



Application for Lex Green Clean

Step 1

We decided to research the harmful effects of dry cleaning. Dry cleaning uses a chemical called perchloroethylene (Perc). Perc is a very harmful chemical that is labeled by the EPA as a likely human carcinogen and is toxic to the nervous system

We first came across this topic when we went to the dry cleaners to pick up some clothes. The stench was so strong that after five minutes of waiting, we became slightly nauseous and our nose and eyes started getting irritated. This made us think, how were the workers surviving with such a smell? We spoke to Ms. Joy Onasch from the Toxic Use Reduction Institute (TURI) at UMass, Lowell. She said that there was an alternative to dry cleaning called wet cleaning. This topic affects our community, and communities around the country.

Wet cleaning doesn't use harmful chemicals like dry cleaning. Instead, many wet cleaning detergents are biodegradable. Wet cleaning is much better for the environment than dry cleaning. So, why wouldn't a dry cleaner want to switch? The main issue is cost. Existing dry cleaners have the upfront cost of \$50,000 - \$70,000 to switch to wet cleaning. But, there are operating cost savings due to reduced regulatory requirements, lower energy usage, liability and disposal costs.

The reason we're interested in this problem is that Perc is harmful to the environment and humans. Perc effluence spilled or mishandled, could ruin our environment for generations to come. We want to ensure that the environment is safe when we grow up.

Step 2

Do you realize that when you send your suits and jackets off to the dry cleaners, they may return with a potential carcinogen? Most cleaners currently use a 'Dry cleaning' process that removes stains and contaminants using Perc (Perchloroethylene) - a synthetic chlorinated hydrocarbon used since the mid 1930's. Perc is not safe for our health and the environment. <http://www.epa.gov>

Perc has hazardous effects, from short and long term exposure, on employees and customers. With short-term exposure, the effects include skin, eye, respiratory irritation, headache, and nausea. With long-term exposure, the effects are liver, kidney, and central nervous system failure. The International Agency for Cancer has listed Perc as a

potential carcinogen. Perc is classified as a “hazardous air pollutant” by the US EPA
http://www.bredl.org/pdf2/perc_brochure.pdf

Perc vapors are released in the air during the transfer of clothes and dry air exhaust. When Perc gets into the atmosphere, it breaks down into other toxic chemicals that may deplete the ozone layer. Perc is present in the effluence and in the residue generated.

Our research on <http://www.turi.org/> showed that 85% of dry cleaners still use Perc. As mentioned in step one, during our visit to a dry cleaner, we smelled a strong odor and felt sick, raising many questions. If Perc is so bad, why are we using it? Isn't there another method? This puzzled us, and gave us the idea for our project.

We visited Ms. Joy Onasch - Community Program Manager of Toxic Use Reduction Institute (TURI). TURI is working to find alternative ways to reduce toxicity. Under the Toxic Usage Reduction Act (TURA) of 1989, TURI/EPA are promoting practices for a cleaner and safer environment, and the use of wet cleaning to dry cleaners.

Wet cleaning is a non-toxic, environmentally safe alternative to dry cleaning, using computer-controlled washing machines, biodegradable soaps, and pressing equipment. Ms. Onasch said, “There are many other alternatives...but there are unknowns about those... we feel it's better to go to wet cleaning.”

Prior to our experiments, we conducted a survey to understand the awareness of dry cleaning and alternate cleaning issues. Our survey found:

- 82% of respondents were unaware of dry cleaning hazards,
- 75% were unaware of the severity of Perc.
- After we shared information about dry cleaning, wet cleaning and the hazards of Perc,
- 60% of the people surveyed were ‘very likely’ to switch,
- 39% were ‘somewhat likely’ to switch.

We heard that cleaning quality needed to be assured to make the switch to wet cleaning.

We decided that public presentations, surveys, talking to people and most importantly having all the information in one knowledge base (our public website), were crucial in assisting the switch to wet cleaning. We explored different web design options, and came up with our own website to help dry cleaners and customers switch. To test the quality of cleaning, we compared dry cleaning and wet cleaning results.

We attended a demonstration given by “Best Neighborhood Dry Cleaners”, in Medford, MA. It showed us the process of switching to wet cleaning and associated challenges.

