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Multiprocess Wet Cleaning

Cost and Performance Comparison of Conventional Dry Cleaning and An Alternative Process

EXECUTIVE SUMMARY

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MULTIPROCESS WET CLEANING:

COST AND PERFORMANCE COMPARISON OF CONVENTIONAL DRY CLEANING AND AN ALTERNATIVE PROCESS

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U.S. Environmental Protection Agency
Office of Pollution Prevention and Toxics
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ECOCLEAN International, Inc.
The International Fabricare Institute
The Massachusetts Toxics Use Reduction Institute
The Neighborhood Cleaners Association (NCA)

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MULTIPROCESS WET CLEANING: COST AND PERFORMANCE COMPARISON OF CONVENTIONAL DRY CLEANING AND AN ALTERNATIVE PROCESS

EXECUTIVE SUMMARY

The EPA's Office of Pollution Prevention and Toxics (OPPT) has been working with the dry cleaning industry through its Existing Chemicals Program to reduce exposure to perchloroethylene (PCE). PCE is the chemical solvent used by most dry cleaners to clean clothes. With more than 34,000 commercial shops in neighborhoods and malls across the country, dry cleaners are one of the largest groups of chemical users that come into direct contact with the public.

PCE is designated as a hazardous air pollutant under Section 112 of the Clean Air Act and under many state air toxics regulations. On September 15, 1993, EPA set national emission standards for new and existing PCE dry cleaning facilities. According to a study conducted on Staten Island and in New Jersey, PCE is among the toxic air pollutants found at the highest concentrations in urban air.

The potential health and environmental concerns associated with the use of PCE led the dry cleaning industry and the EPA to form a partnership to explore ways to further reduce exposure to dry cleaning chemicals.

BACKGROUND

In May 1992, OPPT, under its Design for the Environment (DfE) program, convened the International Roundtable on Pollution Prevention and Control in the Dry Cleaning Industry. Researchers, industry representatives, and government officials met to exchange information on a number of issues related to the dry cleaning industry, including exposure reduction, regulation, and information dissemination. A variety of concerns were discussed including some newly documented studies of residential exposures in apartment buildings where dry cleaning operations are located. Also new concerns about soil and groundwater contamination from dry cleaners were discussed.

In order to evaluate a full range of exposure control options and alternative cleaning methods, the DfE program and industry are collaborating on a Cleaner Technologies Substitute Assessment (CTSA) for the dry cleaning industry. Through the CTSA, the EPA is systematically examining a number of alternative cleaning technologies, substitute solvents, and methods to control and limit chemical exposure from dry cleaning. The CTSA will also weigh the trade-offs of different options in terms of risk, performance, cost, energy impacts, and resource conservation. As part of the CTSA, the EPA formed a partnership with the dry cleaning industry to compare the costs and performance of a potential alternative cleaning process that relies on the controlled application of heat, steam, and natural soaps to clean clothes

that are typically dry-cleaned. Characterization of any environmental concerns that may be associated with this process will be accomplished separately in the CTSA.

DEMONSTRATION PROJECT

The DfE program in collaboration with the Neighborhood Cleaners Association (NCA), the International Fabricare Institute (IFI) and a commercial vendor, ECOCLEAN International, Inc., conducted a short term, high volume test in November and December 1992 to compare the costs and performance of the conventional dry cleaning method that uses PCE and an alternative "multiprocess wet cleaning" process. The EPA agreed to participate in the wet cleaning demonstration, as part of the CTSA, to test the viability of a non-solvent alternative process.

The wet cleaning process tested is an aqueous based cleaning process that relies on heat, steam, pressing and soap to clean clothes. Although the process uses water, garments are not necessarily fully immersed or saturated with water. A wet cleaner selects among various cleaning techniques (including steam cleaning, spot removing, hand washing, gentle machine washing, tumble drying, and vacuuming) to ensure that garments made of different fabrics are cleaned without damage. The cleaning method selected is dependent on garment type, fabric condition, and soiling. The wet process tested is only one of a number of potential alternative wet and dry processes the EPA plans to evaluate as part of the CTSA.

