

A Cooperative Project between the U.S. Environmental Protection Agency and the Garment and Textile Care Industry

design FOR THE ENVIRONMENT



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Garment and Textile Care Program



partnership with the drycleaning industry to reduce exposures to perc. EPA's DfE Garment and Textile Care Program (GTCP) encourages professional clothes cleaners to explore environmentally-preferable technologies capable of cleaning most garments labeled "dryclean only." Numerous companies in the garment and textile care industry have begun to use a water-based system called wetcleaning in place of traditional, solvent-based drycleaning.

Case Study: Wetcleaning Systems for Garment Care

As part of a cooperative effort between the U.S. Environmental Protection Agency (EPA) and the professional garment and textile care industry, the EPA Design for the Environment (DfE) Program recognizes the wetcleaning process (i.e., water-based cleaning systems) as one example of an environmentally-preferable technology that can effectively clean garments.

Currently, most of the nation's 34,000 commercial drycleaners use perchloroethylene (PCE or perc) as a solvent to clean garments. Since 1992, in response to growing health and environmental concerns about perc, EPA has been working in a voluntary

Historical Perspective

Professional cleaners, during the 1930s and 1940s, cleaned about one-fourth of all customers' garments in water. At that time, cleaning in water was a very different process than is modern wetcleaning. It was a labor intensive, hand-washing process used primarily for natural fiber garments and for certain types of soils. Traditional drycleaning solvents were used to clean the remaining three-fourths of customers' garments. Nonflammable drycleaning solvents were developed and introduced during the 1950s. These solvents allowed cleaners to dryclean virtually any type of fabric, including natural fibers. As a result, cleaning in water was no longer viewed as necessary.

Driven by the health and environmental concerns associated with traditional drycleaning solvents, recent advances in wetcleaning technology, garment care, and textile manufacturing have resulted

DISCLAIMER: This case study has been reviewed by the U.S. Environmental Protection Agency (EPA) and approved for publication. It is based on experiences gained from projects conducted by EPA's Design for the Environment Program in collaboration with partners from industry, public interest groups, and research/educational institutions. The information contained in this document does not constitute EPA policy. Further, mention of trade names or commercial products does not imply endorsement or recommendation for use. All product performance information was supplied by the manufacturer(s) and has not been independently corroborated by EPA.

in the emergence of commercial wetcleaning as a viable and environmentally-preferable clothes cleaning technology. Trained professional cleaners are now able to wetclean many garments that typically have been drycleaned, such as silks, woolsens, linens, suede, and leather.

How Wetcleaning Works

Modern wetcleaning occurs in a commercial setting and consists of the following key elements: 1) computer-controlled washers and dryers; 2) specialized detergents (that are milder than home laundry products); and 3) trained and skilled personnel. Further, specialized finishing equipment may be required for garment pressing to be most effective.

If a cleaner has well-trained and skilled hand-finishing staff, specialized finishing equipment is not necessary.

It is also possible to wetclean garments in laundry-grade washers and dryers. In the absence of modern wetcleaning equipment, this approach requires more finishing labor and is amenable to a narrower range of garment types relative to modern wetcleaning.

Computerized operations allow for precise mechanical control in order to gently wash, dry, and finish garments. Modern wetcleaning machines may be programmed for various settings such as mechanical action, water and drying temperatures, moisture levels in the dryer, and water and detergent volume. The flexibility of this technology

The Benefits and Challenges of Wetcleaning Relative to Traditional Drycleaning

	Benefits	Challenges
Effect on Clothes	No chemical smell Whiter whites Easier to remove water based stains Better cleaning performance for some items	Some garments can shrink Some garments can change in color More difficult to remove grease based stains
Environmental Effects	No hazardous chemical use No hazardous waste generation No air pollution. Reduced potential for water and soil contamination.	Increased water use
Cost	A larger portion of the cost of cleaning clothes is associated with workers' salaries rather than chemical production and hazardous waste disposal.	Cleaners may charge more for some items to cover the increased labor costs associated with pressing and finishing.
Types of Clothes	Cotton Wool Silk Leather/suede Wedding gowns Highly decorated beads and sequins	Some acetate linings Antique satin Gabardine Some highly structured garments
Availability	All cleaners have the capacity to wetclean some items with their existing equipment and skills. Nationwide, there are a growing number of wetcleaning shops with specialized equipment and trained personnel.	In order to wetclean the widest range of garment types, knowledge of fibers and fabrics is required along with specialized cleaning and finishing equipment that many cleaners may not yet possess.



provides cleaners with the controls to administer a customized wetcleaning cycle suited to a garment's specified needs.

