 cars x \$80 = \$800
Payback Period	Less than 2 years	Less than 2 years
Facility Comments	"Our facility saved money by reducing our inventory and used oil filter disposal costs. The washing machine has made cleaning the filters a simple task. This product is a proactive approach to minimizing environmental impacts caused by filter disposal."	"Our facility is helping the environment by producing less waste. Reusable oil filters have finer filtration than conventional oil filters; reusable filters can serve as an inspection tool because contaminants can be seen on the wire cloth screen."

VENDOR CONTACT INFORMATION

PureCycle Filter System
(612) 338-1250
<http://www.purecyclefilters.com>

System One Filter System
(209) 687-1955
<http://system1filter.com>

Racor
(209) 521-7861
<http://www.parker.com/racor>

Vortex Fluid Filter Technologies
(888) 286-7839
<http://www.vortexfilter.com>

These vendors provided information for this fact sheet. This list is not complete: other vendors may provide similar or identical products and services.

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).



This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



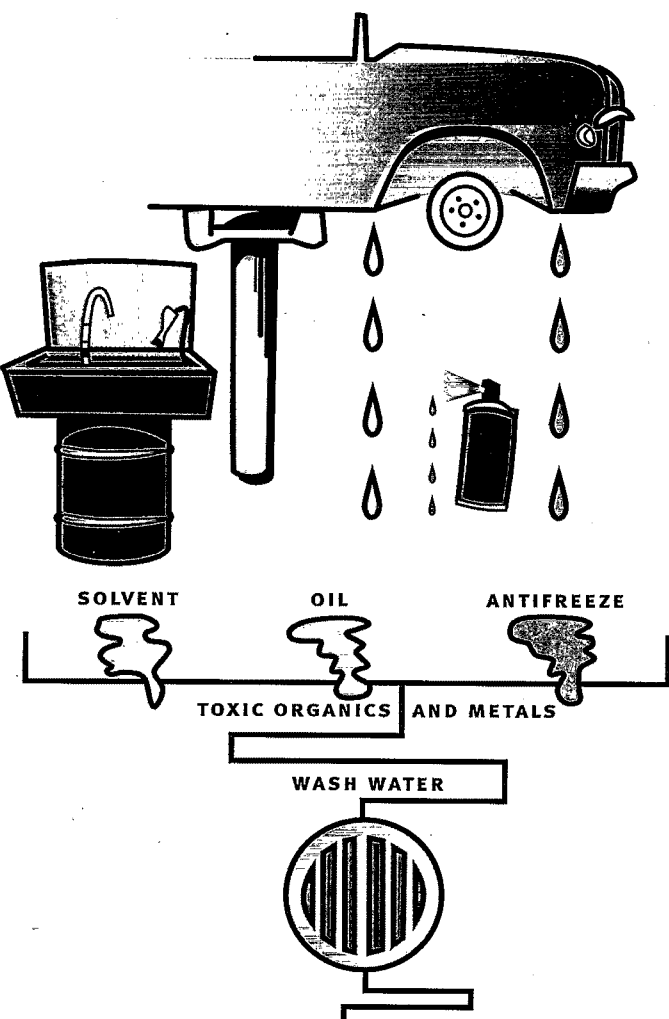
FLOOR CLEANUP

Best Environmental Practices for Auto Repair and Vehicle Fleet Maintenance • November 1999

