THE DIRTY TRUTH

HOW TOXIC CLEANING PRODUCTS ARE PUTTING CANADIANS AT RISK

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THE DIRTY TRUTH:
How Toxic Cleaning Products Are Putting Canadians At Risk

By ENVIRONMENTAL DEFENCE

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ABOUT ENVIRONMENTAL DEFENCE

ENVIRONMENTAL DEFENCE is Canada's most effective environmental action organization. We challenge, and inspire change in government, business and people to ensure a greener, healthier and prosperous life for all.

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EXECUTIVE SUMMARY

Whether you're no fuss or a neat freak, cleaning should be about fighting grime, not fighting for your health. On store shelves across the country there is a wide variety of products to help you get the job done—from sprays and gels to detergents and wipes. But, many Canadians might not be aware that a lot of these products could be as tough on human health as they are on dirt.

And that's exactly what we found in our study: in the homes of 14 volunteers that we tested, air quality decreased considerably by simply cleaning with conventional products.

Canadians spend on average 90 per cent of their time indoors[1], so it's important that the air quality in our homes is healthy. However, volatile organic compounds (or VOCs for short) that are found in many cleaning products cause indoor air pollution and have been identified as a hazard to human health.[2] The adverse effects of VOCs include irritation to eyes, nose, mouth and throat, headaches, skin problems and asthma. Very high concentrations may even lead to damage to the lungs, liver and nervous system.

Exposure to these pollutants can be especially harmful to infants and children. Studies have shown that children exposed to VOCs may suffer from respiratory, allergic, or immune effects—including increased risk of childhood asthma.[3] Pregnant women have a heightened sensitivity to VOCs; exposure to VOCs during pregnancy is associated with low birth weights[4] and lower IQs in infants.[5] On top of this, some VOCs are suspected or known to cause cancer in humans.

In the homes of 14 volunteers that we tested, air quality decreased considerably by simply cleaning with conventional products.

When it comes to cleaning products, we buy a lot of them. In 2014 alone, Canadians spent more than $641 million on products like window sprays and floor cleaners. When you break that down, we're spending $200-$300 per each household annually on products that we think help us maintain healthy homes, when in fact they could be doing the opposite.[6]

Since 2005, ENVIRONMENTAL DEFENCE has worked to protect people and our environment from toxic pollution. We've educated people about the cancer-causing and hormone-disrupting chemicals in every-day products and the harm they can do. We successfully led the charge to get bisphenol A (BPA) out of baby bottles and phthalates out of toys in Canada. Over the years, we tested makeup for heavy metals, men's body care products for hormone-disrupting chemicals, and cord blood of newborns for persistent toxic chemicals. Now it's time that we expose the dirty secrets behind Canada's cleaning products and urge industry and government to clean them up.

We're spending $200-$300 per each household annually on products that we think help us maintain healthy homes, when in fact they could be doing the opposite.[6]

We decided to test popular cleaning products in real homes with real people to determine the potential impact on Canadians' health – a first-of-its-kind for Canada. We gave 14 volunteers a set of cleaning products to clean their kitchens. We provided nine volunteers with a selection of Canada's most popular conventional cleaning products (based on sales and retail shelf space) from different cleaning categories – wipes, sprays, and liquids. For comparison, we provided three volunteers with certified green products and two volunteers with products that had non-verifiable green claims on the label (no disclosure or partial disclosure of ingredients on the label).*

We then sampled the air in the volunteers' homes while they cleaned their kitchens for half an hour. CASSEN Testing Laboratories, an accredited laboratory, then checked the samples for VOCs. As no standard for indoor VOC levels exists in Canada, we compared the results to the German AGÖF institute's standard for indoor VOC levels. It suggests that a healthy home should have no more than 1,000 µg/m^3 of VOCs in the air.

What we found was quite a mess:

VOC levels went up in all of the households due to cleaning product use, with stark differences between conventional and green products:

- ***After cleaning, the air quality in 12 of the 14 tested households exceeded the German recommended level for indoor VOC levels.***
- ***For eight households, air quality went from decent to poor during the cleaning (four of those households had relatively poor indoor air to begin with, but the cleaning made it worse.)***
- ***VOC increases for conventional products were three times higher compared to the green products with an average increase of 920 µg/m^3 vs. 320 µg/m^3.***
  - *For the nine homes where conventional cleaners were used, total VOCs increased by an average of 120 per cent.*
  - *For the three homes cleaned with certified green products with full disclosure labels, the increase averaged 35 per cent.*
  - *For the two homes cleaned with products that made a green claim on the label but did not disclose ingredients, the increase in total VOCs averaged 100 per cent.*

After the cleaning, the air quality in 12 of the 14 tested households exceeded the German recommended level for indoor VOC levels.

