



DISSOLVING THE MYTHS ABOUT AQUEOUS CLEANING

Myth	Fact
1 Aqueous cleaning units do not clean parts as well as solvent units.	Aqueous spray cabinets can clean even difficult-to-clean parts such as wheel bearings.
2 Part rusting is a problem.	Rust inhibitors in aqueous cleaners decrease the chances of rusting. Rusting can be further minimized by drying parts immediately after cleaning.
3 Aqueous cleaning is expensive.	Most shops can save money by 1) implementing aqueous spray cabinets to reduce cleaning labor and 2) maximizing aqueous solution life.
4 Aqueous cleaning wastes are a hassle to manage.	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.
- Spent mineral spirits is a hazardous waste and the shop owner is responsible for proper disposal of all hazardous wastes.
- 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 shop. Minimize your costs and 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 shops 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. Two types of aqueous cleaning units that are applicable to most auto repair shops—microbial sink-top and spray cabinets—are described below. Most shops will likely meet all their cleaning needs by implementing both types of units. Specialty shops that clean many transmissions and carburetors may also want to investigate using ultrasonic and immersion type units (not covered here). For information on all types of aqueous cleaning units, see the fact sheet “Case Studies in Aqueous Parts Cleaning”.

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
- 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 (used) to \$8,000

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 significantly extending solution life

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



Maximizing aqueous solution life

Aqueous cleaning solutions can 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.

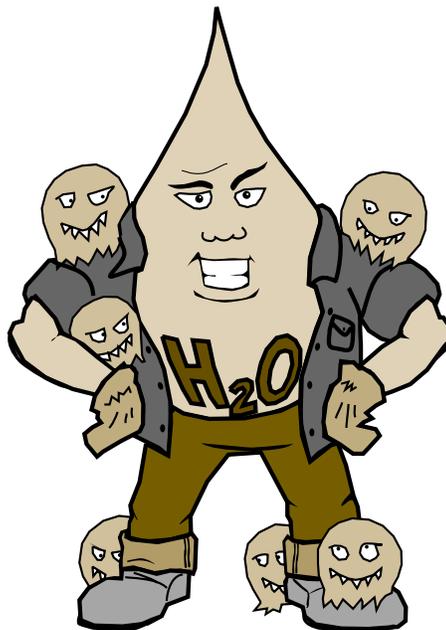
Perform oil skimming. Oil skimmers remove free-floating oil from the solution, reducing the amount of oil residuals left on parts and significantly extending solution life. Microbial units do not need oil skimming because microbes degrade the oil.

Accept solution discoloration. Many aqueous solutions turn gray or brown during use, but this discoloration does not affect 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.



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!

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.

Unit Selection Tips

Check References: Obtain and check vendor references to determine the unit cleaning performance and maintenance requirements at other shops.

Demonstrate the Unit: Demonstrate a unit and aqueous solution before making a purchase. Most vendors allow shops to demonstrate units for 30 to 60 days at no cost.

solution life

"I've used the same solution in my microbial sink-top unit for 2 1/2 years, and it's still going strong." — Ted Patterson

Ed's Auto Clinic, Fremont, California

Keeping your microbes happy

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.

Regulatory Action	Effective Date
The sale, or distribution in California of any automotive products* (brake cleaners, carb cleaners, engine degreaser and general purpose degreasers) that at the time of sale or manufacture contains methylene chloride, perchloroethylene, or trichloroethylene is prohibited.	June 30, 2002
The use of any automotive products containing methylene chloride, perchloroethylene, or trichloroethylene by owner or operator of an automotive repair facility are prohibited.	December 31, 2002

*aerosols or bulk products less than 2 gallons.

For additional information on the above Air Toxics Control Measure (ATCM) or additional regional/local air quality requirements for your area, you can search the California Air Resources Board Website at <http://www.arb.ca.gov/toxics/amr.htm>

Managing aqueous cleaning wastes

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

Waste Solution. Aqueous cleaning solutions generally qualify as hazardous waste after extended use because concentrations of metals such as cadmium, copper, lead, and zinc may exceed state limits. Therefore, auto repair shops 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 dump waste solution in the sewer or septic system.

Used Filters. Some metal casing 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. Plastic and cloth filters should not be recycled with used oil filters. These 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.

Full service lease agreements

Convenience at a cost. Most auto repair shops 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.