KEEPING CLEAN AND SAFE p.2

FLOOR CLEANUP DONE RIGHT p.3

SPILL PREVENTION EQUIPMENT p.4

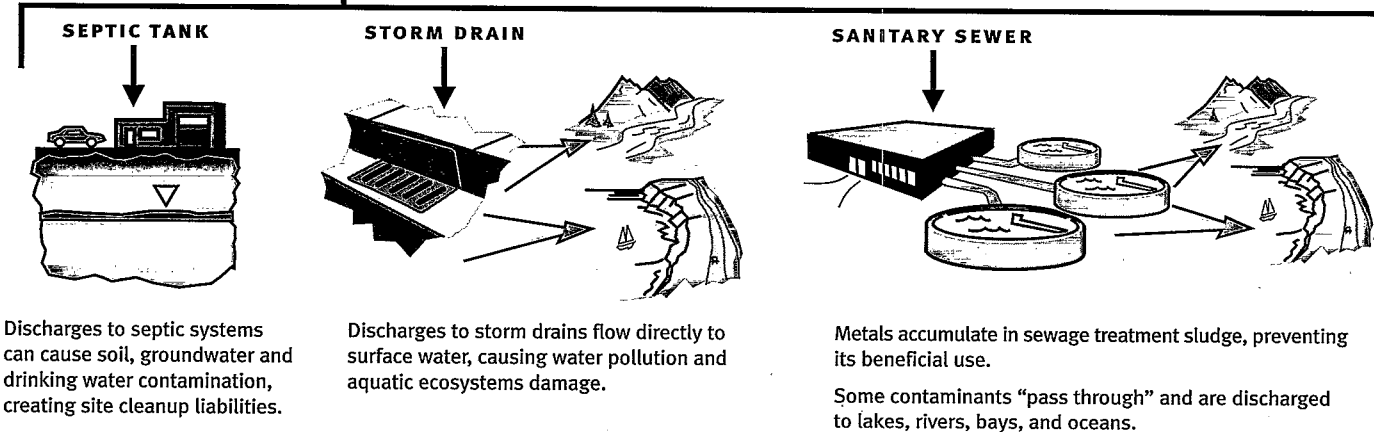


Why keep a dry shop?

The history of wastewater regulations is clear: discharge limits will continue to become more stringent. Minimize the impact of these regulations on your shop by adopting a dry shop goal. A dry shop is a shop that has sealed all its floor drains. Although a 100-percent "dry shop" may not be feasible in your area due to melting snow and ice, the methods and equipment presented in this fact sheet will help you reduce floor wash water volume and contamination. This, in turn, reduces your liabilities, protects the environment and community, and even saves you time and money spent cleaning floors.

The effects of flushing wash water down storm drains

Water flows untreated from storm drains directly to creeks, streams, lakes, bays, and oceans. If this water is contaminated, it can harm aquatic life; even soapy water can upset aquatic ecosystems. The Clean Water Act makes it illegal to discharge pollutants to surface waters; violators can face imprisonment and fines of up to \$25,000 per day! Storm drain connections to indoor drains or sinks are prohibited in most areas. Storm drains are usually located outside a shop. If you are unsure about the nature of your shop drains, ask the building manager or local sewer authority whether any of the drains are connected to storm water sewers.



Discharges to septic systems can cause soil, groundwater and drinking water contamination, creating site cleanup liabilities.

Discharges to storm drains flow directly to surface water, causing water pollution and aquatic ecosystems damage.

Metals accumulate in sewage treatment sludge, preventing its beneficial use.

Some contaminants "pass through" and are discharged to lakes, rivers, bays, and oceans.

Keeping your shop clean and safe

When used together, the following practices and equipment significantly reduce the amount of water needed to clean shop floors. Minimizing wastewater generation will reduce environmental liability and help your shop stay ahead of tightening regulations.

- Prevent spills from ever reaching the floor. (See back page for equipment.)
- Stop if there's a drop! Never walk away from a spill. If spills are not cleaned up immediately:
 - Workers can slip and fall.
 - Oil, antifreeze, and other spilled material

can mix and be tracked around your shop and into vehicles.

- You will spend more time and money washing the floor.
- Mechanics should carry rags so that small spills can be wiped dry when they occur.
- In case a medium-sized or larger spill occurs, cleanup equipment should be well marked. For example, attach red flags to mop buckets used for spill cleanup so they can be easily located by workers. Keep all spills out of sewer drains
- Sweep your floor with a broom every day to prevent unnecessary dirt and contaminant buildup.
- Never hose down your work area! This practice generates large quantities of contaminated wash water that is discharged to a sewer, or worse, is flushed out of the shop to a storm drain.
- If you use a pressure washer to clean your floors, be sure the wash water is disposed of properly. Even if pressure washing is performed by a contractor, your shop is responsible for proper management of the wash water and can be held liable for its illegal disposal. The best way to avoid this liability and the costs associated with pressure washing is to clean up spills when and where they occur.

Consider sealing your shop floor

Sealing your shop floor with epoxy or other suitable sealant can be expensive (typical cost for epoxy sealing is \$1.50 to \$2.00 per square foot), but there are several benefits. An epoxy-sealed floor:

- Won't absorb spills as a concrete floor does.
- Makes spill cleanup easier. (You can squeegee small spills into a dustpan and pour liquid into appropriate drum.)
- Requires less time and water to clean.
- Lasts for years and reduces long-term liability for cleanup of a contaminated shop floor and soil below.
- Looks great to customers and workers alike.



Always "Stop
if there's a drop!"

Use absorbents wisely

Pigs, pads, pillows, and mats

- Keep these absorbent devices on-hand to prevent very large spills from spreading.
- After use, wring out the absorbed fluid into the proper drum for recycling or disposal, and reuse the absorbents.
- Spent absorbent devices must be disposed of properly. This involves determining whether the spent absorbent is a hazardous waste.