But there's more than just the increased VOC levels that we found concerning. VOCs in consumer products have the potential to react with other chemicals present in indoor air, resulting in additional harmful substances that can dimish your indoor air quality. For example, terpenes – a common fragrance ingredient found even in green products – can react with ozone. The reaction can result in an increase of formaldehyde, which is a known carcinogen.

Government action is needed to reduce risks from VOC exposure, but unfortunately, the federal government is dragging its feet. A planned regulation for VOC concentration limits in some consumer products, including cleaning products, was supposed to be published in the summer of 2014.[7] It has been inexplicably delayed with no confirmed publication date.[8]

In light of our findings, ENVIRONMENTAL DEFENCE has suggestions for consumers to protect their health and to take action, and is calling for industry and government to clean up their acts. Because when Canadians are cleaning their homes, the last thing they should worry about is what could be impacting their families' health.

VOLUNTEER PROFILE # 1

Marty – Cobalt, Ontario

Total VOCs before cleaning: **800 µg/m³**
Total VOCs after cleaning: **2,700 µg/m³**
Increase: **1,900 µg/m³ (238 per cent)**
Products used: ***conventional only*** – **Lysol Allpurpose Cleaner Lemon Crisp, Mr. Clean Disinfectant Lemon Crisp, Windex Original**

"I'm shocked to see such bad VOC results after cleaning my kitchen with the conventional products. I have young grandkids running around my house frequently, so I'm concerned. I will give green products a second look now. We need to make cleaning products less toxic."

RECOMMENDATIONS

1 For Government Decision Makers/Regulators

Label consumer products
Regulators should introduce full mandatory on-label ingredient disclosure, including fragrance ingredients. When carcinogens or reproductive toxicants are present, consumer products need to carry additional warning labels.

Set VOC limits for residential and consumer products
The federal government should set guidelines for residential indoor air VOC levels and publish the planned regulation on consumer product VOC content without further delay. Such federal regulations are needed for the industry to make products safer.

Research VOCs from consumer products in residential air
More research is needed into residential indoor air quality, the potential of VOCs to react with other common indoor air pollutants, and the long-term health effects of these exposures, especially on pregnant women.

2 For Companies

Disclose ingredients
Fully disclose all ingredients of cleaning products, including those added as fragrances or fragrance additives.

Reduce VOCs in products
Lower the VOC content in consumer products to make them safer for Canadians.

3 For Consumers

Add your voice
Demand full disclosure of chemicals in everyday products by signing our petition at *environmentaldefence.ca/label.*

Choose safer products
Use products with fully disclosed ingredients on the label, especially by opting for green products. Find out which companies are coming clean on product ingredients, how to avoid toxic products and how to make your own low-VOC cleaning products at *environmentaldefence.ca/cleaning.*

Keep your home well ventilated while cleaning
Always keep windows open or ventilation fans running during and after cleaning (for 30 minutes to an hour) if fan exhausts outside. Keep children, especially babies and toddlers out of the room when using cleaning products.

INTRODUCTION

Canadians spend more time inside than ever before—with the average person now spending 90 per cent of their time indoors.[9] So the quality of the air we breathe in our homes and workplaces matters greatly to our health. There are many factors that influence how healthy our indoor air is—and the use of cleaning products is one of them.

What is the potential health impact of popular cleaning products? Are the chemicals in these products potentially causing more harm than good? These were the questions that we wanted to find answers for with our new and unprecedented study. For the first time in Canada, the VOC impact of cleaning products was tested in volunteer homes.

Previous studies of indoor air and potential health impacts of cleaning products have largely been conducted under tightly controlled conditions in laboratories. While this certainly makes measurement simpler, it fails to account for the different circumstances, intensities, and individual habits of people cleaning their own homes.

Researchers are increasingly recognizing that this gap exists in product testing. A 2014 study for Denmark's National Research Centre for the Working Environment in Copenhagen pointed out that more "testing under realistic conditions that mimic user pattern behaviour is warranted."[10]

In the real world, many consumers do not read instructions before using cleaning products and many will use more than the recommended amount due to the belief that "more" equals "cleaner."

Volatile organic compounds are a large group of carbon-based chemicals that easily evaporate (or "off-gas") at room temperature. There are thousands of different VOCs – both naturally occurring and human-made.