During the test, nearly 1500 garments were collected from consumers employed in government agencies in Washington D.C. and New York City, and transported to the Neighborhood Cleaners Association New York School of Dry Cleaning in Manhattan, New York. The clothes were separated into lots of 50 items each and random selection (flip of a coin) determined which garments would be drycleaned with PCE and which would be cleaned using the alternative wet cleaning process. No consideration of garment or fabric type influenced the selection process. After the clothes were randomly divided between the wet and dry process, 712 articles were wet cleaned and 787 were drycleaned. After cleaning, both sets of clothes were pressed on the same equipment and returned to the customer. Attached to each cleaned garment was a postage-paid evaluation form to solicit customer satisfaction information. The customers were not informed of which process was used to clean their clothes.

ECONOMIC FEASIBILITY STUDY

The experimental results from the New York School of Dry Cleaning were first used to conduct an engineering cost analysis comparison of both cleaning processes used in the demonstration project. The engineering cost analysis examined the raw operating costs and cost of the equipment that was unique to each process. Eleven cost items differed between the two cleaning methods including equipment maintenance and repair, electricity, hazardous waste disposal, and capital recovery cost. Those costs that were similar to both processes, such as the labor time needed to press the garments, were not compared. The engineering cost analysis

found that the measured cost per lot (50 items of clothing) for cleaning at the dry cleaning school was virtually identical.

Conditions in the New York School of Dry Cleaning do not completely mirror those in a typical dry cleaning operation. The size and age of the machines and the efficiency of the location of spotting and finishing equipment is different for an operation set up to teach than for a facility which must maintain a production schedule. Therefore it was necessary to develop a model that would be applicable to a wide variety of real world operations. Data was collected from equipment vendors, industry organizations, and EPA reports to construct the hypothetical model plant analysis. An annual sales volume of $5,000 per week was used to represent the size of a typical large dry cleaning establishment. The costs for the model plant were calculated using modern drycleaning equipment, including dry-to-dry drycleaning machine equipped with a refrigerated condenser (RC) control device. The financial results were examined by estimating the annual cost for 81 separate expense items. The annual cost, profit (revenue minus cost), return to capital investment, and other financial measures were developed for each model facility.

The economic feasibility study examined the financial results for a facility exclusively performing drycleaning, a facility exclusively performing multiprocess wet cleaning, and "mixed mode" facilities offering both types of cleaning service. The mixed mode analysis examined a range of facilities from a mix of 95 percent drycleaning and five percent wet cleaning (the "95/5" facility), to a mix of five percent drycleaning and 95 percent wet cleaning. Thus there are 19 mixed mode plants, plus the two dedicated facilities.

In addition to the mix of cleaning methods used at a facility, the feasibility analysis examined two types of operations: new facilities and conversions. Conversions are existing PCE drycleaning facilities that add multiprocess wet cleaning capabilities. The primary difference between the two types of facilities is the size of the drycleaning equipment. The analysis of the mixed mode conversion facilities assumes the plant uses the same size drycleaning equipment as a dedicated drycleaning, while the new facility selects the best size equipment for the quantity of clothes they are planning on drycleaning. For each of these two types of facilities, the economic feasibility study estimates the annual costs for a total of 40 different facilities: dedicated drycleaning and wet cleaning plants (there is no "conversion" analysis for the dedicated plants), 19 mixed mode new facilities, and 19 mixed mode conversion facilities.

Economic Feasibility Study Results

The principal results of the model plant analysis are estimates of the total annual private costs for the various facilities. The dedicated dry cleaning facility serves as the basis for comparison (the base case). The estimated annual cost for the dedicated dry cleaning facility is nearly $240,000 (all facilities have annual revenues of $260,000). The estimated cost for the dedicated wet cleaning facility is almost $1,000 (0.4 percent) less than the cost of a dedicated dry cleaning facility. The costs for new mixed mode plants are generally slightly less than the cost of the dedicated dry cleaning plant for plants doing at least 50 percent drycleaning. Costs are higher for new facilities doing less than 50 percent drycleaning, primarily because the

drycleaning equipment is being underutilized. Annual costs for converting an existing drycleaning facility to mixed mode operations are generally $1,000 to $2,000 higher than the dedicated drycleaning plant, even for plants doing over 50 percent drycleaning. When drycleaning less than 50 percent of the garments, the difference in costs increases.