Others features of the modern wetcleaning process include: a) specialized fabric softeners, b) dye-setting agents that reduce bleeding, c) milder bleaching agents, and d) fabric finishes that restore fabric hand. Further, the production of new fibers and fabrics, that are especially amenable to wetcleaning, is helping to ensure that wetcleaning methods clean garments at least as well as traditional drycleaning methods. The chart opposite outlines the benefits and challenges of modern wetcleaning relative to traditional drycleaning.

Regarding mechanical agitation, a wetcleaner can set a machine to as few as six revolutions per minute to reduce the stress placed on delicate fabrics during the wash cycle. In contrast, a typical home washing machine may rotate (i.e., mechanically agitate) garments several dozen times per minute. To safely clean fabrics that can shrink when washed in water and then dried, cleaners can increase the amount of water spun out of wet garments after the final rinsing cycle so that minimal drying is needed. They can also control the temperature and humidity levels during the drying process to prevent shrinkage.

As an alternative to mechanical agitation, various companies are exploring the use of ultrasonic sound waves and the injection of very small (micron-size) air bubbles to agitate clothes during the wash cycle. It is believed that non-mechanical agitation would be gentler to fabrics and garments, perhaps producing better cleaning results and shortening the finishing process.

Trained wetcleaners also use other tools to ensure that garments are safely cleaned. For clothes that bleed, cleaners can apply an agent that prevents dye from washing out of the garments. New, milder bleaching detergents can be used to remove tough stains without diminishing color. Fabric softeners and finishes can be added during the wetcleaning process to restore fabric softness, body, and crispness.

Lastly, wetcleaners possess the equipment and expertise to professionally press and finish all wetcleaned garments.

Does Wetcleaning Involve Laundering or Hand Washing?

For years, professional cleaners have been using methods such as conventional laundering and hand washing in addition to drycleaning. While both of these processes are water-based and require cleaners to know which fabrics need special treatment, they are not the same as wetcleaning. Laundering uses standard washing and drying machines to clean certain non-delicate garments that normally would *not* be drycleaned, such as cotton slacks and shirts. Hand washing is labor-intensive and therefore limited to very delicate garments such as silk and dyed fabrics. Machine wetcleaning, in comparison, is an environmentally-preferable, high volume method of professionally cleaning clothes using state-of-the-art technologies.

Prevalence of Wetcleaning

The number of professional cleaners using wetcleaning has risen greatly in the past several years. Many are using specially designed and highly automated wetcleaning machines. Others are wetcleaning using their existing professional laundry equipment paired with the new wetcleaning detergents and specialized training. There are currently over 250 cleaners who describe themselves as wetcleaners. However, based upon sales of wetcleaning equipment and supplies, a conservative estimate of the number of cleaners offering some level of wetcleaning suggests over 3,000 establishments, or approximately 10 percent of the garment and textile care industry.

Nationwide, a number of professional cleaners have completely and successfully converted from using traditional drycleaning methods to using modern wetcleaning methods. A much larger group have found that wetcleaning, in combination with drycleaning, is more efficient and economical to implement. These shops utilize either a perc or petroleum machine along with wetcleaning equipment, or send their non-wetcleaned items off-site to either another company-owned shop or to a wholesaler. Each individual shop owner

must evaluate his or her operational and financial issues to determine the level of wetcleaning that is most appropriate. By offering some degree of wetcleaning, the professional cleaner is able to provide more cleaning options, adjust their operations to the greatest cost efficiency, and contribute to a cleaner environment.

Performance

The effectiveness of wetcleaning is a much debated question in the professional cleaning industry. Studies indicate, however, that wetcleaning usually performs as well as drycleaning or better for some garments. A study, conducted in 1997 by the University of California at Los Angeles (UCLA), estimates that the percentage of garments that can be wetcleaned using state-of-the-art wetcleaning technologies ranges from 30 percent to 100 percent of all garments that are typically drycleaned. The percentage varies according to geographic location, customer type, and operator. Moreover, in 1998, the International Fabricare Institute (IFI) stated that most garment care establishments—using their existing equipment and procedures—can wetclean from 30 to 40 percent of all customers' garments with minimal difficulty. IFI further stated that 60 to 80 percent of all customers' garments can be wetcleaned using specialized equipment, specialized detergents, and trained and skilled labor.