- ***Most scents or odours are made of VOCs.***
- ***Common VOCs include acetone, benzene and formaldehyde.***
- ***In homes, VOCs can emanate from building materials (flooring, paint), furniture (plastic, wood finishes), exhaled cigarette smoke and products like air fresheners and cleaning supplies.***
- ***Typically, VOCs have short-term and long-term health effects.***
- ***Because the concentrations of VOCs are usually relatively low and long-term health effects develop slowly, research on the health impacts of indoor air quality and VOCs is still developing.***

For the first time in Canada, the VOC impact of cleaning products was tested in volunteer homes.

Given the lack of tests in realistic settings, we decided the logical next step in assessing the safety of household cleaners was to test them in real homes. We recruited 14 volunteers to take part in our study and worked with an accredited laboratory to conduct the air testing. We focused on a group of substances that are a major contributor to air pollution: volatile organic compounds (VOCs).

We focused on VOCs because they are a major contributor to poor indoor air quality (and outdoor air pollution) and are linked to respiratory problems, including asthma. There is also evidence that some VOCs are linked to cancer. Because there are many potential sources of VOCs in the home—including carpets, paint and furniture—it was important to measure the degree to which cleaning activity affected the level of total VOCs and potentially worsened indoor air quality.

There are also concerns about the mix of VOCs that can be present in homes from multiple sources. The health effects of chemicals are often studied on a chemical-by-chemical basis, but in reality we are exposed to mixtures, which can have additive or synergistic effects; meaning mixtures of chemicals can have effects that are different than the effects from exposure to the individual chemicals.

Fragrance ingredients can also contribute to overall VOC levels. Fragrance ingredients do not increase the effectiveness of a cleaning product. While your home might smell nice, the underlying ingredients might be harmful to your health.

HOW WE CONDUCTED OUR STUDY

To identify the top-selling conventional cleaning products in Canada, we used market research data and shelf space assessments in major retailers, as well as consulting "most popular" product lists on major retailer websites. We then created a list of 21 popular products, which we purchased off the shelf from two major retailers in January 2015. Because our focus was not on specific brands, but on investigating potential risks associated with an average Canadian's use of cleaning products, we provided nine volunteers with a mix of these popular products.

VOLUNTEER PROFILE # 2

Shaun – Toronto, Ontario

Total VOCs before cleaning: **880 µg/m³**
Total VOCs after cleaning: **1,700 µg/m³**
Increase: **820 µg/m³ (93 per cent)**
Products used: ***conventional only*** **– Mr. Clean Meadow Rain, Lysol Disinfecting Wipes, Pledge Multisurface Cleaner**

"During and after the cleaning there was a strong odour in the room and it bothered me for sure, but I'm surprised to see such a big increase in VOCs. I won't be using those products again. I've gone back to green products that are much milder with less fumes."

LIST OF CLEANING PRODUCTS USED

Conventional —

- *Lysol All-Purpose Cleaner – Lemon*
- *Lysol Disinfecting Wipes – Spring Waterfall*
- *Lysol Power and Fresh – Fresh Orange*
- *Lysol Power and Fresh Multi-Surface – Lemon*
- *Mr. Clean Liquid Muscle – Crisp Lemon*
- *Mr. Clean Liquid Muscle – Meadows and Rain*
- *Mr. Clean Multi-Surface Cleaner – Summer Citrus*
- *Pinesol Multi-Surface Cleaner*
- *Windex Multi-Surface Cleaner*
- *Windex Original*

Green products with full ingredient disclosure —

- *Seventh Generation Dish Cleaner – Free and Clear*
- *Seventh Generation Disinfecting Wipes*
- *Seventh Generation Granite and Stone Cleaner – Mandarin Orange*
- *Seventh Generation All-Purpose Cleaner – Free and Clear*
- *Seventh Generation Wood Cleaner – Lemon and Chamomile*
- *Nature Clean Glass Cleaner*
- *Method All-Purpose Cleaner – Beach Sage*

Green claim on the label but did not disclose ingredients —

- *Clorox Greenworks All-Purpose Cleaner "98% naturally-derived"*
- *President's Choice GreenVert All-Purpose Cleaner – Fragrance Free – claim: "with no harsh chemical fumes or residues"*
- *CLR Bath and Kitchen Cleaner – claim: "biodegradable"*
- *Pledge Multi-Surface Cleaner – claim: "99% natural"*

** Nature Clean is certified by EcoLogo. Seventh Generation participates in the USDA Biobased Certification program. Method is certified by Cradle to Cradle.*

While green products represent a small share of the market, a growing number of Canadians are turning to these brands as an alternative. For this reason, we asked three volunteers to clean with a mix of green products. Two volunteers used products with unverifiable green claims.