Floor sweep (grease sweep, "kitty litter," rice hull, etc.)

- These absorbents should be used only when the spill can not be cleaned with shop rags or dedicated mops (see next page).
- Restrict the use of these absorbents to cleaning up gasoline, solvent, or other hazardous waste chemical spills. Manage these contaminated absorbents as hazardous waste.
- Use floor sweep until it no longer absorbs fluids. Recycle used floor sweep if possible, or dispose as hazardous waste. Floor sweep can be processed to reclaim and recycle absorbed compounds. Ask your vendor about recycling opportunities for spent floor sweep.

HYDROPHOBIC MOPS



Hydrophobic mops absorb only oil, not water or anti-freeze. They are available from the following vendors:

CCP in Cleveland, OH (800) 321-1050

Hy-Tec Environmental in Walnut Creek, CA
(800) 336-4499

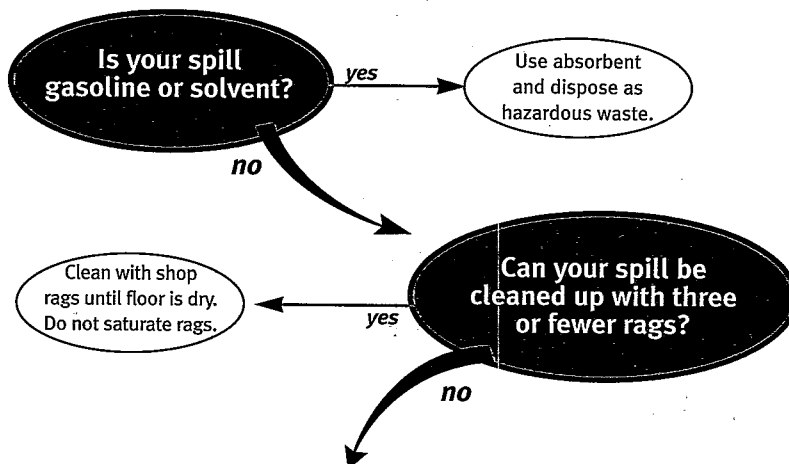
These vendors provided information for this fact sheet. This list is not complete: other vendors may provide similar or identical products and services.

customer perception and employee moral

"Cleaning up spills when they occur saves us time and money and keeps the shop looking clean, which my customers and workers both appreciate."

—Larry Moore

Larry's Autoworks
Mountain View, California

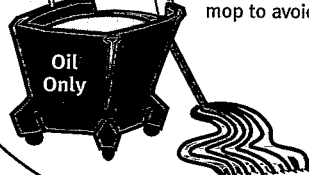


THE 4-STEP FLOOR CLEANUP METHOD

1

If oil is present, mop it up first.

Use a hydrophobic mop only.
Restrict back-and-forth movement of mop to avoid spreading spill.

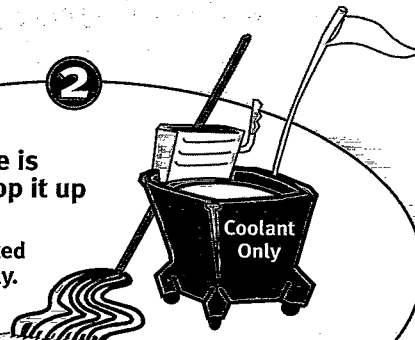


Transfer to used oil drum for recycling.

2

If antifreeze is present, mop it up now.

Use a dedicated cloth mop only.



Transfer to waste coolant drum for recycling.



3

Use rags to dry surface.

Clean with rags until floor is dry.
Do not saturate.

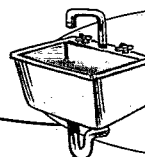
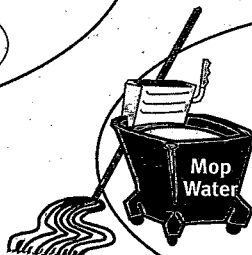


Send rags to an industrial laundry or properly dispose.

4

Use a wet mop only if necessary for final cleaning.

Use a mild, non-caustic detergent.



Dump wash water down a sink or toilet (but check with the local sewage agency first).

Spill prevention equipment

Water troughs for secondary containment of used oil and waste antifreeze
(available from your local feed store)

- These are the same inexpensive troughs that are used for livestock. Fluids can be pumped out for use or recycling.
- Clearly mark all stored materials.
- Inspect troughs daily for leaks.
- Keep troughs clean and dry.

