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**THE MASSACHUSETTS  
TOXICS USE REDUCTION INSTITUTE**

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**UTOPIA CLEANERS  
ARLINGTON, MASSACHUSETTS**

**GARMENT WET CLEANING**

**TOXICS USE REDUCTION INSTITUTE  
CLEANER TECHNOLOGY  
DEMONSTRATION SITES PROGRAM**

**Technical Report No. 35**

**1996**

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**University of Massachusetts Lowell**



**Utopia Cleaners  
Arlington, Massachusetts**

**Garment Wet Cleaning**

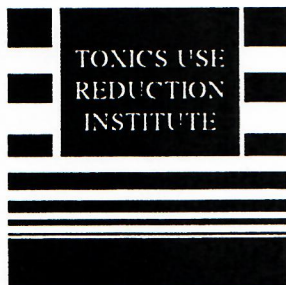
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**The Toxics Use Reduction Institute  
University of Massachusetts Lowell**

**1996**



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## Preface

In its 1996 fiscal year, the Massachusetts Toxics Use Reduction Institute launched the first Cleaner Technology Demonstration Sites Program. The goal of the program was to promote the adoption of cleaner technologies by Massachusetts industry. Five companies were selected as demonstration sites to showcase the implementation of technologies that embrace the concepts and principles of toxics use reduction. The program, which included a series of visits to the facilities and related presentations and publications, allowed individuals and firms to observe and assess their value first-hand. Site visits were open to industry, environmental groups, community groups, the media and others.

Associate sponsors of the program included the Massachusetts Office of Technical Assistance for Toxics Use Reduction, the Executive Office of Environmental Affairs, the Department of Environmental Protection, the Environmental Protection Agency of New England, and the Associated Industries of Massachusetts.

This was the first of an annual program allowing a broad range of companies to showcase cleaner technologies. The program will continue to provide grants to recognize the many companies across the Commonwealth that have used toxics use reduction and cleaner technologies while enhancing their firm's competitiveness.

The following report is an in-depth analysis of the cleaner technology demonstrated at Utopia Cleaners, Arlington, Massachusetts.

We would like to express sincere thanks to John Raschko, Office of Technical Assistance, Deborah Savage, Tellus Institute, and Tom Votta, Tellus Institute for their helpful comments and insights in the development of this report.

## Notice

This report has been reviewed by the Institute and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Toxics Use Reduction Institute, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.



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## 1.0 INTRODUCTION

Over 80% of the U.S. professional garment cleaning industry today uses perchloroethylene (perc). In 1991, more than 30,000 dry cleaning shops nationwide used 270 million pounds of perc, two-thirds of which was lost to the atmosphere.<sup>1</sup> In recent years, studies have identified ecological and human health hazards associated with perc usage. The National Institute for Occupational Safety and Health has recommended that perc be handled as a human carcinogen, the Environmental Protection Agency (EPA) has classified it as a possible human carcinogen via oral exposure<sup>2</sup>, and dry cleaners that use perc must comply with a variety of federal regulations requiring the use of emission control technologies and practices.

Utopia Cleaners of Arlington, Massachusetts has revolutionized its garment cleaning business by replacing its nine year old Renzacci dry cleaning machine with DaeWoo wet cleaning equipment. This replacement has eliminated the use of perc in its Arlington facility. By shifting its business to wet cleaning, Utopia Cleaners serves as a great example of toxics use reduction.<sup>3</sup> By replacing perc with water and biodegradable detergents, Utopia no longer generates any hazardous waste and is no longer subject to most environmental regulations.

## 2.0 GARMENT CLEANING TECHNOLOGIES

Customers choose to clean their garments for many reasons. The garment may be soiled, it may have an objectionable odor, or it may simply be wrinkled. Depending on garment type, care labelling, and consumer preference, garments may either be professionally cleaned or cleaned at home. Garments cleaned at home are typically machine washed with water-based detergents, or hand washed. Professional garment cleaners must use the specific cleaning process that will solve the problem without damaging the garment. The cleaner will pre-treat soils, if necessary, and then may use perc, petroleum, or water-based cleaning equipment to clean the garments. In addition, a professional cleaner provides finishing operations such as steaming and pressing.

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<sup>1</sup> Wolf, Katy, "Case Study: Pollution Prevention in the Dry Cleaning Industry: A Small Business Challenge for the 1990's," *Pollution Prevention Review*, Summer 1992.

<sup>2</sup> U.S. EPA, Office of Compliance, "Sector Notebook Project: Profile of the Dry Cleaning Industry," EPA/310-R-95-001, September 1995, p.31.

<sup>3</sup> As defined by the Massachusetts Toxics Use Reduction Act (TURA) of 1989, TUR is "... in-plant changes in production processes or raw materials that reduce, avoid, or eliminate the use of toxic or hazardous substances or generation of hazardous byproducts per unit of product, so as to reduce risks to the health of workers, consumers, or the environment, without shifting risks between workers, consumers, or parts of the environment."