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

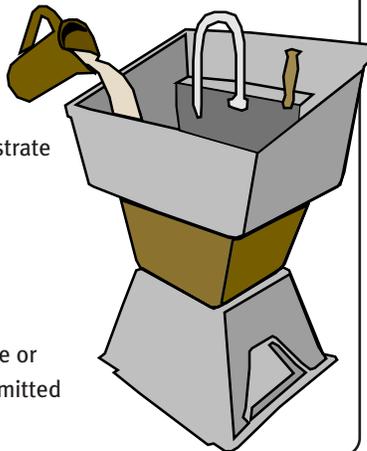
Microbial Sink-Top Units Generate:

Waste Solution (every several years)

- Send off-site as hazardous waste or sample to demonstrate solution is nonhazardous

Used Filters (every 3 to 8 weeks)

- Dispose as hazardous waste or with engine oil filters if permitted



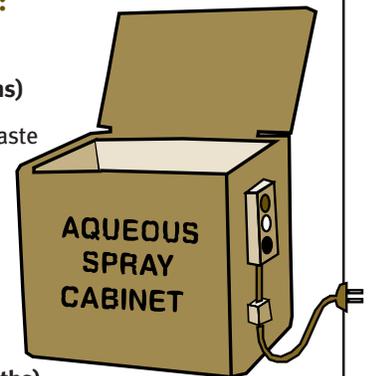
Spray Cabinets Generate:

Waste Solution (every month to every 6 months)

- Send off site as hazardous waste or sample to demonstrate solution is nonhazardous
- Include sludge

Skimmed Oil (every 2 weeks to every 2 months)

- Recycle with used motor oil



waste management

"The only wastes our microbial sink-top generates are filters, which are replaced 3 times per year."

—Bruce Ackerman

Ackerman's Volvo Service, Berkeley, California

Aqueous cleaning cost worksheet

Use this worksheet to estimate costs and savings associated with switching from solvent to aqueous cleaning. This worksheet can be used to estimate costs to convert from one or more solvent units to a microbial sink-top unit, a spray cabinet, or both a microbial sink-top and spray cabinet.

The sample calculations provided are for a shop with two solvent units that converts to one microbial sink-top unit, which handles 40% of the original cleaning workload, and one spray cabinet, which handles 60% of the original workload. The values provided in the sample column serve only as an example, as actual costs and savings will vary according to shop-specific conditions.

CURRENT SOLVENT CLEANING COSTS (leased units with servicing)		your facility	sample
A	Number of solvent units leased		2
B	Current cost per service visit per unit		\$159
C	Number of times unit serviced per year		6
D	Total annual solvent service cost (A x B x C)		\$1,908
E	Cost of electricity used per year per unit		\$280
F	Total cost of electricity used (A x E)		\$560
G	Loaded hourly labor rate of shop worker		\$50
H	Total number of cleaning labor hours per week		5
I	Total yearly labor cost (G x H x 52)		\$13,000
J	Total annual cost for solvent cleaning (D + F + I)		\$15,468
CONVERSION TO MICROBIAL SINK-TOP CLEANING UNITS		your facility	sample
K	Number of microbial sink-top units to be purchased		1
L	Unit purchase price		\$1,295
M	Total capital cost of sink-top units (K x L)		\$1,295
N	Cost per gallon of aqueous cleaner		\$6
O	Estimated aqueous cleaner use per year in gallons		48
P	Aqueous cleaner purchase cost per year (N x O)		\$288
Q	Cost per replacement filter		\$10
R	Number of replacement filters per year		4
S	Total cost for replacement filters (Q x R)		\$40
T	Cost of electricity use per year per unit		\$300
U	Total number of cleaning labor hours per week		2
V	Total yearly labor cost (G x U x 52)		\$5,200
W	Total sink-top unit operation and maintenance (O&M) cost ([P + S + T] x K + V)		\$5,828
CONVERSION TO AQUEOUS SPRAY CABINET CLEANING UNITS		your facility	sample
X	Number of spray cabinets to be purchased		1
Y	Spray cabinet purchase price		\$3,000
Z	Total capital cost of spray cabinets (X x Y)		\$3,000
AA	Cost per gallon of aqueous cleaner		\$6
BB	Estimated aqueous cleaner use per year in gallons		48
CC	Aqueous cleaner purchase cost per year (AA x BB)		\$288
DD	Cost per gallon of spent solution (including sludge) disposal		\$3
EE	Gallons of solution in spray cabinet		35
FF	Number of solution changes per year		2
GG	Total cost for spent solution disposal (DD x EE x FF)		\$210
HH	Cost of electricity use per year per unit		\$500
II	Number of cleaning hours per week (typically reduced by 80%)		0.6
JJ	Total yearly labor cost (G x II x 52)		\$1,560
KK	Total yearly spray cabinet O&M cost ([CC + GG + HH] x X + JJ)		\$2,558
RESULTS			
LL	Total capital cost (sink-top and spray units) (M + Z)		\$4,295
MM	Total cost savings (including labor) (J - W - KK)		\$7,082
NN	Payback period in years (LL ÷ MM)		0.6