Some of the volunteers were enthusiastic cleaners while others were more relaxed. We enrolled a mix of men and women and did our testing in late winter, when doors and windows were closed and the effects would not be diluted by outside ventilation. The volunteers conducted roughly half an hour of kitchen cleaning.

From left: Toronto resident, Jenny cleans her kitchen as part of an experiment by ENVIRONMENTAL DEFENCE. While she cleans, an air pump (on the right) captures an air sample to be tested.

An ENVIRONMENTAL DEFENCE staff member took two air samples, one per day on two consecutive days, in the kitchen of each volunteer. The first air sample was taken on the day before cleaning was to begin, to measure the baseline indoor air levels of VOCs. The second sample, taken the next day, was commenced when volunteers started cleaning. It began at the same time (within 15 minutes of the previous day's start time) and for the same time period. Each sampling activity lasted approximately two hours. For the samples, air pumps provided by CASSEN Testing Laboratories drew air into stainless steel sorbent tubes. Following the cleaning, the air samples were sent to CASSEN in Toronto for analysis.

The volunteers cleaned their kitchens using only the products we had supplied. We strongly encouraged them to not do any major cleaning for a five to seven-day period before the study started to avoid any contamination of the results.

We also asked the volunteers not to change any personal care products and to follow their regular routine as much as possible over the two days of the sample collection to ensure results were not skewed by other factors, such as a change in fragranced personal care products.

Our cleaners' jobs were done—it was now up to the lab to tell us what the effect on the air quality in the volunteers' homes had been.

WHAT WE WERE LOOKING FOR AND WHY

As outlined previously, our study looked at the presence of VOCs in indoor air before and during the use of cleaning products. VOCs are ubiquitous: in addition to carpets, paint and furniture, sources include glue, dish and laundry detergents, cigarettes and even clothes that have been to the dry cleaner. For healthy air, it is important to keep VOC levels low, so let's take a closer look at the health risks.

Volatile Organic Compounds and Your Health

High levels of VOCs can cause eye, nose and throat irritation, shortness of breath, headaches, fatigue, nausea and dizziness. Lower levels can contribute to asthma and skin problems. Higher concentrations can even have neurotoxic effects like causing damage to the liver, kidney, or central nervous system.[11]

Some VOCs are suspected to cause cancer in humans and have been shown to cause cancer in animals. The health effects caused by VOCs depend on the concentration and length of exposure to the chemicals.[12]

VOC CONCENTRATION[13]	SHORT-TERM HEALTH EFFECTS
Less than 200 µg/m^3	No irritation or discomfort expected
200 µg /m^3-3,000 µg /m^3	Irritation and discomfort may be possible
3,000 µg /m^3-25,000 µg /m^3	**Discomfort expected and headache possible**
Greater than 25,000 µg /m^3	**Toxic range where other neurotoxic effects may occur**

**The chart above is taken from HealthLink BC, a health information service provided by the government of British Columbia. Exposure durations were not specified by HealthLink BC.*

More research is needed to better understand the long term effects of VOC exposure, but there is evidence that chronic exposure can increase the risk of cancer.[14] The World Health Organization (WHO) classified outdoor air pollution as a human carcinogen in 2013,[15] and VOCs are a significant contributing factor to poor air quality.

Studies by the U.S. Environmental Protection Agency (U.S. EPA) found "levels of about a dozen common organic pollutants to be two to five times higher inside homes than outside, regardless of whether the homes were located in rural or highly industrial areas."[16] The U.S. EPA adds that "while people are using products containing organic (carbon-containing) chemicals, they can expose themselves and others to very high pollutant levels, and elevated concentrations can persist in indoor air long after the activity is completed."[17]

According to a study done for the California Air Resources Board (CARB), cleaning products may include VOCs that are classified in that state as toxic air contaminants.[18] But the California researchers pointed out that it wasn't just direct exposure to air contaminants in the products that was of concern. They explained that, "Additional exposures of potential concern arise owing to reactive chemistry that occurs in the indoor environment. This chemistry converts non-toxic primary constituents into secondary pollutants that may pose human health risks."[19] In other words, using cleaning products can trigger chemical reactions in indoor air that create new substances that also affect air quality.