## 2.1 Dry Cleaning

Perc-based dry cleaning has been popular because of perc's non-flammable nature and its ability to clean garments with minimal shrinkage, color bleeding, or wrinkling. In recent years, however, influenced by information on the ecological and human health hazards related to perc exposure and by regulations, the dry cleaning industry has been changing the way they use perc. In order to meet stricter emission standards, dry cleaning equipment manufacturers have continuously developed new machines to reduce perc emissions and increase perc recovery and reuse.

The principle of perc dry cleaning involves adding perc, detergents, and other chemicals to a machine loaded with garments. The garments are agitated to encourage the penetration of the cleaning agent (solvent) into the fibers of the garment. When the cleaning cycle is complete, the machine rinses the garments with fresh perc and then extracts the cleaning agent from the clothing and recycles it. The clothing is then tumble-dried.

There are three basic types of perc-based dry cleaning equipment: transfer, dry-to-dry vented, and dry-to-dry closed loop, which comprise 34%, 21%, and 45% of the perc-based dry cleaning industry, respectively.<sup>4</sup>

### 2.1.1 Transfer Machines

In transfer systems, the garments are cleaned in one machine and the perc-laden clothing is manually transferred by an operator to a dryer where the perc is evaporated from the clothing. Significant air emissions, which affect operators, workers, and customers through inhalation, occur during this transfer. The operator handling the perc-saturated clothing may also experience skin irritation from direct contact with the solvent. Although transfer systems contribute to the highest perc exposures and releases in the garment cleaning industry, they may be retrofitted with room enclosures and vapor recovery systems to capture some air emissions.

### 2.1.2 Dry-to-Dry Vented Machines

Dry-to-dry vented machines expose workers, customers, and the surrounding environment to reduced levels of perc emissions. In these machines, garments are immersed in perc and then dried, eliminating the perc emissions that result from transferring saturated clothing between machines. However, there are still emissions from dry-to-dry vented machines which are designed to vent perc to the atmosphere. These machines may be retrofitted with control devices, such as refrigerated condensers, to capture the vented emissions.

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<sup>4</sup> U.S.EPA, Office of Compliance, "Sector Notebook Project: Profile of the Dry Cleaning Industry," EPA/310-R-95-001, September 1995, p. 15-17.



### 2.1.3 Dry-to-Dry Closed Loop Machines

Dry-to-dry closed loop machines do not vent emissions to the atmosphere, since the air used for drying is continuously recycled through the machine. Perc is recovered from this air stream by cooling it to below its dew point with a refrigerated condenser. The "cleaned" air is recirculated back into the cleaning drum, and the condensed perc is captured and returned to the solvent tank. (See the process flow diagram in Figure 1.) Although closed loop machines are not designed to release perc to the atmosphere, they may have fugitive emissions from leaks and worn gaskets.

### 2.1.4 Perc Recovery and Reuse

The recovery and distillation of perc generates hazardous waste from several sources. Perc from the washing cycle is passed through a filter, which removes suspended (non-soluble) soils before returning the perc to the next cycle. The liquid solvent is also periodically sent through a distillation unit to remove fats, oils, and other soluble soils. Sludge generated in the filtration unit is also sent to the still to recover as much perc as possible. Residue sludge must be removed from the still and disposed of as hazardous waste.

Perc vapor is recovered through carbon adsorbers and/or refrigerated condensers. Refrigerated condensers use water for cooling, while carbon adsorbers generate large amounts of perc-contaminated waste water in the desorption process. Some perc is separated from the desorption water in a water separator and returned to the process, but some perc-contaminated water may be discharged to the sewer, evaporated, or disposed as hazardous waste.