Changing from dry cleaning to wet cleaning is costly. It costs around \$50,000- \$70,000 dollars to switch. But dry cleaners with newer machines can retrofit and reprogram their

machines for wet cleaning. There are operating cost savings in wet cleaning due to simpler regulatory requirements, lower energy usage, lower liability, and disposal costs. TURI offers grants for dry cleaners to switch. But dry cleaners perceive business risks, so 85% of dry cleaners are still Perc based. In addition, unlike Perc-based effluence, wet cleaning discharge is acceptable in all sewage systems. At this point, in some states, such as Massachusetts, the wet cleaning discharge cannot be disposed in septic tanks, while other states do permit such discharges.

So, we decided to compare the effluents from wet cleaning with those from laundry detergents used in homes. To do a scientific analysis, we worked with Dr. James Glick of the Northeastern University and Dr. Jim Hauri of Assumption College, who let us use their equipment to run the experiments and helped interpret the results.

The scientific experiments suggest that wet cleaning effluents contain less output material than regular detergent. This data can get towns to reconsider the decision to not let wet cleaning waste into septic tanks. In addition, our data collection regarding the performance of wet cleaning shows that it cleans as well as Perc based dry cleaning. Finally, our survey results and discussions with dry cleaners and consumers show that education of the community, dry cleaners and regulators will be key in making change happen. We thus hope our project contributes to improving our environment.

Step 3

Our plan has two parts:

1. Scientific
2. Community involvement

Scientific portion:

1. To compare wet and dry cleaning.

Make samples of 7 different fabrics and stain with five different stains. Then, send them to a dry cleaner and a wet cleaner and observe the results.

2. To compare the effluence of a wet cleaning to that of domestic washing.

After consulting Joy Onasch of TURI, we found that this experiment has not been done before.

Community involvement portion:

1. To talk to dry cleaners and other organizations, such as the North Eastern Fabricare Association, Toxic Usage Reduction Institute (TURI) about less toxic choices.
2. Conduct a survey amongst consumers.

3. Make a presentation at our public library and to the Selectmen of Lexington, MA.
4. Create a website, to assist consumers and drycleaners thinking of switching to wet cleaning.

We met several times a week after school to plan an outline and timeline for our project. We distributed the tasks amongst us and regularly communicated via email.

Timeline and Resources:

- October – December 2009 - We met Ms. Onasch of (TURI). Researched online regarding effects of Perc, Clean Air Act, EPA publications and septic regulations for wet cleaning effluence in Massachusetts and other states. We called the dry cleaners in our town and noted their method of cleaning. Rani called Ms. Onasch to find dedicated wet cleaners in our area. Isha contacted Mr. Peter Blake of NEFA. Attended the wet cleaning demonstration at “Best Neighborhood Dry Cleaners”, in Medford, MA.
- January – February 2010 – Contacted University of Massachusetts, TURI, EPA, Assumption College, Northeastern University, to find a lab to conduct our experiment. Contacted dry and wet cleaners to participate in our experiment. We stained the fabric squares with five different stains (*coffee, wine, oil, chocolate and lipstick*). Rani looked into Web design sites. Isha contacted the library to reserve the room for our presentation.
- March 2010 – Analyzed the results of our experiment, created website. Made fliers and power point for our library presentation. Distributed fliers in our community and via e-mail. We divided the steps for the online application amongst us.

We planned to measure and compare the results of the dry/wet-cleaned fabric on the basis of stain removal and shrinkage. We decided to test and compare the effluence of domestic and wet cleaning for chloride, fluoride, sulfate, nitrate, TSS, and Solid Phase Extraction to see if wet cleaning is just as safe as domestic washing.

Our solution was to educate our community about safer cleaning alternatives and provide them with the information based on our scientific experiments. We believe in consumer education and awareness, that “knowledge is power” and if the customers demand it, the dry cleaners will supply it.

Step 4

We did four experiments: one measuring the quality of wet cleaning, and three measuring environmental effects.

Our first experiment tested the effectiveness of wet cleaning compared to dry cleaning. We bought 7 fabrics (sequined, light cotton, dark cotton, mixed, silk, wool and polyester), cut them into equal squares, stained them with 5 stains (coffee, wine, oil, chocolate, and lipstick) and labeled them. We gave half the fabrics to a wet cleaner,

and half to a dry cleaner. Results of the analysis of the fabrics for stain removal and shrinkage are shown below.