For example, the researchers point to terpenes, a group of VOCs. Terpenes, are derived from plant oils, and "are widely used in cleaning products and air fresheners because of their favourable solvent properties and pleasant odours."[20] Terpenes are an example of a common fragrance ingredient in cleaning products that can cause harmful cross-reactions with indoor air.

VOLUNTEER PROFILE # 3

Nabil – Montreal, Quebec

Total VOCs before cleaning: **1,200 µg/m³**
Total VOCs after cleaning: **2,000 µg/m³**
Increase: **800 µg/m³ (67 per cent)**
Products used: ***conventional only*** **– Mr. Clean Meadow Rain, Lysol Disinfecting Wipes, Pledge Multisurface Cleaner**

"There was a very strong odour from the cleaning products—it stayed for two days. I was already concerned about ventilation in my house, but now I really need to do something about it. I don't want high VOC levels to put my health at risk."

Given their prevalence in cleaning products, terpenoid compounds were one of the types of VOCs detected in our study. Our test found more than one hundred VOCs, including alcohols, aldehydes, esters and ethers.

The type of ozone in question is ground-level ozone, a 'bad' form of ozone as it's a harmful pollutant for humans. Ozone occurring in indoor air should not be confused with 'good' ozone in the troposphere (i.e. the earth's ozone layer) which blocks harmful UV radiation.

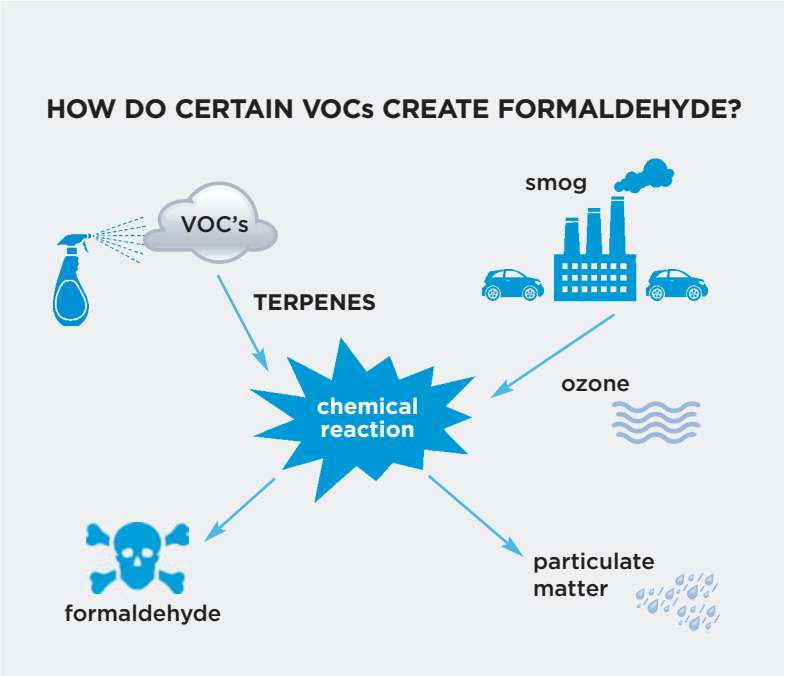
Ground-level ozone is largely the result of emissions from fossil fuel combustion, including car exhaust.[21] Ozone in indoor air is either drawn in from outside air or is produced by other sources within the home (such as a computer printer).

Ozone in indoor air can be detrimental by itself, but when mixed with terpenes, rapid reactions can form even nastier chemicals.

According to the CARB researchers, "ozone-terpene chemistry produces the hydroxyl radical, which triggers an array of indoor chemical reactions, and the formation of formaldehyde, a toxic air contaminant with a low acceptable exposure limit."[22] Formaldehyde is a known carcinogen.

The ozone-terpene reaction can also create particulate matter (microscopic solids), which can lead to lung irritation, trigger asthma, cause heart disease and other health problems. In fact, the California study found that ozone-terpene reactions caused by the use of cleaning products led to "substantial secondary production of particulate matter."[23]

The California study also found that using cleaning products with terpenes when ozone was present increased formaldehyde levels by 6-12 parts per billion (ppb). California's standard for chronic exposure to formaldehyde is 2 ppb. Unfortunately, no comparable standards for chronic formaldehyde exposure exist in Canada. Health Canada has issued guidelines for indoor, residential exposure to formaldehyde.[24] Over an eight hour exposure period, the maximum level recommended for formaldehyde is 40 ppb. Short-term exposure limits set by the federal government are inadequate in this context as regular cleaning could lead to long-term exposure to low levels of formaldehyde, which can also be hazardous to human health.[25]



Similarly, terpene-ozone reactions also led to particulate matter levels that greatly exceeded California's average annual exposure limit and that were at or above the state's 24-hour exposure standard.