Funnel drum covers

Funnel drum covers are available from Hy-Tec Environmental at (800) 336-4499, Spill Cleanup Direct at (800) 356-0783, and Todd Automotive at (800) 467-2750. *(These vendors provided information for this fact sheet. This list is not complete: other vendors may provide similar or identical products and services.)*

- These items minimize spills when transferring liquids from one container to another.
- They also can be used to drain oil filters.

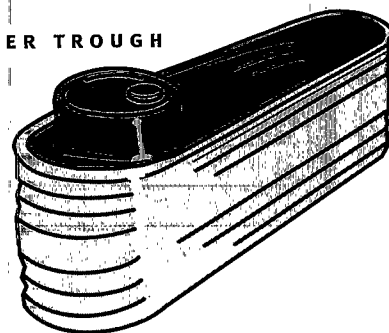
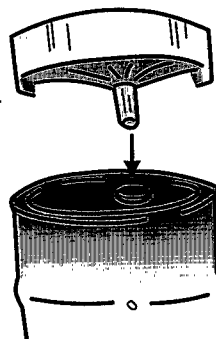
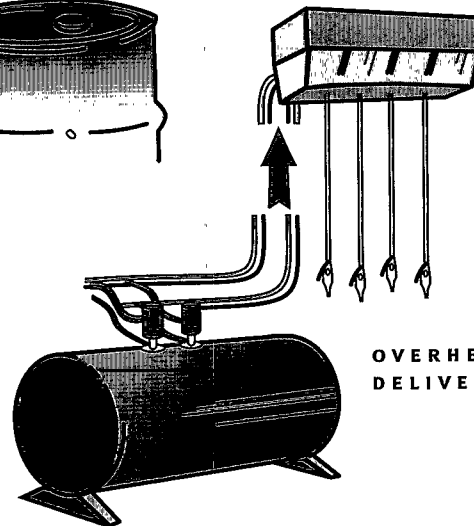
Bulk, pressurized, overhead fluid delivery
(available from all major motor oil manufacturers)

- Used for oil changes and lube jobs to reduce spills.
- Allows these jobs to be done more quickly.
- The equipment is often provided by the oil manufacturer at no charge.

You can make a difference!

A shop owner or manager must send a clear message to technicians about how clean the shop should be kept and how spills should be prevented and cleaned up. It's your responsibility to make proper spill prevention and floor cleaning top priorities for every technician.

WATER TROUGH

FUNNEL
DRUM COVEROVERHEAD FLUID
DELIVERY

FURTHER SUGGESTIONS

- Regularly maintain your oil/water separator.
- Clearly mark all indoor drains.
- Stencil "No Dumping" near storm drains.
- Change fluids at a location far from sewer connections

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).



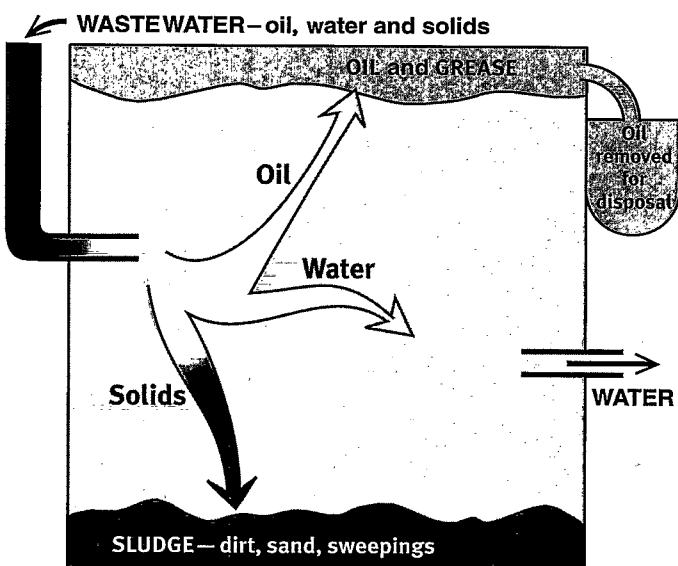
This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



OIL/WATER SEPARATORS

Best Environmental Practices for Auto Repair and Fleet Maintenance • November 1999

Simplified diagram of OWS operation



Heavier or Lighter Than Water? OWSs treat vehicle and floor wash water by allowing substances lighter than water to float and substances heavier than water to sink. Many OWSs also have baffles, coalescers, and oil skimmers to speed-up or enhance separation of these substances.

Why be concerned about oil/water separators?

Oil/water separators (OWS) can be costly to maintain, and if not properly managed, can pollute surface and ground water, and lead to costly violations. Have you taken steps to minimize the effects of your OWS on your budget and the environment? This fact sheet discusses the basic operation of OWSs in handling vehicle and floor wash water, and techniques to improve OWS performance and reduce costs and liabilities. To make sure your OWS works properly, remember:

Eliminate contaminants: Don't rely on the OWS to handle wash water from fuel, coolant, solvent, oil, or paint spills. Instead, clean up spills when and where they occur with dry methods (see the *Floor Cleanup* fact sheet).