One aspect of wetcleaning, generally agreed upon, is that the relative proportion of garments that can be successfully wetcleaned is increasing over time as professional cleaners gain experience with this new technology. Future studies and changes in care labels will help determine the percentage of clothes that can be *routinely* wetcleaned. On a nationwide basis, wetcleaning is not a complete replacement for drycleaning processes at this time. At present, drycleaning in perc remains the most widely-used method of large-scale garment cleaning. However, a number of professional cleaners have found that they can clean up to 100 percent of all garments (that used to be drycleaned) using automated, state-of-the-art wetcleaning techniques and adequately trained personnel.

Garments cleaned by traditional drycleaning methods are not subjected to the same conditions as those garments that are immersed and agitated in water. Although modern wetcleaning machines have eliminated most of the problems that can stem from immersion in water, certain fabrics can shrink, certain dyes can bleed, and fabric texture can be altered just as they can in traditional solvents; neither method is perfect. The primary difference between the two technologies is that drycleaning relies on solvents such as perc and specialized detergents to clean clothes, while wetcleaning uses water and environmentally-preferable detergents that present less risk to human health and the environment than do perc and other traditional solvents.

Customer Acceptance and Satisfaction

Consumer demand for environmentally-preferable cleaning methods is on the rise. This increase is evidenced by the rising number of facilities offering wetcleaning services, the growing number of wetcleaning machines sold during the past several years, and the growing number of new wetcleaning products on the market.

Several studies have addressed consumer attitudes towards wetcleaning. In a 1996 study, the Center for Neighborhood Technology (CNT) found that 83 percent of customers reacted very positively or somewhat positively upon hearing about wetcleaning and that 87 percent rated the quality of the process as good or excellent. The UCLA study reveals that more than 91 percent of customers found wetcleaning to produce excellent or good cleaning results.

As public concern regarding exposures to traditional drycleaning solvents continues to grow, customers will see cleaners who offer wetcleaning as responsible businesses that are concerned about the environment. Several states now offer pollution prevention recognition programs that in part help to promote cleaners who wetclean. Various states are also developing professional wetcleaning certification programs and other incentives for cleaners to adopt environmentally-preferable processes.



Environmental, Safety, and Health Impacts

The EPA *Cleaner Technologies Substitutes Assessment for Professional Fabricare Processes*, published in June of 1998, concludes that the environmental, safety, and health impacts associated with modern machine wetcleaning are less than those associated with traditional drycleaning solvents. Wetcleaning chemicals are biodegradable and generally benign. As a basis of comparison, the impacts associated with wetcleaning are essentially identical to the environmental, health, and safety impacts associated with laundering.

The cleaning agents in wetcleaning wastewater--if left untreated and discharged directly into a waste, river, or stream--could pose risks to aquatic life. However, wetcleaning wastewater is normally discharged into a public sewer system and treated at the local wastewater treatment facility in accordance with water quality standards established under the Federal Clean Water Act. Under these normal circumstances, risks to aquatic life are minimized.

The wetcleaning process does not generate hazardous waste, air emissions, greenhouse gases, or ozone depleting substances; therefore, compliance with Federal and state hazardous waste regulations is eliminated. As a result, the environmental regulatory burden associated with wetcleaning is much less than the regulatory burden associated with the use of other traditional drycleaning solvents.

Potential human health and safety impacts are limited to minor skin and eye irritation should excess contact occur. Skin and eye exposure to cleaning agents can be eliminated or minimized through adherence to proper operational procedures.

The volume of water used for wetcleaning is greater than that required for traditional drycleaning processes. Wetcleaning consumes from two to six gallons of water per pound of clothes cleaned. Advances in wetcleaning machine technology, such as washers with water reuse tanks, are expected to result in even lesser amounts of

water consumption. In general, wetcleaning machines use less water per gallon than conventional laundry equipment.

Several studies have examined water and energy consumption associated with wetcleaning. The most comprehensive study, conducted by UCLA, found that wetcleaning has only a minor impact on water use and that it uses slightly less electricity and slightly more natural gas than drycleaning.

Capital and Operating Costs

Capital and operating costs associated with wetcleaning vary by establishment due to differences in operations, such as daily cleaning load. The costs for modern wetcleaning machines range from approximately \$12,000 to \$37,000 for a washer and dryer (30 to 50 pound capacity). In comparison, the costs for a perc washer/dryer of comparable capacity range from approximately \$32,000 to \$47,000 and the costs for a comparable petroleum machine range from approximately \$35,000 to \$52,000.