In urban centres in Canada, the occurrence of smog means higher concentrations of ground level ozone. For this reason, the possibility of terpenes reacting with ozone during cleaning is a very real concern, especially during the summer when outdoor ozone levels peak.

The ozone-reacting potential of terpenes is just one example for the multiple health risks associated with VOCs, especially mystery ingredients that fall under the umbrella term of fragrance ingredients. Unfortunately, it's not currently possible to know what's in most products because in Canada there is still no requirement for manufacturers to disclose what is added to a product under the umbrella term "fragrance." The composition of a product's fragrance is still considered a trade secret, creating a serious information gap that leaves consumers at risk.

Until stringent labelling rules lead to full ingredient disclosure, you may be paying for that "lemon fresh" scent with poorer indoor air quality, but you can't tell by looking at the product ingredient label.

VOC Standards and Guidelines

Governments in North America and Europe, including state level governments, have had an evolving approach to VOCs as research into indoor air pollution increasingly indicates the health risks associated with exposure.

Guidelines exist in California for VOCs from building materials[26], and the EU also has guidelines for VOCs associated with paint[27]. Health Canada offers a guideline for the VOCs formaldehyde and toluene[28] (a compound that's not often used in cleaning products), and recommendations for reducing VOC exposure from consumer products used at home.[29] Unfortunately, no guidelines for total VOCs in indoor air in Canadian homes exist. Likewise, guidelines for VOC content in consumer products don't exist, despite promises from the federal government.

*

As a non-governmental organization, AGÖF serves as Germany's professional association for indoor pollutant assessment and laboratory analysis, ecological product testing, and sustainable and healthy building consulting. AGÖF has published guidance values for VOCs. Its work is supported by Germany's federal environmental protection agency, the Umweltbund-esamt. Due to the lack of legislated standards, AGÖF-established VOC guidance values have taken on quasi-legal status in Germany.

In Canada, the proposed *Volatile Organic Compound (VOC) Concentration Limits for Certain Products Regulations* were scheduled to be published in summer 2014 in the Canada Gazette (to make them official) but they have been delayed. According to Environment Canada, the proposed regulations will likely be published sometime in 2015.[30] Once published, the regulations will take effect in two years. There has yet to be any confirmation of when or if these regulations will actually be published this year. It seems as though, the federal government is causing an unnecessary delay for regulations that could help limit Canadians' exposure to indoor VOCs.

VOCs guidelines that include chemicals frequently associated with cleaning products (in contrast to guidelines limited to VOCs from building materials or paint), have been established by the German organization AGÖF, the Association of Ecological Research Institutes.[31]

In the absence of established guidance values in Canada, we compared the results of our cleaning product air quality tests to the values determined by AGÖF.

Guidelines for VOC content in consumer products don't exist, despite promises from the federal government.

VOLUNTEER PROFILE # 4

Jenny – Toronto, Ontario

Total VOCs before cleaning: **980 µg/m³**
Total VOCs after cleaning: **1,300 µg/m³**
Increase: **320 µg/m³ (33 per cent)**
Products used: ***green only*** **– Seventh Generation Natural All Purpose Free and Clear (no fragrance), Seventh Generation Dish Cleaner Free and Clear, Seventh Generation Granite and Stone Mandarin Orange**

"I live in a condo and I'm already struggling with getting fresh air. It's difficult to open the windows due to the noise and dust. The last thing I need is worse indoor air from conventional cleaners. I will continue to use green cleaning products to avoid any higher VOC levels in my living space; the green products work just as well."

WHAT WE FOUND

Increased Total VOC Levels

In every home we tested, total VOC levels increased after cleaning. However, the increase was lower in the homes that used certified green products compared to the homes that used conventional cleaners.