Wash without detergents: Emulsifying cleaning compounds disperse oil in wash water and make OWSs ineffective—oil passes right through to the sewer. High pressure water or non-emulsifying cleaners are sufficient for most cleaning applications.

Minimize loading: Minimize the amount of solids and oils that enter your OWS. The less solids and oils that reach the OWS, the less frequently sludge and floating oil must be removed from the OWS and the better it will work. Also, minimize the amount of wash water reaching the OWS. Excessive water flow can flood an OWS, forcing wastewater through it too fast to allow separation; the result: oil and other contaminants pass right through to the sewer. *OWSs should not be used to treat storm water runoff.*

TROUBLE SITUATIONS	POTENTIAL IMPACT	REMEDY
Chemicals and spills reach OWS	<ul style="list-style-type: none">• Sewer discharge violation• Sludge requires disposal as hazardous waste	<ul style="list-style-type: none">• Eliminate floor drains from shop• Clean up spills when and where they occur• Use dry cleanup techniques in shop
Sludge builds up in OWS	<ul style="list-style-type: none">• OWS is less effective because solids have less time to settle	<ul style="list-style-type: none">• Eliminate storm water flow into the OWS using berms or curbs• Install additional grates and screens on drains• Use sloping pavement and sediment traps around drains
Excessive floating oil accumulates in OWS	<ul style="list-style-type: none">• Oil discharged to sewer during high flow periods	<ul style="list-style-type: none">• Pump out accumulated oil on a regular schedule• Use oil-only absorbent pads to remove and recycle oil• Use high-pressure, low-volume sprays for vehicle washing
Detergents reach OWS	<ul style="list-style-type: none">• Oil is emulsified and flows out of OWS to sewer	<ul style="list-style-type: none">• Do not use oil-emulsifying cleaning solutions (detergents)• Wash vehicles and engines less often

How do I keep oil and solids out?

- **Filter filter filter.** The best way to reduce OWS sludge is to keep solids out of vehicle and floor wash water. Install progressively finer grates and screens over the drains to the OWS inlet in order to maximize solids separation:
 - Begin with steel bars spaced 3/4 to 1-inch apart at the OWS drain inlet
 - Add sequentially finer grates and screens (3/4 and 1/4-inch screens or 1/4-inch expanded steel mesh)
 - Finish with reusable absorbent material to remove very small particles.
- **Use oil-only absorbents to separate and recycle oil from your OWS.** In some older OWSs, it is not easy to collect and remove separated oil. If your OWS does not have an oil trough or other oil collection device, you can use reusable absorbent pads that absorb only oil and grease. Put these pads on the water surface to collect floating oil. Once saturated, squeeze the oil from the pads; this oil can be managed with your used oil, if the squeezed oil is not contaminated with hazardous waste (get data on your wash water quality or analyze a sample at least once to verify). The squeezed absorbent pads can be reused.
- **Use microbes to digest oil in your OWS.** Bioremediation is a proven technique to minimize the oil content in OWS effluent and sludge and to reduce OWS cleanout frequency. Microbes added to an OWS break down petroleum products suspended or dissolved in the wastewater, floating oil, or sludge. Facilities using bioremediation have eliminated wastewater violations and have reported reducing their sludge petroleum content by more than 80 percent. Such reductions can lower the regulatory status of OWS sludge, which will affect the required disposal method and disposal costs. Bioremediation is typically performed under a vendor service contract. Microbes are added to an OWS or inter-

ceptor lines on a regular basis to replenish microbe populations. Microbes are nontoxic and completely safe; the main by-products of bioremediation are water and carbon dioxide. Vendor service contracts usually cover all materials and labor; monthly costs range from \$75 to \$130, depending on the size and contaminant loading of the OWS.

BIOREMEDIATION BENEFITS:

- Lower hydrocarbon levels in OWS effluent
- Less contaminated sludge and lower volume of sludge
- Reduction or elimination of odor

LIMITATIONS OF BIOREMEDIATION:

- Microbe populations can be killed by harsh chemicals or pH levels greater than 8.5; do not use detergents that are caustic or contain emulsifiers

Case studies:

Car Repair and Car Wash

Salem Boys Auto of Tempe, Arizona used sloping pavement, grates, and screens to minimize OWS loading. These controls, together with bioremediation, decreased the sludge cleanout frequency and cost by 75%.