The estimated costs can be used to estimate annual profit (revenues minus annual costs). The profits for all the mixes at new facilities are shown on Exhibit ES.1, and the profits for conversion facility mixes are shown on Exhibit ES.2.

Exhibit ES.1

ANNUAL PROFIT: NEW FACILITY

Opening a New Clothes Cleaning Facility

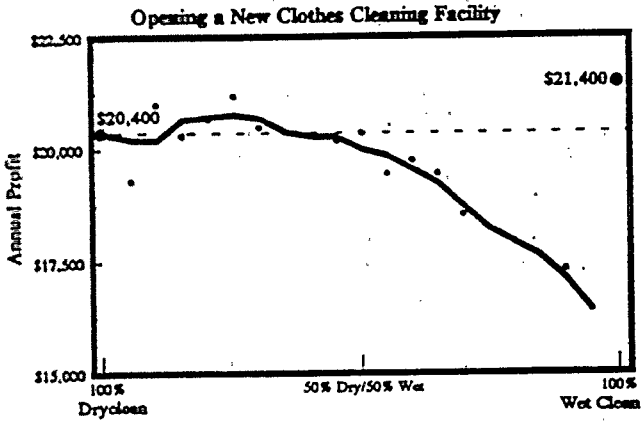
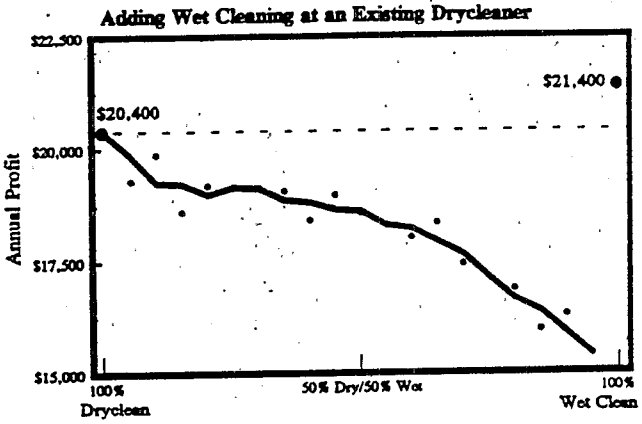


Exhibit ES.2

ANNUAL PROFIT: CONVERSION

Adding Wet Cleaning at an Existing Drycleaner

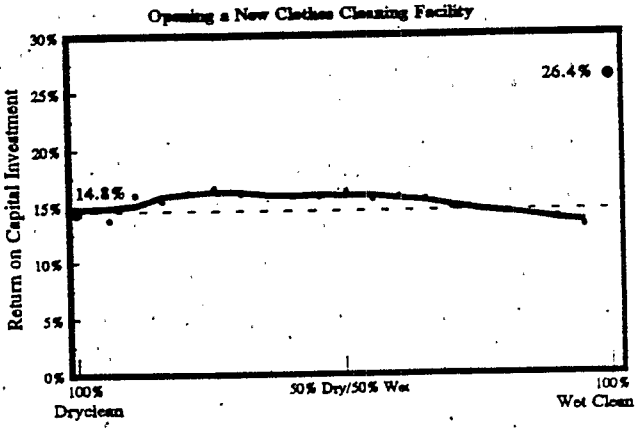


While profits are a very important financial indicator, the return to investment is also important and reveals an important difference in the cleaning processes. Because multiprocess wet cleaning uses substantially less expensive equipment than dry cleaning, less capital investment is required for the wet cleaning plants.[1] A dedicated wet cleaning plant requires 41 percent less initial investment (almost $57,000 less) than a dedicated drycleaning plant. The combination of somewhat higher profit and substantially less investment produces a much greater return on investment for wet cleaning: 26.3 percent versus 14.7 percent for drycleaning. The new mixed

Exhibit ES.3

RETURN ON INVESTMENT: NEW FACILITY

Opening a New Clothes Cleaning Facility



[1] In spite of the difference in capital costs, total costs are similar between the processes because multiprocess wet cleaning uses nearly three times as much skilled labor as drycleaning.

mode facilities have a modestly higher return on investment than the dedicated drycleaners for plants doing at least 30 percent drycleaning. Below 30 percent drycleaning the underutilized drycleaning equipment again results in poorer financial performance, giving a somewhat lower return on investment. The estimated return on investment in new facilities are shown in Exhibit ES.2.

