

ALTERNATIVES TO PERCHLOROETHYLENE USE IN drycleaning

The City of Los Angeles Environmental Business and Neighborhood Services (EBNS) Division promotes best management practices that reduce or avoid the use of hazardous or toxic chemicals. Growing concern over perchloroethylene (perc), a solvent widely used in dry cleaning, has led to efforts to ban or restrict its use. The purpose of this fact sheet is to inform users about viable alternatives to perc and the regulations related to its continued use.

Industry Characteristics

Most dry cleaning shops are owner-operated, with fewer than five employees and often run by family members. South Coast Air Quality Management District (SCAQMD) data shows that 2,181 machines are permitted to operate at 2,086 shops. About two-thirds of these machines are of 3rd generation design (i.e., dry-to-dry transfer, closed-loop, primary emission control only). These machines may be used until 1 November 2007. The other third are of 4th or 5th generation design (i.e., dry-to-dry transfer, closed-loop, equipped with primary and secondary controls). These machines may be used until 31 December 2020.

Serious environmental concerns also exist. Perc is very stable and does not readily degrade. When released into the environment, it can result in long-term impacts to both soil and groundwater. Contamination has been found at many shops where poor practices along with cracked slab floors and leaking sewer lines has resulted in releases. Site cleanup is expensive and some landlords have refused to renew leases for those who continue to use perc.

Must I Stop Using Perc?

No, SCAQMD Rule 1421 provides for a gradual transition. Shops that start business after 6 December 2002 cannot use perc. Older

shops may operate no more than one perc system. The use of 3rd generation machines is allowed until 1 November 2007 and the use of 4th or 5th generation machines is allowed until 31 December 2020. Training requirements (all operators must pass a CARB-authorized program) and maintenance practices are also imposed. A state-licensed repair company must clean the cooling coils and replace all major gaskets every two years.

Further control may be imposed to ensure compliance with Rule 1402. This rule seeks to limit the lifetime cancer risk to the surrounding community due to the release of a TAC. Risk is based on the amount released, the location of the shop, and distance to nearest sensitive receptor.

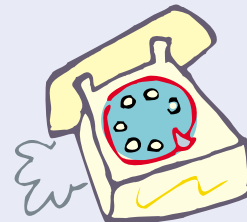
For a 4th or 5th generation machine, SCAQMD testing found perc solvent

mileage to be slightly less than 900 pounds of clothes cleaned per gallon. Typical perc use was 8 gallons per month per shop with 50 percent vented to air and 50 percent present in spent filters and still bottom sludge.

SCAQMD screening tables indicate that perc use of more than 1 to 2 gallons per month may pose an unacceptable risk to receptors within 25 meters of the source. At 75 meters, the risk may be acceptable for shops using less than 6 to 9 gallons per month (the typical amount). Shops having a severe limit imposed by the SCAQMD may need to install an alternative system to maintain productivity.

Further Information

This fact sheet was derived from a recent City sponsored study of alternatives to perc used in dry cleaning. A copy of the study may be obtained by contacting:



**City of Los Angeles Environmental Affairs Department
Environmental Business & Neighborhood Services**
(213) 978-0888

OTHER POINTS OF CONTACT:

California Cleaners Association
www.calcleaners.com (800) 390-8409

Cleaners On Line
www.cleanersonline.com

Halogenated Solvents Industry Alliance
www.hsia.org (703) 741-5780

International Fabricare Institute
www.ifi.org (800) 638-2627

Korean Drycleaners – Laundry Association
www.kdla.org (310) 679-1300

Pollution Prevention Education and Research Center
www.departments.oxy.edu/uepi/pperc (323) 259-1420

**South Coast Air Quality Management District
Small Business Assistance**
www.aqmd.gov (909) 396-3185

Available Help

The SCAQMD has a \$2 million grant program to assist in the purchase of equipment. The majority of these grants have been for DF-2000 followed by wet cleaning. The grants amount to \$5,000 for hydrocarbon-based solvents, \$10,000 for wet cleaning (washer and dryer, tensioning form finisher, and tensioning pants finisher), and \$20,000 for liquid CO₂. The funding for silicone-based solvents (i.e., GreenEarth) has been suspended.