	Stain Removal		Shrinkage	
	Dry cleaning	Wet cleaning	Dry cleaning	Wet Cleaning
Sequins	0.8	0.8	0	1
Wool	0.8	1	1	1
Light Cotton	0	0.9	1	1
Dark Cotton	0.8	1	1	1
Silk	0	0.5	1	0.5
Mixed	0.6	1	1	1
Polyester	0.8	0.8	1	1
	0.54	0.85	0.85	0.92

We assigned zero for no cleaning, one for complete cleaning and 0.5 for partial performance. Row values show the average across stains for a material type. The values at the bottom are averages of the respective cleaning method. Notice that the averages for wet cleaning were higher than dry cleaning for both criteria. (Note, these results are from one trial).

Our next 2 experiments were at Dr. James Hauri's lab at Assumption College. We did an Ion Chromatograph (IC) Test, and a Total Suspended Solids (TSS) Test. We took the effluence from wet cleaning, regular domestic cleaning detergents, and tap water, packaged in one-pint plastic bottles to the lab.

For the TSS test, we recorded the weight of three empty beakers, filled them with 100 mL of each sample, then put them on a hot plate. After liquid evaporated, we weighed the amount of material left. We subtracted the before weight from the after weight, and multiplied the difference by 10,000 to give us the milligrams per Liter results shown below.

Sample	Weight Before (g)	Weight After (g)	mg/liter
Tap Water	49.4196	49.4284	88
Regular Detergent	48.7672	48.8168	496
Wet Cleaning	63.0657	63.0807	150

Milligrams per liter is the units of the solid material in the effluence. Domestic detergent had three times more solid material than the wet cleaning detergent.

The second test we did with Dr. Hauri was the IC test. We tested for nitrate, sulfate, chloride, and fluoride in wet cleaning and regular detergent. We used a Metrohm Ion Chromatograph (IC). After filtering the samples using 0.45 mm filters, we put the

material into the IC. We had the IC read high concentration standard solutions diluted at 1:10, 1:20, and 1:30 proportions. We wrote down the data for the substances. After using the Microsoft Excel “regression” function to link concentration to reading, we used our samples to get the data below.

Concentration of	Fluoride	Chloride	Nitrate	Sulfate
Wet cleaning	1:62.49	1:6.76	1:121.29	1:38.78
Reg detergent	1:42.61	1:5.20	1:113.15	1:36.52
Water	1:104.63	1:7.65	1:131.92	1:41.67

The ratio is the concentration at which the material is in the effluence, hence a larger number indicates a smaller amount. Wet cleaning was better than regular detergent here, too.

The third test, done at Dr. James Glick’s lab at Northeastern University, was the Gas Chromatograph (GC) with Mass Selective Detector (MS) test.

For the GC and MS concentrations, we diluted the domestic detergent (using the TSS values above) to match the concentration of wet cleaning detergent. We put the samples in the GC oven, and then inserted 10 mL of vapor into the MS machine. It gave us line graphs which indicated the chemical that formed a certain peak. The values in the table below measure the positive difference between regular detergent and wet cleaning, divided by regular detergent, and multiplied by 100.

(1) A list of chemicals where wet cleaning had a higher percentage than domestic detergent effluence.

Isopropyl Myristate	204.35
2,6,10,15,19,23-hexamethyl-2,6,10,14,18,22-Tetracosahexaene	75.78
5-Octadecene	42.23
1-Hexadecanol, 2-methyl	39.22
1-Dodecene	17.84

(2) A list of chemicals where domestic detergent effluence had a higher percentage than wet cleaning.

9-Octadecene	23.55
Undecane	39.42
2,2-Dimethoxybutane	43.26
Dodecanoic acid	61.99
1-Dodecanol	67.16

7-Octen-2-ol, 2,6-dimethyl- 100

All the chemicals that were in the wet cleaning effluence were in regular detergent effluence. Most of the chemicals were around the same levels, except the chemical Isopropyl Myristate, which was greater in wet cleaning. But, after consulting the Toxic Substance Control Act (TSCA) site, we found that it was nontoxic. Through our Cleaning Effectiveness, IC, TSS, and GCMS tests, we were able to quantitatively evaluate the performance of wet cleaning.