PERFORMANCE EVALUATIONS

In addition to an economic analysis of the wet cleaning process, performance evaluations were conducted during November, 1992 through January, 1993 at the NCA New York School of Dry Cleaning, and at the University of Georgia Textiles, Merchandising and Interiors Department. There were three parts to the testing: general customer satisfaction survey of cleaned garments, customer satisfaction survey of 13 selected test garments, and a technical wear study (using the same 13 test garments) measuring catastrophic and short term effects of both the wet and dry cleaning methods.

For the general customer satisfaction survey, 900 of the garments collected from the general public were returned to the owners with a brief, postage paid evaluation form attached. The form consisted of multiple choice questions evaluating the consumer's perception of the quality of the cleaning process including appearance, odor and overall acceptability. The consumer was not informed of which process was used to clean the garment. Over 350 cards were returned. The results from the postcards were tallied and compared for each of the cleaning processes. Both the wet and dry cleaning methods generated negative and positive responses, with a statistical preference shown by consumers for the wet cleaning process, particularly in regard to odor.

In the customer satisfaction survey of the 13 selected test garments, the clothes were worn by volunteers and periodically cleaned by an assigned process over a period of four weeks. Following the wear period, an independent group of consumers were asked to judge the garments cleaned by each process and the control garment in terms of acceptability of the cleaning process, that is, would they accept this garment from a cleaner. When participants were asked to judge between three identical test garments; one that had been worn and wet cleaned over a four week period, one that had been worn and dry cleaned over the same period and a control garment that was never worn, both negative and positive responses were generated for each process. In fact, there was no statistical difference in the responses to the garments cleaned by the two processes.

In the technical wear study, the shrinkage, stretching, color change, and odor of each of the same 13 garment types, were measured and compared to an identical control garment that was not worn. The results of this study are limited for several reasons. The wear and cleaning patterns of the test garments were not typical of normal consumer wear. In addition, the limited quantity of data due to the number of garments and the short duration of the test, make it difficult to draw firm conclusions regarding the short term effects of either the wet or dry

processes on garments. The technical wear study, however, was able to characterize effects such as shrinkage or stretching, and found no appreciable difference between the two processes.

During the course of the demonstration, a total 712 garments were wet cleaned. The garments were selected randomly, without regard to suitability for wet cleaning. Only one garment was reported to be damaged (due to a manufacturing defect), and no other garments were reported to have been negatively affected.

Performance Evaluation Limitations

When designing the performance evaluation portion of the demonstration project, EPA and its study partners understood that there were unavoidable limitations to what a limited performance evaluation could achieve. Many of the limitations stem from the short term nature of the study. The general wear customer satisfaction survey was limited to a single cleaning of the garments. The technical wear study examined the effects on the garments of three cleanings. Thus the study was able to collect some information on short term effects of cleaning, but could not examine the long term implications, such as effects on garment life or level of cleanliness over many cleanings. The results of the performance evaluation must be considered as preliminary findings.

One issue raised about multiprocess wet cleaning is how well the process actually cleans garments. There is not a clear scientific measure of cleanliness even under laboratory conditions. Defining cleanliness for garments as they are typically worn is even more difficult. The performance evaluation did not attempt to rigorously examine the level of cleanliness achieved by either cleaning process, although the evaluation did collect information on whether the customer was satisfied with the cleanliness. A garment may have been cleaned well enough by the one time cleaning to satisfy the customer, but repeated cleanings, if incompletely removing soils and stains, could allow such foreign materials to build up to an unacceptable level. A short term performance test cannot examine this issue. The EPA is working with industry in developing a method to measure cleanliness, and will explore this issue further in the Cleaner Technology Substitutes Assessment of clothes cleaning.