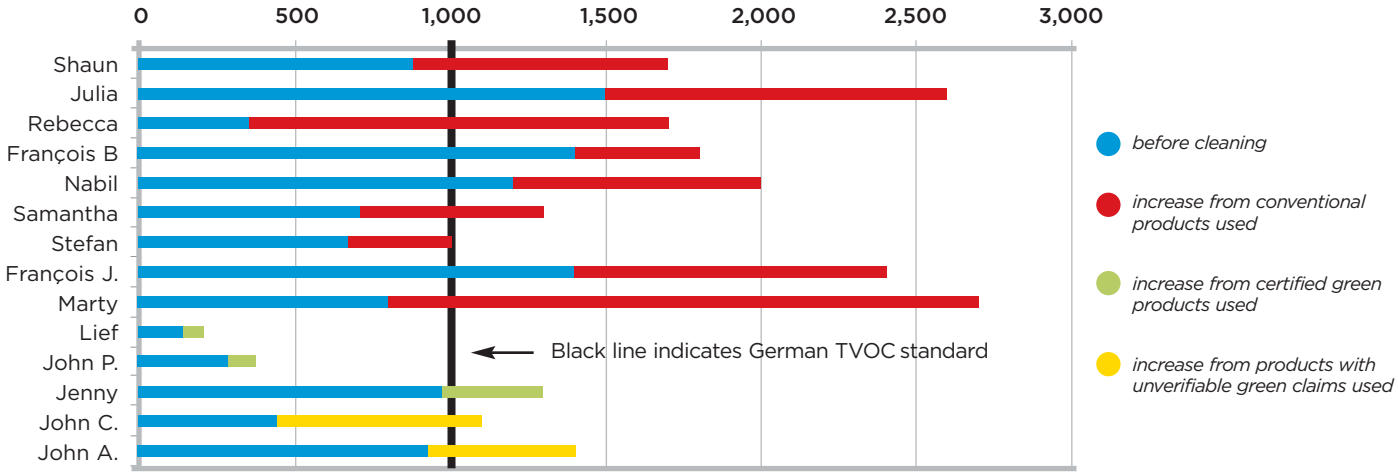
For the nine homes where conventional cleaners were used, total VOCs increased by an average of **120 per cent.***	For the three homes cleaned with green products with full disclosure labels, the increase averaged **35 per cent.***	For the two homes cleaned with products with green claims, total VOCs increased by **100 per cent.***

** See appendix for more information*

To put these increased levels of VOCs into perspective, we used the AGÖF-established values for comparison. AGÖF guidance recommends a total VOC (TVOC) concentration of no more than 1000 µg/m^3. Twelve of our post-cleaning air samples exceeded this amount: nine that included conventional cleaning products, one sample that included green products with full ingredient disclosure, and one product with unverifiable green claims.

In other words, out of the 14 tested households, 12 ended up exceeding the German VOC standard for indoor air after cleaning. Four of these households already had VOC levels above the recommended value of 1,000 µg/m^3. Their air quality worsened even more due to the cleaning products. The other eight households had acceptable levels of VOCs before the cleaning but showed concerning levels of VOC after the volunteers cleaned their kitchen.

TOTAL VOC LEVELS BY VOLUNTEER



Comparison of VOC Exposures

How did the VOC levels in the volunteers' homes stack up, compared to other locations where people can be exposed to these chemicals?

Green building standard[32]
500 µg/m

Nail salon[33]
1,600 µg/m (average)

Volunteers home – conventional products
1,900 µg/m (average)

New car[34]
2,000 µg/m

BREAKING DOWN THE RESULTS

Due to the nature of VOCs, we found a multitude of different compounds in our samples. Among the chemicals that we found were VOCs that are typical cleaning product ingredients such as alcohols, aldehydes, esters, glycols, and aromatic hydrocarbons.

We also found terpenoid compounds in our samples. "Terpenoid compounds, because of their low odour threshold and pleasant fragrance, are often used in cleaning products to produce a characteristic scent," explains CASSEN Testing Laboratories in its analysis of the results. High terpenoid VOC levels were even found in one green cleaning product. It should be noted that green products may contain terpenes as this class of chemicals occurs naturally (e.g. in pine resin).[35]

Terpenoids are a complex class of chemicals. For the purpose of this report, we took a closer look at five common terpenoid compounds: limonene, linalool, dihydromyrcenol, eucalyptol and alpha-pinene. Cumulative levels for these five terpenoids increased by at least 100 per cent during cleaning for 13 of 14 tested households. Some samples even showed concentrations 20 times the pre-cleaning terpenoid levels.

Parallel to total VOCs levels, green products had a smaller impact on air quality for the five selected terpenoids. On average, the combined selected terpenoid levels rose by nearly 80 µg/m^3 for those samples were green products were used (both full and partial disclosure labels). In contrast, terpenoid levels increased by 135 µg/m^3 when conventional products were used.