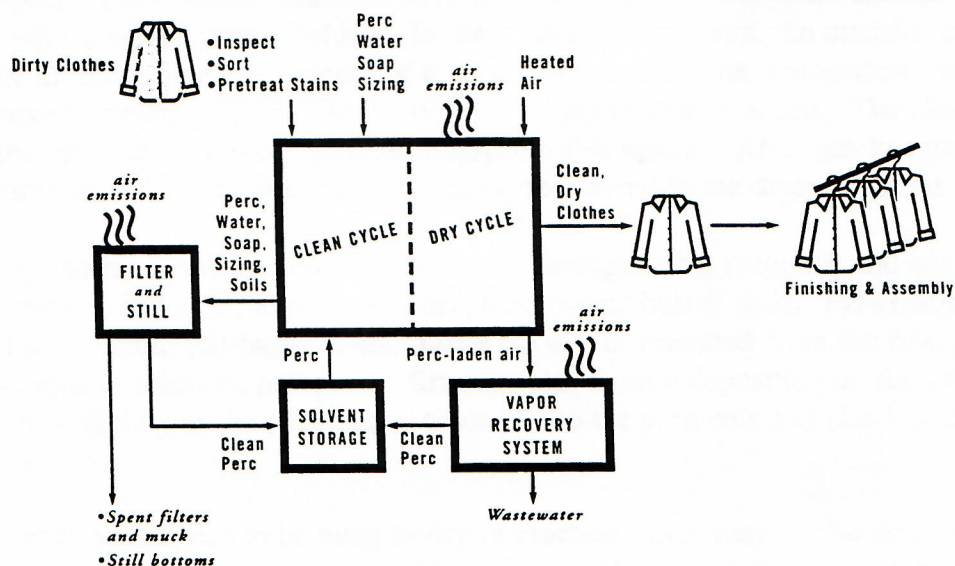


Figure 1: Process Flow Diagram for Dry Cleaning



## 2.2 Wet Cleaning Systems

Garment wet cleaning is an effective way to reduce significantly or eliminate the need to clean special care fabrics with perc. Wet cleaning uses biodegradable detergents and water instead of perc. Two types of garment wet cleaning are used to achieve the best quality garment care: multiprocess wet cleaning and machine wet cleaning. Both of these wet cleaning methods are distinct from home laundering, since the necessary skills and the knowledge of fibers and fabrics are unique to the garment care professional.

These cleaning processes have enabled garment care professionals to increase significantly the percentage of garments they clean in water. New wet cleaning technologies and cleaning agents are continually being developed, many of which improve and simplify the cleaning process.

### 2.2.1 Multiprocess Wet Cleaning

In multiprocess wet cleaning each garment is handled individually and water is applied in a controlled manner. The process involves operations such as sorting, stain removal, gentle hand washing, scrubbing, steaming, and hang drying. This is a time-consuming and labor-intensive process that requires a somewhat higher level of skill than dry cleaning.

### 2.2.2 Machine Wet Cleaning

The need for machine wet cleaning became evident with the realization that the labor-intensive nature of multiprocess wet cleaning would not be economically feasible as a stand alone process. Specially engineered machines have been developed to wet clean clothes in an automated but extremely gentle fashion. In these advanced systems, the machine operator may program the cleaning time, the amount of mechanical agitation, the temperature, and the degree of water extraction specific to the type of garments being cleaned. The clothes are placed in the machine with water and cleaning/protective agents. After gentle agitation, the water is extracted and the garments are manually transferred to the drying process (see Fig.2).

Wet cleaning machines use special soaps based on biodegradable materials and enzymes that effectively remove inorganic as well as hydrophilic (water-based) soils. Pre-treatment is only necessary for lipophilic (oil-based) soils. Once the soil is separated from the fiber, the soaps suspend the soils in solution, preventing dirt and color from redepositing on the garment. Use of soaps with a slightly acidic pH inhibits color loss to the garments and also benefits certain fibers such as wool.

Some clothes may still need to be hung to dry (a practice which may not be done with perc-cleaned clothes), while many can be dried by machine. Leaving some residual moisture in the garment helps avoid shrinkage. New clothes dryers may be equipped with sensors to monitor the amount of moisture left in the garments and therefore avoid shrinkage due to over drying.



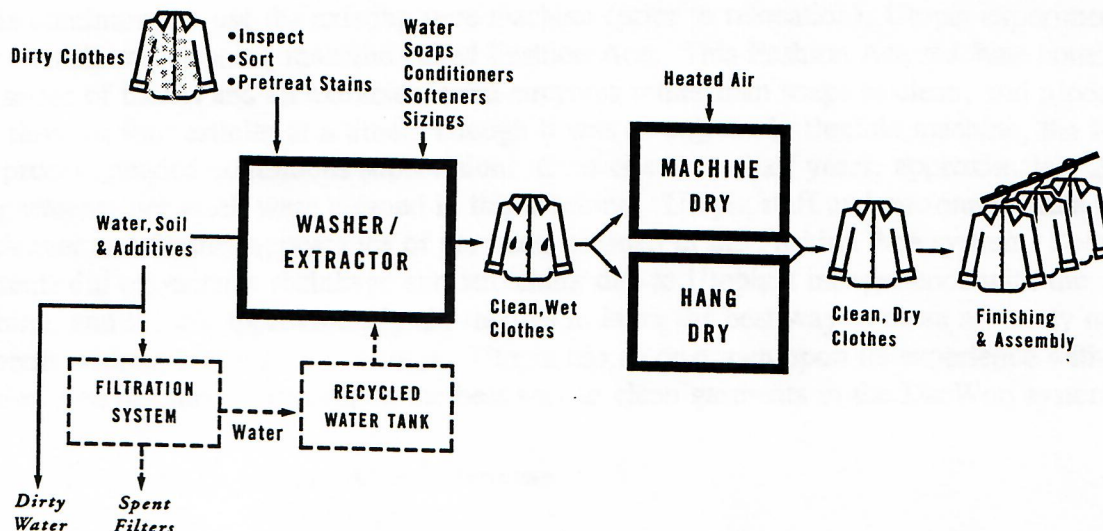


Figure 2: Process Flow Diagram for Wet Cleaning

There is a range of wet cleaning equipment that has been successfully used by garment care specialists to achieve the performance results that they want at a price that is acceptable to their customers. Some cleaners have achieved excellent results using standard home washing machines to clean certain types of garments, while others have purchased more sophisticated wet cleaning systems with microprocessor controls and a variety of features. A survey of wet cleaning machine manufacturers was published by the Center for Neighborhood Technology and lists specifications for five machines.<sup>5</sup>

### 3.0 UTOPIA'S WET CLEANING EXPERIENCE

Utopia was motivated to use wet cleaning because of a negative experience with site contamination. The original location of Utopia Cleaners was several blocks from the current site, where both site and equipment were leased. Shortly after the lease was signed, perc contamination was discovered on the site. Under Massachusetts General Law Chapter 21E (similar to the federal Comprehensive Environmental Resource Compensation and Liability Act or Superfund), the owner of Utopia, Myeong-Ho Lowe, was held partially liable for the contamination. A drawn-out legal battle ensued, resulting finally in Utopia's release from its lease and relocation to a nearby site. Over the course of these years in court, Mr. Lowe heard about the growing interest in wet cleaning and decide to try it himself.