As of March 2004, the SCAQMD has received 180 grant applications amounting to \$1,105,000. Grant funds should also be available from the State starting in 2005 when the fee on perc goes into effect. Please contact the SCAQMD Small Business Assistance Program for more information.

Help is also available from the Professional Wet Cleaning Commercialization Project sponsored by PPERC. Each approved applicant receives \$12,500 toward the purchase of new equipment and \$12,000 in guaranteed discounts and technical training. In return, the shop must serve as a demonstration site and network resource. Sites are located in Eagle Rock, Van Nuys, Hollywood, and Marina Del Rey with fourteen more planned over the next two years along with a liquid CO₂ site. Interested parties may contact the PPERC for program details.



Should I Buy A New Perc Machine?

Shops open before 6 December 2002, and if not prohibited by lease agreement, may purchase a perc machine of 4th or 5th generation design. The annualized cost for owning and operating a machine is estimated to be \$0.37 to \$0.45 per pound of clothes cleaned. The attached table presents a comparison of a new perc machine to the alternatives in common use. While perc represents the industry standard, it also has the highest annualized cost.

Major cost factors include system maintenance, regulatory compliance, and hazardous waste disposal. Solvent cost, while not a major part of total cost, will increase over time due to newly imposed fees. The price of perc is \$7 to \$8 per gallon and will increase by \$3 per gallon on 1 January 2005 when a CARB-imposed fee takes effect. This fee increases each year in \$1 increments up to a maximum fee of \$12 per gallon. The fee will be used to fund grants for shops adopting an alternative system.

Before investing in a new perc system, owners should also assess the potential impact of Rule 1402. Rule imposed limits could seriously impact productivity and force the shop to purchase an alternative system. This solution may not be feasible if floor space and/or capital are not available for a second system. Owners should consult the SCAQMD before purchasing a new system.



Comparison of Cleaning Technologies

	Perc	DF-2000	GreenEarth	Wet Cleaning	CO ₂ Cleaning
Capital Cost , for common sizes & models	\$32K – \$64K	\$38K – \$72K	\$38K – \$72K + \$2500 annual fee	\$17K – \$21K washer/dryer; \$10K – \$16K tensioner	\$80K – \$90K
Installation Cost	\$3K – \$5K	\$3K – \$5K	\$3K – \$5K	\$2K	\$10K – \$20K
Typical System Cost, Installed	\$52K	\$59K	\$61K	\$47K	\$100K
System Life	8 – 14 years	8 – 14 years	8 – 14 years	15 years	15 years
Cleaning Performance	Best on oil-based stains, good for water-based stains. Good for rayon, acetate, silk, and wool, some trims are a problem	Almost equal to perc, good for oil-based stains, easier to press, better finish	Not as effective as perc for all stains, good on water-soluble stains	Very good on water-based stains, problem with special construction garments if tensioners are not used.	Good for all soils and all fabrics except acetate; less graying, reduced dye transfer
Cleaning Time, Minutes	45	45 – 60	45 – 60	30 – 45	30 – 40
Operating Cost, \$ Per Pound (a)	\$0.37 – \$0.45	\$0.28 – \$0.36	\$0.32 – \$0.43	\$0.21 – \$0.28	\$0.31 – \$0.43
Air Permits	Use may be limited; weekly leak test; every 2 yrs clean coil & new gaskets	Monthly system inspection & test per Rule 1102, record keeping	Exempt from VOC rules & regs except for record keeping	None	None
Fire Permits	No change, must maintain the emergency vent system	Minimum 1-hr fire-resistive separation with safeguards, if allowed; 2-hr with storage limits	Minimum 1-hr fire-resistive separation with safeguards, if allowed; 2-hr with storage limits	None	Permit for compressed gas storage
Worker Health and Safety	High Risk	Med Risk	Med Risk (under review)	Low Risk	Low Risk
Grant Funding	None	\$5K	Suspended due to potential health concerns	\$10K + \$14K for demonstration sites	\$20K
Training	CARB approved certification; vendor & trade groups	Vendor & trade groups	Vendor & user network	Vendor, local demonstration sites, & outreach program	Vendor only, demonstration site is planned