In 1999, CNT reported that specialized finishing (tensioning) equipment is increasingly recognized as an essential component of the wetcleaning process. Finishing equipment is not necessary if the cleaner has well-trained hand-finishing personnel. In addition, some manufacturers claim that traditional drycleaning pressing equipment works satisfactorily on wetcleaned garments. However, an investment in specialized wetcleaning finishing equipment will reduce labor costs associated with the finishing process. There are two basic types of wetcleaning finishing equipment, form finishers and pants toppers. The costs of each of the two equipment types range from approximately \$6,000 to \$12,000. This price range is comparable to that of traditional drycleaning pressing equipment.

Staff training represents an additional cost which can vary significantly depending upon several factors, such as whether the equipment manufacturer provides training and whether training is conducted in-shop or off-site.

A limited amount of wetcleaning may be conducted in a shop's existing, commercial washing machine by utilizing specialized wetcleaning chemicals. To cost-effectively wetclean a substantial volume of clothes, however, requires capital expenditures for new equipment and training.

Wetcleaned garments typically require more finishing work which has fueled concerns that wetcleaning labor costs may be higher than traditional drycleaning labor costs. However, much of the increased labor cost can be offset by lower costs associated with other elements of the wetcleaning process, such as hazardous waste handling and disposal costs. There is less research addressing mixed-use shops, however one recently completed study revealed that total labor production costs decreased slightly when limited wetcleaning was introduced. One factor, which accounts for this decrease is the maximizing of efficiencies between the two processes.

As with drycleaning, wetcleaning requires the purchase of specialized detergents, spotting agents, and other cleaning chemicals, but wetcleaning does not impose the costs and regulatory burdens associated with traditional solvents. In 1997, UCLA reported that most estimates indicate that the increased cost of wetcleaning detergents is more than offset by savings realized through the elimination of the purchasing, handling, and disposal costs associated with traditional drycleaning solvents.

Environment Canada and UCLA have studied energy consumption associated with wetcleaning. A report, published in 1995 by Environment Canada, found that wetcleaning used 75 percent less electricity and 43 percent more natural gas than traditional drycleaning. Another report, published in 1997 by UCLA, found that wetcleaning used 24 percent less electricity and 23 percent more natural gas than drycleaning. Because electricity and natural gas prices vary by region, cost tradeoffs will likewise vary. Overall, however, utility costs amount to only a small percentage of the total expenses associated with wetcleaning.

Impact on Businesses

Modern machine wetcleaning represents one of the latest technological advances in the garment and textile care industry. It is both a commercially viable and an environmentally-preferable garment and textile care method. In addition, wetcleaning enjoys a competitive edge over traditional drycleaning methods due to lower regulatory compliance costs.

As discussed previously, studies indicate that wetcleaning performs as well as traditional drycleaning with respect to most garment and fabric types, reduces human health and safety impacts, reduces environmental impacts, and has a high level of customer acceptance. Presently, however, wetcleaning cannot completely replace traditional drycleaning due to adverse effects on certain fabrics and dyes, primarily acetates, satins, and gabardines. Ongoing advances in fabrics and dyes, in care labeling, and in wetcleaning technology are addressing these performance issues.

Wetcleaning labor costs can be higher than traditional drycleaning labor costs due to the longer finishing times required for garments. However, much of the extra labor costs are offset by cost savings that may occur elsewhere in the process, such as hazardous waste handling and disposal costs. Labor costs can also be reduced if the cleaner invests in labor saving finishing equipment.

The environmental regulatory burden associated with wetcleaning is significantly reduced. The need to comply with the Federal and state hazardous waste regulations, and with the Federal and state water quality regulations, is eliminated.

Availability of Wetcleaning Equipment and Detergents

In response to the growing demand for wetcleaning, the number of companies that manufacture wetcleaning machines has risen from five in 1996 to nine as of May 1999. In addition, during the past several years, the number of companies that supply wetcleaning detergents and other



chemicals has increased substantially to the present number of 17 suppliers. The new wetcleaning chemicals can be used in traditional laundry equipment provided that a professional cleaner possesses adequate knowledge of fibers and fabrics or has been properly trained.

Listed below is a current compilation of wetcleaning equipment and detergent manufacturers and suppliers. Also, Greenpeace has compiled a list of professional cleaners who offer wetcleaning. This list is available on the Greenpeace web site at:

www.greenpeaceusa.org/media/factsheets/wetcleanlist.htm.