<sup>5</sup> Vasquez, Cynthia, "Wet Clean Machines," Center for Neighborhood Technology, Chicago, August 1995. Note: The DaeWoo machines used at Utopia Cleaners are not included in this report.



### 3.1 Experience with Fashion Ace Equipment

While continuing to use the existing perc machine (prior to relocation), Utopia experimented with a small wet cleaning machine called Fashion Ace. This Fashion Ace machine consisted of a series of basins and an extractor, used enzymes rather than soaps to clean, and processed only three or four articles at a time. Though it was an extremely flexible machine, the Fashion Ace process needed continuous supervision. Over one and a half years, approximately 200 to 400 garments per week were cleaned in this machine. Utopia staff and customers alike noted the cleaner and fresher appearance of garments cleaned in the Fashion Ace system. Some garments did experience shrinkage and stretching due to Utopia's inexperience with the machine, and it took approximately six months to learn the best way to clean a variety of garments without causing any damage. Utopia has since drawn upon its experience with the Fashion Ace machine to determine the best way to clean garments in the DaeWoo system.

### 3.2 Current Equipment and Process

When Utopia moved to its new location in early 1996, it replaced its nine year old Renzacci closed-loop dry cleaning machine and its Fashion Ace machine with four DaeWoo Air-Power Washers (Model DWF-9290PA) and one Cissel dryer (Model L36URS30S) equipped with a humidity sensor. The DaeWoo machines use air bubbles to agitate the clothes, rather than a rotating cylinder, like a conventional home washer, or horizontal "fins," like a dry cleaning or wet cleaning machine (See Figure 3). The bubbles serve to enhance the washing power by increasing the amount of dissolved oxygen and detergent in the water, while being extremely gentle to the garments.

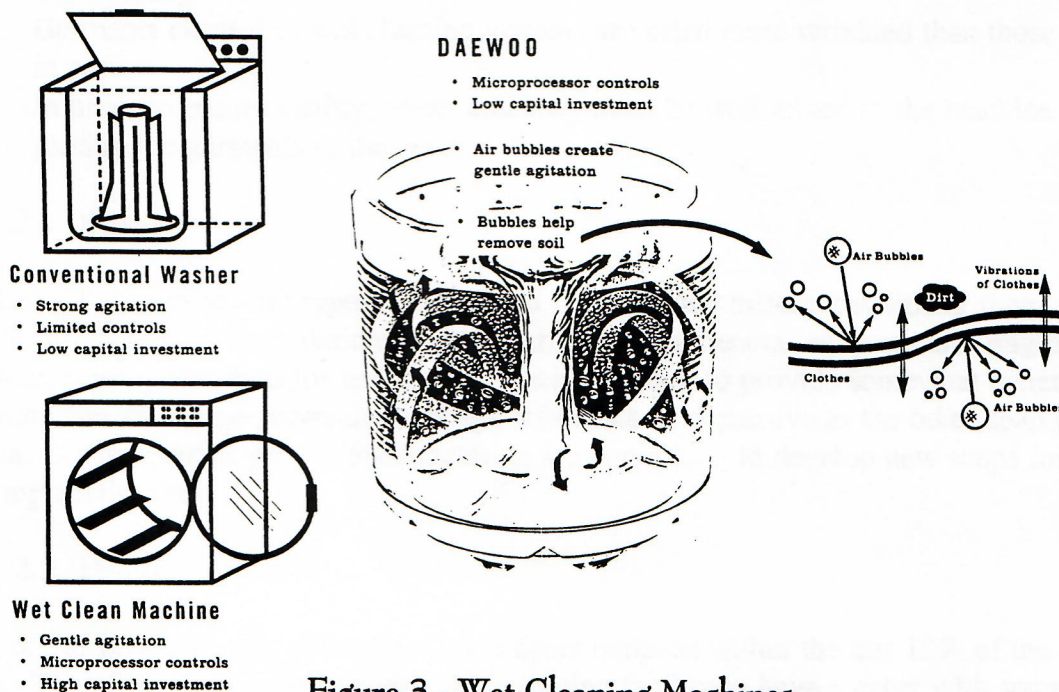


Figure 3 - Wet Cleaning Machines



The machines that Utopia installed have a larger capacity and a more automated process than the Fashion Ace equipment, which significantly reduces labor. The capacity of the four machines combined is approximately equal to that of a single 40 pound dry cleaning machine. The fact that this capacity is split among four machines allows for greater flexibility in the cleaning process. For example, loads can be sorted more specifically by type and color, and special items can be cleaned separately in one machine without compromising the full capacity of the shop. The typical machine cycle is approximately 30 minutes and involves steps typical to any garment cleaning process, including:

- sorting garments by color and fabric,
- pre-treating stains,
- programming the machine (cycle time, rinse frequency, agitation, water level, temperature),
- filling the machine with water,
- adding detergent,
- placing garments in the machines,
- transferring garments to dryer, and
- pressing and finishing garments.