Case study:
Larry's Autoworks

Larry's Autoworks is a full-service auto repair shop with six technicians and 14 bays. Previously, Larry's used 12 labor hours per week to clean parts using two mineral spirits units that were serviced every 6 weeks. In January 1998, Larry's replaced these units with a large EMC Model 100 aqueous spray cabinet purchased used from a vendor and an EcoClean Bioflow20 aqueous microbial sink-top unit. Larry's performs 90 percent of its part cleaning in the spray cabinet, which has reduced cleaning labor by 60%. Larry's uses the microbial sink-top unit to clean only small parts and parts with painted surfaces that might be damaged in the spray cabinet. The spray cabinet solution and sludge are disposed of as separate waste streams every 6 months by a waste disposal company. The microbial unit has not required solution disposal in over 16 months of continuous use. Owner Larry Moore says: "The spray cabinet has improved our productivity as well as the cleanliness of our parts. We even use it to keep our equipment clean, resulting in an overall cleaner shop."



The aqueous spray cabinet that Larry's Autoworks purchased used for \$1,600 performs 90% of its part cleaning.

"Our spray cabinet reduced our cleaning labor 60%, increasing our overall productivity."
—Larry Moore
Larry's Autoworks
Mountain View, California

Case study:
Auto Electric and Fuel

Auto Electric and Fuel has three technicians, performs light-duty cleaning of small parts, and previously used a mineral spirits unit that was serviced every 8 weeks. The shop contracts large cleaning jobs out to a local steam cleaning business. The shop switched to an EcoClean Bioflow20 aqueous microbial sink-top unit in spring 1997 and has not disposed of any solution since that time. The shop cleans more difficult-to-remove soil by first soaking the parts in a small container placed in the sink-top unit. The shop is now saving \$940 per year using aqueous cleaning, and the payback period for the sink-top unit was 1.5 years. The shop owner says: "The solution is nice and warm, much easier on technicians' hands than solvent. The unit meets our cleaning needs very well."

total cost

"Eliminating scheduled servicing by the solvent management company saved us significant money. We estimate \$940 per year savings using aqueous cleaning."

—Doug Mueller
Auto Electric and Fuel, Concord, California

PARTS CLEANING COSTS COMPARISON

Larry's cost summary

<u>Two Solvent Units</u>	<u>Aqueous spray cabinet</u>	<u>Aqueous Microbial Sink-Top</u>
Annual costs	Annual costs	Annual costs
Leasing, waste management \$1,260	Purchase price (one-time) \$1,600	Purchase price (one-time) \$1,300
Electricity (est.) \$1,400	Chemical use \$75	Chemicals \$325
Cleaning labor \$31,200	Solution and sludge disposal \$425	Filters \$60
Total costs \$33,860	Electricity (est.) \$3,100	Servicing \$289
	Cleaning labor \$11,232	Electricity (est.) \$360
	Total costs \$16,432	Cleaning labor \$3,120
		Total costs \$5,454

Total Capital Cost: \$2,900 • Annual Savings: \$14,874 • Payback Period = 0.2 Year

Case study:

Glenmoor Auto Repair

Glenmoor Auto Repair is a full-service auto repair shop with two technicians that service an average of 15 vehicles per day. Previously, Glenmoor leased one solvent sink-top unit that was used about 1 hour per week for cleaning parts and was serviced every 16 weeks. In September 1998, Glenmoor began demonstrating a small EMC Jetsink aqueous spray cabinet and an EcoClean Bioflow20 aqueous microbial sink-top unit, and both units provided positive cleaning results. Glenmoor initially purchased the spray cabinet and currently uses it to clean about 95 percent of all its parts. The spray cabinet reduces cleaning labor by as much as 80 percent. 25 gallons of spent solution (with sludge) is disposed every six months by a waste disposal company. The remaining 5% of Glenmoor's parts cleaning are quick cleaning jobs that are performed in the microbial sink-top unit. Although Glenmoor could perform this small amount of light duty cleaning using rags or its aqueous brake washer, they eventually decided to purchase the microbial sink-top unit for cleaning convenience. The sink-top unit requires filter replacement about every 6 months and has not generated any spent solution in over 9 months of continuous use. The payback period at Glenmoor for replacing solvent cleaning with the sink-top unit and spray cabinet is 1.8 years. If Glenmoor had implemented only the spray cabinet, the payback period would have been less than 1 year. Owner Gary Raver says: "The spray cabinet cleans parts so well that they shine. Our guys like using both of these units."