Wetcleaning Machine Companies

Aqua Clean	Edro
Aquatex	Marvel
Bowe Permac	Milnor
Continental Girbau	UniMac

Wetcleaning Detergent Suppliers

Adco	Kirk's Suede Life
Aqua Clean	Laidlaw
Aquatex	Pariser
Büfa	R.R. Streets
Colorex	Royaltone
Daewoo	Sanitone
Fabritec	Seitz
Fiber Tech	Stamford
Gurtler	

NOTE: The above listing of wetcleaning manufacturers and suppliers was compiled by the Center for Neighborhood Technology (CNT) (Chicago, Illinois). CNT has published a detailed report describing the types of wetcleaning equipment and detergents that are currently available.

What is Design for the Environment?

EPA's Design for the Environment (DfE) Program is a voluntary initiative that forges cooperative partnerships among government, industry, academia, and environmental groups. One of the primary objectives is to incorporate environmental concerns into the design and redesign of products, processes, and technical management systems.

One of the goals of the DfE Garment and Textile Care Program (GTCP) is to provide cleaners with information that can help them run their facilities in a way that is more environmentally sound, safer for workers, and more cost effective. To accomplish this goal, the program utilizes EPA expertise and leadership to evaluate the environmental and human health risks, performance, and cost tradeoffs among clothes cleaning technologies. DfE disseminates information to all interested parties and assists businesses in implementing cleaner technologies.

The GTCP is preparing several documents addressing environmentally-preferable and commercially viable clothes cleaning technologies. The following documents and others are now available in hardcopy and on the GTCP web site at www.epa.gov/dfe/garment/garment.html:

- *Wetcleaning Directory* (EPA 744-B-99-002).
- *Case Study: Water-Based Cleaning System for Suede and Leather* (EPA 744-K-98-017)
- *Case Study: Liquid Carbon Dioxide Surfactant System for Garment Care* (EPA 744-K-99-002)

As more information becomes available on other new technologies, EPA will develop case studies addressing them as well.

References

American Drycleaner, "IFI Issues Official Position Statement on Wetcleaning," August 1998.

Center for Neighborhood Technology (CNT). September 1996. *Alternative Clothes Cleaning Demonstration Shop: Final Report*. Chicago, Illinois.

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Environment Canada. June 1995. *Final Report for the Green Clean Project*. Government of Canada Document No. EN40-5-0/1995/E. Ottawa, Ontario, Canada.

University of California at Los Angeles (UCLA)/Occidental College. December 1997. *Pollution Prevention in the Garment Care Industry: Assessing the Viability of Professional Wetcleaning*. Final Report. Pollution Prevention and Education Research Center. Los Angeles, California.

U.S. Environmental Protection Agency. June 1998. *Garment and Textile Care Program--An Eye to the Future: 1998 Conference Proceedings*. Publication No. EPA 744-R-98-006. USEPA Office of Pollution Prevention and Toxics. Washington, D.C.

U.S. Environmental Protection Agency. June 1998. *Cleaner Technologies Substitutes Assessment for Professional Fabricare Processes*. Publication No. EPA 744-B-98-001. USEPA Office of Pollution Prevention and Toxics. Washington, D.C.

For More Information

- To obtain a copy of the CNT report titled *Wetcleaning Equipment Report: A Report on Washers, Dryers, Finishing Equipment, and Detergents for Machine-Based Professional Wetcleaning*, contact Mr. Anthony Star at:

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2125 West North Avenue
Chicago, Illinois 60647
Telephone: (773) 278-4800, Extension 299
Fax: (773) 278-3840
Visit the CNT web site: www.cnt.org/wetcleaning

- To obtain a copy of the UCLA report titled *Pollution Prevention in the Garment Care Industry: Assessing the Viability of Professional Wetcleaning*, contact Dr. Peter Sinsheimer at:

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Fax: (323) 259-2734
Visit the PPERC web site at:
www.oxy.edu/departments/pperc/

- To obtain a copy of the Environment Canada report titled *Final Report for the Green Clean Project*, contact Ms. Deb Foster at:

Deb Foster
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100 Charlotte Street
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Telephone: (519) 337-3423
Fax: (519) 337-3486
Visit the C2P2 web site at: C2P2.sarnia.com

- Contact the EPA Pollution Prevention Information Clearinghouse (PPIC) to receive an information packet about EPA's DfE Program or the Garment and Textile Care Program (GTCP), or to request single copies of DfE documents, or a revised DfE Publications List:

EPA's Pollution Prevention Information Clearinghouse (PPIC)
U.S. Environmental Protection Agency
401 M Street, SW (7407)
Washington, DC 20460
Telephone: (202) 260-1023
Fax: (202) 260-4659
E-mail: ppic@epa.gov

- Visit the EPA DfE Garment and Textile Care Program web site:
www.epa.gov/dfе/garment/garment.html
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