U.S. Postal Service Fleet Maintenance Facility

The Huntington Beach, California facility used bioremediation to reduce OWS effluent hydrocarbon concentration by more than 80%.

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).

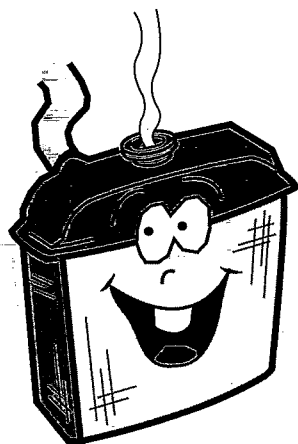


This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution prevention program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.



ANTIFREEZE RECYCLING

Best Environmental Practices for Auto Repair and Fleet Maintenance • November 1999

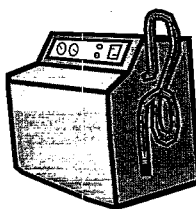


Why recycle antifreeze?

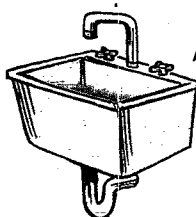
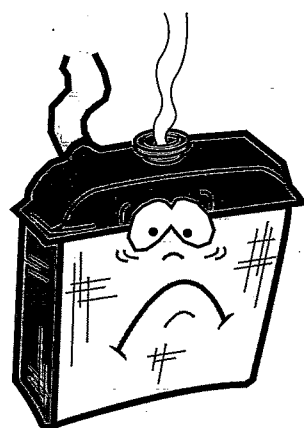
Dumping waste antifreeze may be illegal: waste antifreeze may contain heavy metals such as lead, cadmium, and chromium in high enough levels to make it a regulated hazardous waste. A hazardous waste may never be dumped on land or discharged into a sanitary sewer, storm drain, ditch, dry well or septic system.

It's Cost-Effective: recycled antifreeze is less expensive than virgin antifreeze.

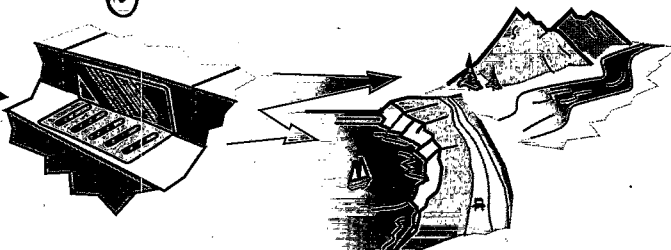
It Saves Resources: ethylene glycol is produced from natural gas, a non-renewable resource.



Waste antifreeze should be recycled either 1) in an on-site unit, 2) by a mobile service, or 3) off-site.



Many sewage treatment agencies responsible for wastewater treatment discourage or forbid waste antifreeze disposal into sanitary sewers.



Waste antifreeze should never be disposed of down storm drains or into surface waters because it causes serious water quality problems and may harm people, pets or wildlife. Doing so is illegal and punishable by fines of up to \$25,000.

WHY BE CONCERNED?

It is estimated that only 12% of all waste antifreeze generated in the United States is recycled each year.



Understanding your options

Due to the many on-site and off-site recycling options available, recycling antifreeze is feasible in all parts of the country. Waste antifreeze can be recycled by three methods:

- 1) **On-Site Recycling:** waste antifreeze is recycled in units purchased by the facility, located on site, and operated by facility employees.
- 2) **Mobile Recycling Service:** a van or truck equipped with a recycling unit visits the facility and recycles waste antifreeze on site.
- 3) **Off-Site Recycling:** waste antifreeze is transported to a specialized recycling company; these services can also resupply the facility with recycled antifreeze.

All waste antifreeze recycling methods involve two steps: 1) removing contaminants either by filtration, distillation, reverse osmosis, or ion exchange and 2) restoring critical antifreeze properties with additives. Additives typically contain chemicals that raise and stabilize pH, inhibit rust and corrosion, reduce water scaling, and slow the breakdown of ethylene glycol.

The type of antifreeze recycling that is best suited to your facility depends on many factors. The table below summarizes some of these factors for different antifreeze recycling alternatives.

Managing recycling wastes

Antifreeze recycling wastes may be contaminated with metals such as lead, chromium, cadmium, copper, or zinc. Depending on the type of recycling performed, wastes may include filters, sludge or resins. As with all wastes, you should obtain data, or test the waste to determine whether it is hazardous and dispose of it accordingly. Off-site and some mobile recycling service vendors will dispose of the wastes for you. If your vendor manages your wastes for you, make sure that proper waste determination and disposal is performed.