Glenmoor Auto Repair use a small, inexpensive spray cabinet which cost them \$1,700. They send large parts off-site for steam cleaning.

Selecting the right type of unit for your shop

Most shops require more than one type of aqueous unit to meet their cleaning needs. For example, a shop may maintain walk-up microbial 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 shop services transmissions or carburetors and does not subcontract the cleaning of these parts, specialized aqueous cleaning units, such as ultrasonic units, are available to meet these special cleaning needs.

PARTS CLEANING COSTS COMPARISON

Glenmoor cost summary

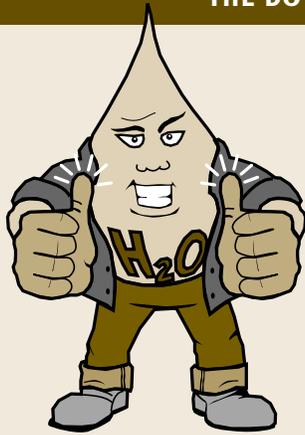
<u>One Solvent Unit</u>		<u>Aqueous Spray Cabinet</u>		<u>Aqueous Microbial Sink-Top</u>	
Annual costs		Annual costs		Annual costs	
Leasing, waste management	\$.690	Purchase price (one-time)	\$.1,700	Purchase price (one-time)	\$.1,300
Electricity (est.)	\$.120	Chemicals	\$.24	Chemicals	\$.24
Cleaning labor	\$.2,600	Solution disposal	\$.240	Filters	\$.20
Total costs	\$.3,410	Electricity (est.)	\$.480	Electricity (est.)	\$.360
		Cleaning labor	\$.494	Cleaning labor	\$.130
		Total costs	\$.2,938	Total costs	\$.1,834

"My spray cabinet cleans parts so well, they shine."

— Gary Raver
Glenmoor Auto Repair
Fremont, California

Total Capital Cost: \$3,000 • Annual Savings: \$1,638 • Payback Period = 1.8 Years

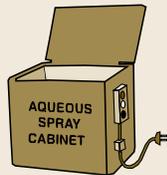
THE DO'S AND DON'TS OF AQUEOUS CLEANING



Do



Use solution with correct inhibitors and dry parts immediately after cleaning to prevent rusting



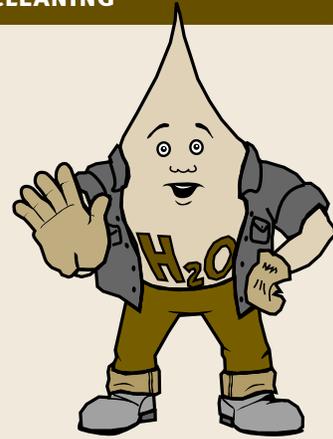
Demonstrate units before purchasing



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 agencies have additional information about compliance and pollution prevention opportunities for auto repair shops and fleet maintenance operations in your state or area. For information on California regulatory compliance issues contact your nearest Department of Toxic Substances Control (DTSC) Regional Office by calling 1-800-728-6942. You may also access the CAL EPA website at www.calepa.ca.gov for links to California Regulatory Agencies. To obtain additional copies "The Pollution Prevention Tool Kit, Best Environmental Practices for Auto Repair" (Document number 626) or "The Pollution Prevention Tool Kit, Best Environmental Practices for Fleet Maintenance" (Document 625) contact "DTSC's Office of Pollution Prevention and Technology Development (OPPTD)" at 1-800-700-5854. Accompanying videos, "Profit Through Prevention" are available at the same phone number for either auto repair (Document number 1504) or fleet maintenance (Document number 1504). DTSC's OPPTD also provides technical assistance and pollution prevention resources to businesses and government agencies. Electronic versions of the fact sheets can be found at: www.dtsc.ca.gov/PollutionPrevention/Vehicle_Service_Repair.html



Mention of trade names, products, or services does not convey, and should not be interpreted as conveying, U.S. EPA, California Department of Toxic Substances Control (DTSC) or any local governments approval, endorsement, or recommendation.

*Second reprint by DTSC, November 2001.