Mr. Lowe has been impressed with the cleaning results of the new equipment, and made the following observations:

- Wet cleaning requires a somewhat higher level of skill to decide the best technique to clean each garment.
- Wet cleaned garments have a better odor than dry cleaned garments.
- The tendency for garments to shrink or change color in wet cleaning is comparable to dry cleaning.
- Garments cleaned in wet cleaning systems are often more wrinkled than those cleaned in perc.
- In order to ensure quality, water and soap must be well mixed in the machine before placing the garments in the water.

### 3.2.1 Soaps

Mr. Lowe has tried several types of soaps and feels that the differences among them are not significant. The soap formulations include surfactants, softeners, enzymes and fragrances. The soap sold by DaeWoo for use with its machine seems to provide somewhat better softening and shrinkage prevention, though it is twice as expensive as the other soap tested at Utopia. As the market grows, manufacturers are continuing to develop new soaps for wet cleaning applications.

### 3.2.2 Drying

Most of the shrinkage that will occur in the dryer happens within the last 10% of the drying cycle. Therefore, it is important for a wet cleaning facility to have a dryer with some type of humidity sensor. Operators at Utopia set the moisture sensor between 10% and 20%, to



ensure that the clothing is removed when still moist. The Cissel dryer at Utopia, Model L36URS30S, has a humidity sensor that measures the moisture in the dryer air. Other dryers on the market use a contact-moisture sensor, which measures moisture in the garments to determine when the garments have reached the desired level of dryness. Utopia still experiences some problems with drying of shoulder pads and other clothes with uneven thicknesses. Mr. Lowe attributes this primarily to heat distribution in the dryer drum, which could be improved if the drum were stainless steel. Additionally, the drum in this model turns only in the clockwise direction. Better drying could be achieved with a reverse-action drum which improves heat distribution to the clothes by exposing more of the garment surface to heated air on each turn.

### 3.2.3 Pressing

Because wet cleaned garments tend to be more wrinkled than garments cleaned in perc, it is beneficial to have state-of-the-art pressing equipment. In order to maintain its high quality of service, Utopia purchased new pressing equipment and only slightly increased the time spent pressing each garment. The pressing equipment now at Utopia includes a Sankosha Panther Press CN200 (pants finisher), a Sankosha Sunformer CN50 (form finisher or "SUZI"), and a utility press. The Sankosha units put tension on the garment while steaming, helping to ease out shrinkage that may have occurred, while removing any wrinkles in the garment's surface. Compared to the old pressing equipment used with the Fashion Ace wet cleaning system, there has been a significant increase in Utopia's pressing capacity.<sup>6</sup> However, compared to its old dry cleaning system, Utopia's pressing rate has slowed by approximately four pieces/hour or one extra hour for every 100 pieces. An analogy made by Mr. Lowe is that dry cleaning with standard pressing equipment is like wet cleaning with his new Sankosha units.<sup>7</sup>

### 3.2.4 Volume

By adopting a wet cleaning system, Utopia Cleaners has significantly reduced the amount of perc used to clean garments, dramatically reducing its impact on the environment, and eliminating exposure to perc in its Arlington facility. Utopia currently cleans approximately 75% of the 100 garments that come into the facility in the DaeWoo machines and sends the remaining 25% out to its Somerville plant to be cleaned in a closed-loop perc machine. Things such as heavy wool coats and blankets are dry cleaned because their wet weight makes them difficult to clean in the DaeWoo equipment due to the gentle nature of the machine. About 25% of the garments brought into its Somerville plant and 25% of those brought to its drop store in Charlestown are sent to Arlington for wet cleaning. The remaining 75% of the garments from each of those locations are dry cleaned at the Somerville shop. Overall, approximately 45% of the combined volume from the three stores is wet cleaned, while the remaining 55% is dry cleaned in the Somerville plant.

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<sup>6</sup> When using Fashion Ace, all garments were air dried. The use of a dryer significantly helps remove wrinkles prior to pressing.

<sup>7</sup> Other manufacturers make equipment that provide similar features to the Sankosha units.



Technically, the number of garments from these other locations that are wet cleaned could increase. However, capacity at Utopia and transport time between the sites have limited this opportunity. The recent installation of two DaeWoo machines at the Somerville facility should help increase the percentage of wet cleaned garments for the three facilities.