Using recycled antifreeze

Can I recycle organic acid technology (OAT) (long-life) coolants?

In 1999, about 30 percent of new passenger vehicles and 5 percent of heavy duty equipment were factory filled with OAT coolants. Many antifreeze recycling units can recycle OAT coolants such as DexCool™. The most important factor when recycling OAT coolant is to use a technology that completely removes the "chemistry" from the waste coolant. Once the coolant has been recycled, it may be returned to a conventional or OAT coolant or depending on the additive package used.

Numerous auto repair and fleet maintenance facilities have used recycled antifreeze produced from on-site recycling units and mobile and off-site recycling services for years without experiencing engine damage or other problems as a result. However, there are a few issues you should be aware of.

Consumer protection and manufacturer warranty issues

As of September, 1999, there is no ASTM quality standard for recycled antifreeze. However, several state agencies, for example California Weights and Measures, have issued product specifications for recycled antifreeze. Also, some vehicle manufacturers, (e.g. General Motors, Ford Motor Company, Detroit Diesel and Cummins) test and certify antifreeze recycling equipment or have developed standards for recycled antifreeze.

Because there is currently no single national recycled antifreeze standard that all recycling methods must achieve, you should select an antifreeze recycling method after discussing coolant quality specifications and vehicle warranty concerns directly with your recycling unit or service vendors. Some vendors can provide certification letters from vehicle manufacturers or state agencies, or will otherwise guarantee the recycled antifreeze they produce.

COMPARISONS OF ANTIFREEZE RECYCLING METHODS

	On-Site Closed Loop	On-Site Batch	Mobile Service	Off-Site Service
Common recycling technologies	filtration or ion exchange	filtration or distillation	filtration or reverse osmosis	distillation
Capacity (gallons per hour)	4 to 5	4 to 100	55 to 210	375 to 500
Facility worker training required	yes	yes	no	no
Facility disposes of recycling wastes	yes	yes	some services	no
Capital cost range (1998 dollars)	\$2,500 to \$13,800	\$3,700 to \$18,000	None	None
Cost range per gallon to recycle antifreeze*	filtration: \$3.00 to \$4.50 ion exchange: \$4.45 to \$7.20	\$0.74 to \$4.50	\$1.75 to \$3.00	\$3.20 to \$3.70
Average labor time required for coolant change per vehicle (minutes)	30 to 60	25 to 35	20 to 30	20 to 30

*Note: Cost ranges are after unit capital cost payback and do not include labor costs. Cost ranges calculated using cost worksheet (see page 3).

Cost analysis worksheet for antifreeze recycling

Complete this worksheet, calculate, and compare antifreeze recycling costs. Compare the highlighted rows (rows E, I, N, and GG) to determine the recycling method with the lowest annual cost. The values provided in the sample column serve only as an example, as actual costs and savings will vary according to facility specific conditions. **Before beginning, refer to page 4 for preliminary questions you should ask vendors.**

BASELINE WASTE ANTIFREEZE GENERATION		your facility	sample
A	Gallons of waste antifreeze generated annually		2,250
OFF-SITE ANTIFREEZE DISPOSAL		your facility	sample
B	Cost per gallon for disposal		—
C	Gallons of antifreeze (virgin or recycled) purchased annually		—
D	Cost per gallon to purchase antifreeze (virgin or recycled)		—
E	Total annual cost = (AxB) + (Cx D)		—
OFF-SITE ANTIFREEZE RECYCLING SERVICE		your facility	sample
F	Cost per gallon for off-site recycling		\$5.10
G	Gallons of antifreeze (virgin or recycled) purchased annually		2,250
H	Cost per gallon to purchase antifreeze (virgin or recycled)		\$3.50
I	Total annual cost = (AxF) + (GxH)		\$19,350
MOBILE ANTIFREEZE RECYCLING		your facility	sample
J	Cost per gallon for mobile recycling		\$3.29
K	Gallons of antifreeze (virgin or recycled) purchased annually		25
L	Cost per gallon to purchase antifreeze (virgin or recycled)		\$3.85/gal
M	Annual waste disposal costs (filters, residual, etc)		\$0
N	Total annual cost = (AxJ) + (KxL) + M		\$7,500
ON-SITE ANTIFREEZE RECYCLING		your facility	sample
General			
O	Gallons of regular (r) or extended life (e) antifreeze (virgin or recycled) purchased annually		378(r) & 452(e)
P	Cost <i>per gallon</i> to purchase antifreeze (virgin or recycled)		\$4.71(r) & \$7.48(e)
Q	Annual antifreeze recycling (number of vehicles or batches)		150 batches
R	Average time to recycle antifreeze (one vehicle or batch) in hours		15 hours per batch
S	Annual maintenance and repair costs		\$800
Equipment			
T	Purchase and shipping of recycling unit		\$8,500
U	Unit installation		\$0
Additives			
V	Annual use rate of regular (r) or extended life (e) additives (gallons or packages per year)		32 gals.(r) & 35 gals.(e)
W	Cost to purchase additives <i>per gallon or per package</i>		\$.25/gal(r) & \$.96/gal(e)
Filters			
X	Cost to purchase filters		NA
Y	Annual filter use rate		NA
Z	Annual cost to test filters		NA
Energy			
AA	Unit voltage (volts)		240
BB	Unit current (amperes)		16
CC	Energy cost (per kilowatt-hour)		0.12
DD	Total energy cost [(AA x BB) ÷ 1,000 x CC x Q x R]		\$1,037 /year
Wastes and disposal			
EE	Annual cost to dispose of recycling wastes (other than antifreeze)		\$0
FF	Gallons of waste antifreeze generated per year		75
CALCULATIONS		your facility	sample
GG	Total annual cost for on-site recycling [(O x P) + S + (V x W) + (X x Y) + Z + DD + EE + (FF x B or F)]		\$7,423
HH	On-site unit capital cost (T + U)		\$8,500
II	Payback period in years for on-site recycling (HH ÷ annual cost difference). Annual cost difference = difference in calculated annual cost for on-site recycling (GG) and alternative method (E, I, or N)		0.7 (off-site vs. on-site recycling)