Step 5

We found that wet cleaning is better for the environment than regular detergent and better at cleaning clothes than dry cleaning. The main reason we did these experiments was to convince our community that wet cleaning does work. We also wanted to have our local government allow wet cleaning to be discharged into the septic system.

We found from our first experiment that wet cleaning cleaned clothes better than dry cleaning. This shows that consumers will not be sacrificing quality to help the environment.

From our last three experiments, we found that wet cleaning was almost always the same or better for the environment than domestic cleaning. In these experiments, we found that wet cleaning and domestic cleaning's effluence had the same chemicals. The chemicals were usually in similar amounts. But, when wet cleaning had higher amounts, the chemical was nontoxic. The solid material in regular detergent was more than three times the amount in wet cleaning, showing that wet cleaning is better for the environment. We also tested the nitrate, sulfate, chloride, and fluoride levels in the samples, and found that wet cleaning was better for the environment again.

We wanted to get the effluence from a wet cleaning facility, but it emptied directly into the sewage system. So, we got a sample of the detergent and ran it in our top-loading washing machine. Also, we had a very hard time finding a wet cleaner who was willing to cooperate and wash our fabric samples. We finally went to Mark Isabelle, of Silver Hanger Cleaners in Bellingham, MA (about 40 miles away from our houses), who was willing to wash our samples. Our main problem was finding a lab that would do our testing. After calling about 15 labs, we finally found Dr. Glick and Dr. Hauri.

If done differently, we would have called Dr. Hauri and Dr. Glick earlier, allowing us to do more runs of the same test. Also, if we had more time, we could have found data for some of the tests that didn't work. We also would have been able to analyze why some of the readings were higher than others if we had more time. If we had found a wet cleaner whose effluence didn't empty directly into the sewage system, we might have gotten slightly more accurate readings. Though we encountered these problems, we worked hard and fixed them.

Step 6

Community awareness is the foundation of our project. Our efforts to convince dry cleaners to switch to wet cleaning have just begun.

To promote community awareness, we did web based and manual surveys and talked to several community members. We gave presentations to town Selectmen and at the library, to raise awareness about Perc and introduce people to eco-friendly wet cleaning. The survey of attendees revealed 96% were "very likely" to switch.

We created a knowledge base for consumers and dry cleaners on our website, <http://www.wetcleaning.weebly.com>. This site allows dry cleaners to receive an abundance of information about wet cleaning, steps necessary to switch to wet cleaning, and equipment needed. The site also answers frequently asked questions, displays experiment photos, and a survey. Our Selectmen have agreed to mention our project and our website in their meeting on Monday March 15th 2010. Here is the link to their letter -

http://wetcleaning.weebly.com/uploads/2/4/7/4/2474477/selectman_letter.pdf

Our project proved the effectiveness of wet cleaning compared to dry cleaning. This can help gain consumer confidence, and will encourage more people to switch.

Our scientific experiment deduced that wet cleaning effluence is as safe and non-toxic as domestic cleaning detergents. Based on this conclusion, we need to follow up with EPA, as Massachusetts does not allow wet cleaning effluence to be discharged in septic tanks. With 25% of Massachusetts towns using septic tanks, it is hard to make Massachusetts Perc free without changing the law.

We worked for about 5-6 months on this project. It took a lot of time and effort to get all the support and a lab to perform our experiments. The most important thing we learned from this project is: **"Never give up, and try harder!"**

Based on our experience, it will at least take 8-10 months for the first few dry cleaners to switch. Convincing the community and town council should be the first step. Convincing a dry cleaner to switch is quite a task, as most of them are small business owners, and are reluctant to taking any risks. Even having a conversation to put forth the idea of wet cleaning is challenging. Most dry cleaners we met were non-English speaking small business owners. Having a language translator on the team would smoothen the process. Having dedicated government resources to help out with this change would expedite the process. Government funding, and special rebates and tax deduction policies would hasten the switch.

We need community support, lawmakers' cooperation, a helping hand to navigate dry cleaners through the process, and government funding to make this change a reality.

This is just the beginning! We plan to make Massachusetts Perc-free.