#### 4.0 ENVIRONMENT, HEALTH & SAFETY

Perc was introduced to the dry cleaning industry approximately 40 years ago as a solution to the safety hazards associated with other solvents that were being used in the industry at that time, primarily petroleum based solvents. Because it has a high flash-point, perc usage improved the safety of the dry cleaning industry. However, recent experience and scientific research have revealed that perc has detrimental effects on the environment and human health. A variety of epidemiological studies have documented an association between the following human health effects and perc exposure<sup>8</sup>:

- Peripheral neuropathy (dizziness and fainting) through chronic exposure
- Three- to four-fold increased odds of miscarriage
- Various forms of cancer (esophageal, kidney, and leukemia)
- Menstrual disorders
- Male and female infertility
- Skin sensitization and eye irritation

There have been no studies performed to evaluate the health effects of the wet cleaning process. However, by replacing the use of perc in the garment cleaning business with non-toxic wet cleaning detergents, the negative health and environmental effects associated with the use of perc in dry cleaning will be eliminated.

Regardless of the level of control equipment used on a dry cleaning machine, it is inevitable that some perc will eventually be released to the environment and workers will be exposed. The major pathways by which dry cleaning operations release perc are:

- fugitive emissions during transfer of garments to dryer
- fugitive emissions during still cleaning or filter replacement
- vented emissions
- filters and muck (used solvent is passed through a filtration system; muck refers to the sludge which builds up on the filters)
- still bottoms, or the sludge that accumulates when perc is distilled and returned to the process
- fugitive emissions from leaky pipes, seals, flanges, and pumps
- contaminated wastewater from water separators (from carbon adsorbers, refrigerated condensers & stills)

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<sup>8</sup> Aggazotti, Gabriella, et. al., "Occupational and Environmental Exposure to Perchloroethylene (PCE) in Dry Cleaners and Their Family Members," Archives of Environmental Health, V49, No.6, (1994).



- dryer exhaust
- transportation and on-site spills
- incineration of solvents and filters
- volatilization from the clothes during the pressing process
- off-gassing from dry cleaned clothes in the first few days after they have been cleaned

In addition, dry cleaning workers may be exposed to perc or other solvents while using stain removal agents to pre-treat stains on the garments. Wet cleaning stain removal agents will not include such solvents in their formulations since they are not compatible with a wet process. Stain removal for the wet cleaning process may, however, use agents such as ammonia, sodium hypochlorite, and hydrogen peroxide, which are associated with adverse health effects and must be handled with care.

By implementing this wet cleaning system, the workers at Utopia Cleaners are no longer exposed to perc at the Arlington facility, and Mr. Lowe is no longer encumbered by the regulations and liability associated with the generation of hazardous waste.

#### 4.1 Environmental and Health & Safety Regulations

There are no regulated hazardous wastes or air emissions produced in the wet cleaning process. The detergents used in wet cleaning are biodegradable and will not harm sewer or septic systems.

By contrast, perc is regulated under several environmental statutes, requiring significant compliance efforts from individuals in the dry cleaning industry. The major federal statutes that potentially affect a commercial dry cleaning business are listed below. State and local regulations vary from location to location.

- Resource Recovery & Conservation Act (RCRA)
- Comprehensive Environmental Response, Compensation, & Liability Act (CERCLA) or Superfund
- Clean Air Act Amendments (CAAA) of 1990
- Occupational Safety & Health Act (OSHA)
- Clean Water Act
- Safe Drinking Water Act

#### 4.2 Water and Energy Use

Water enters the dry cleaning process as moisture brought in on the clothing, water added to the perc to help in the removal of water soluble soils, and water used to distill, cool, and reclaim the solvent. When Utopia was dry cleaning in its original location, no cooling tower was used in the solvent reclamation process, and thus large quantities of water were used. A dry cleaner that uses a carbon adsorber may also use large quantities of water for desorption



which would then go to a water separator. Although separator water typically contains low concentrations (150 ppm) of perc, perc-contaminated water is classified as a hazardous waste under U.S. Environmental Protection Agency (EPA) regulations if it contains more than 0.7 ppm perc.<sup>9</sup> Therefore, to avoid initiating RCRA, it is suggested that perc-contaminated wastewater be properly disposed of as hazardous waste, regardless of concentration, generating significant disposal costs.

Utopia's new facility uses significantly less electricity and water than the old dry cleaning plant. Water consumption depends on the type of wet cleaning systems that are used. Utopia's water consumption has decreased because the wet cleaning process uses less water than the cooling cycle of the old dry cleaning machine. The 21-pound DaeWoo machine uses between 0.8 to 3 gallons of water per pound of clothes, compared to the larger wet cleaning machines which may use between 4 and 6 gallons per pound of clothes.<sup>10</sup> Options to reduce water use through in-process recycling are being developed to meet the needs of the industry.

#### 4.3 Reductions in Toxic Chemical Use and Release

Before converting to a 100% wet cleaning facility, but after the implementation of the Fashion Ace system, Utopia used 150 to 175 gallons (2025 to 2363 pounds) of perc annually. Utopia generated approximately 3600 pounds of perc contaminated waste (including filters and sludge) annually at its Arlington facility, which was removed by a hazardous waste handler. Since converting to wet cleaning, Utopia no longer generates hazardous waste and is no longer regulated under the Clean Air Act, RCRA, and analogous state and local statutes. Additionally, Utopia's liability under CERCLA and M.G.L. Chapter 21E has been all but eliminated. The Somerville facility still uses approximately 1350 pounds of perc annually to dry clean garments accepted at all three facilities.