(a) Based on a study by the City of Los Angeles EBNS Division. Reported range is for a shop cleaning 50,000 to 85,000 pounds of clothing per year and it accounts for capital equipment (including installation), solvent, power, process supplies (including water and detergent), system maintenance, regulatory compliance, waste disposal, and operator training. The base cost for rent, labor, insurance, and other fixed expenses has not been quantified.

What About the Alternatives?

Most alternative systems can be classified as solvent-based cleaning, professional wet cleaning, or liquid carbon dioxide (CO₂) cleaning. The two most common alternative solvents in use in the basin are DF-2000 (ExxonMobil) and GreenEarth (GE Silicones). Other solvents include PureDry (Niran Technologies Inc.), Rynex (ARCO), Resolve (R.R. Street & Co.), and Comexsol (New York Machinery Tech, Inc), although their local use has not reported by the SCAQMD.

DF-2000

DF-2000 (ExxonMobil), a hydrocarbon-based solvent, is the most popular alternative to perc. Similar solvents are available from other major refiners but their local use has not been reported. Solvent mileage in a system designed for DF-2000 is almost the same as perc (i.e., about 800 pounds of clothing per gallon). The total annualized cost for owning and operating a DF-2000 system is estimated to be \$0.28 to \$0.36 per pound of clothes cleaned.

Modern machines designed for hydrocarbon solvent are tightly controlled and provide dry-to-dry operation. Most include refrigerated condensers, computerized controls for temperature and cycle times, improved gaskets and sealants to avoid leaks, oxygen/CGI sensors and/or inert gas purging for fire safety, and vacuum assist to aid drying.

All persons owning or operating a dry cleaning shop that uses a solvent other than perc must comply with SCAQMD Rule 1102. This rule specifies that machines must be inspected for liquid and vapor leaks on a monthly schedule and operators must maintain a log of solvent use. Any operator may perform inspection and testing since there is no requirement for operator training and certification.

No person can operate or maintain a dry cleaning plant unless issued a valid Los Angeles Fire Department (LAFD) permit. The LAFD must also approve any construction or remodeling, a change in the class or quantity of solvent used, or a change in the cleaning method or equipment.

Most solvents used in dry cleaning, except for perc, are classified as Class IIIA liquids (i.e., flash point at or above 140 °F and below 200 °F). A Class IIIA shop and its associated operations must be separated from all other businesses by two-hour fire-resistive walls so long as the total

quantity of Class IIIA liquid within the building does not exceed 1,320 gallons and the individual containers or tanks do not exceed 330 gallons.

The LAFD may also approve the permit based on an "alternate method of compliance". For example, one-hour fire walls might be acceptable if the shop is equipped with an automatic fire-protection sprinkler system or if the dry cleaning equipment incorporates one or more safeguards to prevent fire. Most new systems have temperature sensors, oxygen sensors, combustible gas indicators, and safety controls to ensure safe operation. Even so, permit approval is granted on a case-by-case basis.

GreenEarth

GreenEarth (GE Silicones) is composed of a siloxane-based solvent. Siloxanes are liquid silicones that are commonly used in cosmetics. They have no odor and they are not volatile organic compounds (VOCs). Users are not required to obtain a SCAQMD permit but the recordkeeping requirements of Rule 1102 are enforced. The purchase price for GreenEarth is \$15 per gallon and shops must pay an annual user fee of \$2,500. The total annualized cost for a GreenEarth system is estimated to be \$0.32 to \$0.43 per pound of clothes cleaned.