GETTING STARTED RECYCLING YOUR ANTIFREEZE: QUESTIONS FOR VENDORS

Answers to many of these questions will help you complete the cost analysis worksheet on page 3.

On-site, mobile, or off-site recycling

- What types of additives are added to the recycled antifreeze?

- What is the availability, length, and coverage of the warranty on the unit or recycled antifreeze?

- Is the unit or recycled antifreeze certified by any vehicle manufacturers?

- Can you provide performance data about antifreeze recycled by this equipment?

- What wastes are generated (filters, sludge, resin, still bottoms)?

- Who will dispose of the wastes?

- What is the waste generation rate?

- Is the waste considered hazardous?

- What is the cost per gallon to recycle the antifreeze? What does this cost include?

- What contaminants prevent your unit or service from recycling antifreeze?

- Does the technology recycle OAT coolants and propylene glycol?

- Can you provide any references in the area who are using your unit or service?



On-site, closed loop antifreeze recycling unit flushes the coolant system during recycling.



On-site, batch antifreeze recycling units are available with filtration or distillation recycling technology.

Additional questions for on-site equipment vendors

- Does the technology feature filtration, distillation, reverse osmosis, or ion exchange?

- Is the on-site unit designed for portable, closed-loop use or stationary, batch processing?

- Is the unit powered by electricity or compressed air?

- What voltage or pressure is required to operate the unit?

- How is the unit operated?

- How much operator time is required to operate the unit?

- How much additive is needed per gallon of recycled antifreeze?

- Do you provide additive packages for OAT coolants?

- How much do the additives cost?

- How are the additives obtained?

- Is antifreeze testing required to determine how much additive to add or is it fixed?

- What type of antifreeze testing equipment is provided with the unit (litmus paper, refractometer, titration kit, other)?

- Will you train our mechanics how to properly use the unit?

- Is a unit available for a short demonstration or trial period?

- What is supplied for the demonstration?

- Where is the nearest technical sales representative?

- How much does the unit cost?

- Are there any other initial costs such as accessories or special additive costs?

- Do you offer lease options; if so, what is the monthly lease cost?

Your state or local government environmental agency has more information about compliance and pollution prevention for auto repair shops and fleet maintenance operations in your state or area. Additional fact sheets and information can be found at www.epa.gov/region09/p2/autofleet. This fact sheet is part of a package of fact sheets entitled either "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (publication number EPA-909-E-99-001) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (publication number EPA-909-E-99-002). To obtain copies of either package, call (800) 490-9198. Accompanying videos, "Profit Through Prevention", are available at the same phone number for either auto repair (number EPA-909-V-99-001) or fleet maintenance (number EPA-909-V-99-002).



This fact sheet was produced by the Environmental Protection Agency (EPA) Region 9 pollution protection program. Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, official EPA approval, endorsement, or recommendation.

EPA 900-B-99-002
November 1999

Region 9
(WST-14)

United States Environmental
Protection Agency

THE POLLUTION PREVENTION TOOLKIT

Best Environmental Practices for Fleet Maintenance

Cost-effective strategies to improve environmental performance and worker safety