#### 5.0 WET CLEANING COSTS

A meaningful cost comparison between wet and dry cleaning is difficult to accomplish with data collected for this case study because many changes were made at Utopia in addition to its change to wet cleaning. Table 1 presents a list of estimated actual costs associated with either the wet cleaning or dry cleaning process, but these figures alone do not support a direct comparison or total cost assessment. A more detailed breakdown of costs is being developed by Tellus Institute and will be included in a forthcoming U.S.EPA Pollution Prevention/Waste Minimization manual for dry cleaners.

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<sup>9</sup> Center for Emissions Control, "The Safe Handling of Perchloroethylene Dry Cleaning Solvent," August 1995, p.11.

<sup>10</sup> Patton, Jo and William Eyring, Center for Neighborhood Technology, "Alternative Clothes Cleaning Demonstration Shop, Final Report," September 1996, pp.3-5.



Table 1

		Dry Cleaning	Wet Cleaning
Capital Costs			
Dry-Dry Closed Loop (35 lb. capacity)		\$35,000	-----
DaeWoo Model DWF-9290PA (4)		-----	\$3,800
Cissel Model L36URS30S		-----	\$3,000
Sankosha Panther Press CN200		\$12,000	
Sankosha Sunformer CN50		\$7,000	
Annual Operating Costs			
Hazardous Waste Disposal		\$1,800	-----
Filter Purchase		\$400	-----
Electricity Use		\$4,800	\$1,800
Gas		-----	\$3,600
Oil		\$1,800	-----
Water and Sewer		\$3,000	\$1,000
Cost of Cleaning Agents	perc	\$1,275-\$1,500*	-----
	soaps & detergents	\$300	\$750**

\* assumes perc cost of \$8.50/gallon

\*\* assumes \$0.20/8 lb. load

## 6.0 TRANSFERABILITY OF WET CLEANING TECHNOLOGY

As Utopia's experience with and knowledge of wet cleaning technology increased, the percentage of garments that are wet cleaned has also increased. There are a growing number of facilities in the United States and many established facilities in other countries that are able to process all or most of their garments with wet cleaning equipment.

Customer reactions to wet cleaning have been mixed. Utopia posted information about the benefits of wet cleaning during its transition period and now receives many customer requests



that their garments be cleaned with the wet cleaning process exclusively. However, other customers fear that wet cleaning will damage their clothes due to the dry cleaning stipulation on care labels. The Federal Trade Commission (FTC) is currently reviewing care labelling rules to evaluate the possibility of changing the "dry clean only" phrase to incorporate professional wet cleaning as well. The FTC has received comments on the feasibility of changing the care labelling rules to include wet cleaning, and has requested additional comments.

The Center for Neighborhood Technology in Chicago performed an independent analysis in conjunction with a 100% wet cleaning shop over the course of one year. The information in this report is helpful to anyone interested in opening a wet cleaning shop. Some of the key conclusions are<sup>11</sup>:

- A significant portion of garments now cleaned in traditional dry cleaning solvents can be wet cleaned.
- There is strong customer demand for alternative garment cleaning methods.
- Color loss, migration or splotchiness are not significant performance problems in wet cleaning.
- Dimensional change (shrinking and stretching) is the most significant performance problem in wet cleaning.
- With the current state of technology, commercial operations relying on 100% wet cleaning face the challenge of maintaining cost effective, high quality performance for a small percentage of garments.
- Wet cleaning is safer for the environment than traditional dry cleaning.

The experience of Utopia Cleaners shows that wet cleaning is a viable alternative for the garment cleaning industry. In addition, the increasingly strict environmental regulations and mounting hazardous waste disposal costs may weigh heavily enough on the industry to induce more garment cleaners to make this environmentally friendly switch. Since the owner of Utopia also owns a perc plant, the Arlington facility has the advantage of being a perc-free facility, a benefit for both workers and customers. Many dry cleaning plant owners may choose to install wet cleaning systems in conjunction with their perc machines to handle increased volume of work while reducing the amount of perc they use.

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<sup>11</sup> Patton, Jo and William Eyring, pp. 3-5.





## Cleaner Technology Demonstration Site Case Study Utopia Cleaners, Arlington, MA

### Garment Wet Cleaning

#### Summary

Perchloroethylene, or perc, is the cleaning agent used by over 80% of U.S. dry cleaners. More than 30,000 dry cleaning machines nationwide used 270 million pounds of perc in 1991, two thirds of which was lost to the atmosphere.<sup>1</sup> Though emission control technologies have helped to reduce the volume of perc that is lost, large amounts of perc are still used by the dry cleaning industry. In recent years studies have identified ecological and human health hazards associated with perc usage,<sup>2</sup> prompting users and consumers to seek alternative processes. One garment cleaning alternative that has emerged uses water and biodegradable detergents to remove soils. Utopia Cleaners of Arlington, Massachusetts has purchased a DaeWoo wet cleaning machine which replaced its perc dry cleaning machine, making Utopia a perc-free garment cleaning facility.