Several GreenEarth systems are in use in the basin but concerns over worker health and safety has slowed their adoption. Toxicity tests by Dow Corning shows the solvent to increase the incidence of tumors in female rats. It is Dow's contention that the level of exposure associated with tumor development greatly exceeds typical workplace or consumer exposure. The USEPA has stated that these findings may indicate that there is a potential carcinogenic hazard but further study is required. Final test results are not expected until late 2004.

Professional Wet Cleaning

Professional wet cleaning is done in a separate washer and dryer of special design. The rotation of the wash drum is controlled to provide smooth acceleration and deceleration, resulting in an ultra-gentle action. The program software determines the best combination of wash drum water level, washing time, degree of agitation, temperature, chemical injection, and extraction cycle for a given batch of clothing.

As with aggressive wash drum agitation leading to damage, prolonged tumbling in the dryer causes shrinkage. Another cause of shrinkage is excessive drying, which accelerates when the final moisture is removed. To minimize potential shrinkage, the dryer is designed and controlled to provide a gentle tumbling action and to avoid over-drying.

The cleaning cycle takes about 45 minutes from washer through dryer, not including finishing. This dry-to-dry time is equivalent to the time needed by a new perc machine. However, wet cleaning can process more loads per hour because it uses a separate washer and dryer. A second load may begin washing while the first load is drying. The annualized cost for a new wet cleaning system is estimated to be \$0.21 to \$0.28 per pound of clothes cleaned. This is the lowest cost range reported for all systems analyzed.

A noted problem with wet cleaning is that garments may undergo shrinkage and stretching. Others complain of the need for more labor and a slowdown in production. These problems can be traced to the use of conventional pressing equipment. New tensioning equipment, along with proper operator training, can maintain productivity to a level equivalent to perc. The annualized costs noted above include the purchase of two new tensioning presses.

Another concern is the potential for damage to clothing. A recent study led by the Pollution Prevention Education and Research Center (PPEREC) had five shops participate and they reported a 96 percent success rate even though 62 percent of the garments carried a "dry clean" label. Four shops reported a 99 percent or better success rate and none reported a negative customer response.

Liquid Carbon Dioxide (CO₂) Cleaning

Another alternative to perc is liquid carbon dioxide (CO₂). The DryWash process from Global Technologies operates in a closed-loop mode, with washing, extraction, and drying performed in the same chamber. The machine includes a high-pressure cleaning chamber, a cryogenic storage tank for the liquid CO₂, a filtration and distillation unit for the removal of soil from the solvent, a lint trap, computer control, and safety interlocks. Cool Clean Technologies, Alliance, Electrolux, and Sail Star also offer CO₂ systems.

Cleaning begins by loading the chamber with dirty clothes, sealing the door, and filling the system with liquid CO₂ and detergent. Next, the liquid is circulated and returned to the chamber via fluid jets inside the chamber. These jets are arranged so that the liquid stream impacts the clothes, causing rotation. This design avoids the need for motor, shaft, and seal to rotate the chamber as in other systems.

Following the cleaning cycle, the fluid is filtered, separated from the dissolved oils and detergent, and returned to storage for reuse. The pressure inside the chamber is reduced, resulting in the cooling and drying of the clothes as the liquid evaporates. The vented gas is recompressed and cooled to recover most of the CO₂ as liquid.

Solvent mileage is dependent on the size of the machine and the allotted cycle time. One machine designed for a maximum load of 55 pounds is reported to use 10 to 15 pounds of CO₂ per load. Machines can be adjusted to reclaim more CO₂ by regulating the release pressure at the end of the cycle but this practice results in a longer cycle. The annualized cost for a CO₂ system is estimated to be \$0.31 to \$0.43 per pound of clothes cleaned.

The storage of liquefied gas requires a permit from the LAFD and the system requires a pressure vessel permit from the State. To maintain system safety, only vendor-approved parts should be used for repair. While designed for overall safety, improper maintenance of these systems can result in operator death or serious injury.