The 13 test garments used in the performance evaluation reflect what is sold in the marketplace. However, the selection does not necessarily reflect the mix of garments typically brought in to a drycleaner. The test garments were selected to have a range of care labels, including "Dry Clean Only", "Dry Clean or Machine Wash", and "Do Not Dry Clean". Customers do bring garments to a cleaners that could be laundered at home, either for convenience, stain removal, or to ensure professional finishing (pressing) of the garments which is difficult or impossible to achieve using typical home equipment. However, the majority of garments brought to a drycleaners cannot be readily cleaned at home.

The performance evaluation did not control the conditions under which the garments were worn, although information was collected about the conditions. The general wear garments cleaned in the experiment were collected at federal government facilities in Washington, D.C. and New York City, and the test garments were worn by federal government employees.

Information collected on the locations and activities that occurred while the garments were worn (and getting dirty) indicates most of the garments were worn in offices, cars, homes and shopping. Thus the performance evaluation did not examine the cleaning effectiveness on heavily soiled garments worn in industrial settings, construction sites, etc.

The performance evaluation did not examine whether some detergents, solvent based chemicals or alkaline substances used as spotting agents in the multiprocess wet cleaning system remain in the garments when returned to the customer. Such chemicals are typically removed during the "rinse" cycle of PCE-based drycleaning, but some of the garments cleaned by the wet process are not rinsed. The performance evaluation did not collect any information, or assess whether any chemical residue remaining in the garments is potentially hazardous. Such information is beyond the scope of this current study, and additional research is needed on this question.

Information was not collected on the condition of the drycleaning equipment and solvent during the performance test. The drycleaning equipment used in the study was equipment used for instructional purposes at the New York School of Drycleaning. The study was conducted using the equipment "as is", which may have influenced the results of the PCE drycleaning process. For example, some of the white garments in the performance garments cleaned with PCE appeared to turn pink in color. Dry cleaning solvents kept in proper condition do not discolor. As clothes were sorted by color during the test, no discoloration should have occurred because of clothes in the same load. However, there may have been a "bleeder" in previous loads, which may have left a dye residue in the PCE cleaning solvent which was reused. Recommended solvent care procedures were followed during the cleaning demonstration. However, complete information on the pre-existing condition of the solvent, including previous distillation practices, filter replacements, etc. were not available.

Industry commenters offered other recommendations for future performance evaluations of alternative cleaning processes. For example, in addition to conducting the odor tests in a closed room, the commenters also suggested that the odor test protocol could be enhanced by steaming the garments prior to the test. Steaming will make slight or subtle odors more apparent. These comments, and others received by the EPA in response to this report, will be incorporated in any future tests that may further evaluate clothes cleaning methods.

CONCLUSIONS AND NEXT STEPS

The results of the cost and performance studies indicate that under certain situations, the wet cleaning process is technically feasible and economically competitive with PCE dry cleaning. Wet cleaning appears to be a viable option to reduce the usage of dry cleaning solvents. However, the EPA recognizes that obstacles exist to greater use of the wet cleaning process. For example, the wet process tested is a potential "low tech" solution requiring more labor and greater skill. but dry cleaners may prefer a process allowing for greater automation. Finally, U.S. Federal Trade Commission care labeling rules may prevent widespread wet cleaning of garments with care instructions that read "Dry Clean Only".

Once the risk issues have been examined, this wet cleaning process may become a feasible pollution prevention option for a portion of the dry cleaning industry. The extent and conditions of this wet cleaning demonstration may not be conclusive for all circumstances and the assumptions used for modeling may require alteration. However, the lack of short term catastrophic effects and the preliminary comparability of costs suggest that careful consideration should be given to this and other alternative cleaning methods as dry cleaners face increasingly stringent federal, state, and local regulatory pressure to reduce exposures to dry cleaning chemicals. Through the Design for the Environment Program, the EPA intends to work with stakeholders to lower barriers to feasible pollution prevention options.