#### Background

There are two basic types of dry cleaning systems: transfer and dry-to-dry. In transfer systems garments are immersed in perc and then transferred by the operator to a separate drying machine. Prior to adopting wet cleaning, Utopia operated a dry-to-dry machine in which garments are immersed in perc, extracted and dried in the same machine. Perc is an effective cleaning agent because it is able to penetrate fibers and dissolve lipophilic (non-water soluble) soils such as oils, greases and fats with minimal damage to garments.

There is ongoing debate about the carcinogenicity of perc, with varying positions being taken by different agencies. For example, while the U.S. Environmental Protection Agency (EPA) considers perc a suspect carcinogen, the National Institute for Occupational Safety and Health (NIOSH) recommends that perc be handled as a human carcinogen, and the International Agency for Research on Cancer (IARC) classified perc as a probable carcinogen in 1995.

#### Garment Wet Cleaning

Garment wet cleaning is an effective way to reduce significantly or eliminate the need for perc dry cleaning of fabrics. Two types of garment wet cleaning are currently in use: multiprocess wet cleaning and machine wet cleaning. In multiprocess wet cleaning each garment is handled individually and cleaned using a combination of steaming, spotting, gentle hand washing, scrubbing, tumbling, and/or hang drying. Machine wet cleaning allows the operator to program the cleaning time, the amount of mechanical action, the temperature, and the degree of water extraction specific to the type of garments being washed. A special dryer may be used to monitor the amount of moisture remaining in the garments, thereby avoiding shrinkage caused by over drying.

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<sup>1</sup>Wolf, Katy, "Case Study: Pollution Prevention in the Dry Cleaning Industry: A Small Business Challenge for the 1990s" *Pollution Prevention Review*, Summer, 1992

<sup>2</sup>Aggazzotti, Gabriella, et al, 1994, "Occupational and Environmental Exposure to Perchloroethylene (PCE) in Dry Cleaners and Their Family Members" *Archives of Environmental Health*, Vol. 49, No. 6





Utopia initially used wet cleaning as a supplement to its perc system and as it became more familiar with the benefits, chose to replace its perc system with wet cleaning machines. The DaeWoo system purchased by Utopia is a relatively simple, moderately priced cleaning machine with less programming flexibility than more costly models. The detergents used in machine wet cleaning contain surfactants to remove lipophilic stains and enzymes to remove food stains. These cleaning agents are pH neutral and biodegradable. Garments cleaned in wet cleaning systems are often more wrinkled than those cleaned in perc. In order to maintain the high quality of its service, Utopia has purchased state-of-the-art pressing equipment and has slightly increased the time spent finishing each garment.

### Toxics Use Reduction Assessment

- Before changing to wet cleaning, Utopia used 150 to 175 gallons (2025 to 2363 pounds) of perc annually. Approximately 3,600 pounds of perc contaminated waste was removed by a hazardous waste handler annually, including still bottoms and filters.
- Utopia currently generates no hazardous waste and is no longer regulated under the Clean Air Act.
- The operators and customers of Utopia are no longer exposed to perc in the air.
- The owner of Utopia posted information about wet cleaning during his transition period and some customers now request that their garments be cleaned using wet cleaning only.

### Economic Assessment

- The cost of replacing the existing perc system at Utopia, which was at the end of its useful life, would have been approximately \$40,000. The DaeWoo wet cleaning machine used at Utopia can be purchased for approximately \$1,000, and has approximately one-quarter the capacity of the previously used dry cleaning machine.
- The cost of disposing of spent perc is approximately \$100 per twelve gallon drum. By using aqueous cleaners Utopia saves approximately \$1,800 in disposal costs annually. Additional savings occur through reduced liability for any damages associated with the disposal of perc-contaminated wastes.
- With the cost of one gallon of perc at approximately \$5.50, Utopia saves between \$825 and \$963 in procurement costs annually.
- According to a study done by Environment Canada, the utility costs of wet cleaning are only \$0.02 per day more than dry cleaning based on one hundred pieces per day. This may vary depending on the region and the systems being compared. The two systems compared by Environment Canada were a fifty pound IPSO wet cleaning system, with programmable wash cycles and a frequency controlled motor, and a 55 pound Lindus closed-loop, refrigerated, dry-to-dry perc system.

### Transferability

Although the capabilities of this system are not fully understood at this time, Utopia expects to process 80% of the garments they handle in the wet system and send out the remaining 20% to a conventional perc dry cleaner under the same ownership. However, there are a growing number of facilities in the United States and countless abroad that process all garments in wet cleaning machines. The low capital cost of the system installed by Utopia makes wet cleaning an attractive alternative or supplement to dry cleaning when examining the increasing regulation and associated costs of perc dry cleaning.

This case study is part of the Toxics Use Reduction Institute's Cleaner Technology Demonstration Sites Program.