Clearly, the potential for direct exposure to elevated levels of VOCs was present both during and after cleaning. But, more importantly, in the homes using conventional cleaning products (and the one high terpene green product) there was also the added potential for a terpene-ozone reaction that could lead to the production of both formaldehyde and particulate matter.

We found clear evidence that the use of cleaning products affects indoor air quality and that the greatest negative impact on indoor air quality was associated with using conventional products.

Not All Cleaners Are Created Equal

We found clear evidence that the use of cleaning products affects indoor air quality and that the greatest negative impact on indoor air quality was associated with using conventional products. As we tested products in real-world circumstances, we saw a wide range in individual results. This may speak to differing application intensities of cleaning products by our volunteers in their kitchen environments as well as differences in ventilation.

However, even taking these variables into account, there were notable differences between the results for conventional products and full disclosure green products, with the green products having a lower impact on indoor VOC levels.

Our cleaning was undertaken in late winter (February-March 2015), a time when indoor air quality in most Canadian homes is already often less than ideal. But this too is the reality of living—and cleaning—in a country where windows and doors may be closed for six months of the year.

What can Canadians do to protect themselves and their loved ones from VOC exposure during and after cleaning? It's important to ensure thorough ventilation by opening a window or running your fan (if the air is exhausted outdoors). But even with proper ventilation, it is better to use products with lower air quality impacts—and this is where consumers cannot go it alone.

Under current labelling rules, it's impossible to know what's really inside conventional cleaning products. Full ingredient disclosure has to encompass fragrance components as well. Our testing has shown that harmful chemicals can easily be hidden in undisclosed fragrance ingredients.

More Work Needed

Our sample size was limited, but it provides adequate evidence to indicate that cleaning products can result in a marked increase in indoor air pollution. Further research is needed to investigate this problem. We cannot ignore the potential risks of VOC exposure from the use of cleaning products.

The study draws attention to the lack of clear information offered to consumers when it comes to consumer products and exposure to potentially harmful ingredients and by-products. Existing product labelling requirements are simply inadequate.

VOLUNTEER PROFILE # 5

Lief – Toronto, Ontario

Total VOCs before cleaning: **140 µg/m³**
Total VOCs after cleaning: **200 µg/m³**
Increase: **60 µg/m³ (43 per cent)**
Products used: ***green only*** **– Seventh Generation Natural All Purpose Free and Clear (no fragrance), Seventh Generation Dish Cleaner Free and Clear, Seventh Generation Granite and Stone Mandarin Orange**

"I always wondered how much better the green products really are for your health and the environment. I'm happy that they have only a small impact on my indoor air. I usually don't use green products, but now I will buy more."

Cleaning products vary in terms of their ingredients and resulting contributions to indoor air pollution and exposure to potentially harmful substances. But with existing product labelling, Canadians don't have the information they need to make safer choices about which cleaning products to use and how to use products safely.

Some businesses are making products which release fewer VOCs when used and/or that offer detailed information about ingredients. For example: In 2014, SC Johnson announced plans to disclose product specific fragrance ingredients.[36] However, most companies still don't make ingredient information available. Because most manufacturers also do not list the ingredients used in "fragrances," consumers remain in the dark about what is hiding under this catch-all label.

Similarly, the information some products offer on recommended usage is misleading or poorly presented. We found spray cleaners, for example, that advised in small print that the product should be diluted before use. This runs counter to how average Canadians routinely use their cleaning products—undiluted. How to dilute the product was neither obvious nor explained. And while short term hazards like eye irritation appear on labels, chronics hazard warnings are also needed.

When it comes to making product claims, gaps in existing regulations also became apparent. Some products claimed not to contain "harsh" chemicals or claimed to be "99% natural". What exactly is "harsh" and how does the manufacturer define this? The "natural" claim is also misleading as there is no legal definition of the term. To give an example of how problematic the "natural" claim is: highly reactive chemicals like terpenes and ammonia occur naturally. Just because a chemical is natural, it isn't necessarily safe. Other claims such as "phosphate free" simply muddy the waters, given that phosphates have been subject to strict limits in cleaning products since 2010.[37]

Cleaning your home shouldn't mean making indoor air quality worse or adding to your chemical body burden. Consumers should have the right to know what they are using and how to avoid making their homes less safe while making them sparkle.

CONCLUSION

Our study makes it clear that manufacturers need to come clean on what it is in their products. The good news is that a growing number of companies are opting for full ingredient disclosure (see for example SC Johnson's recent commitment[38,39]). There are also an increasing number of green alternatives on the market, although there are also products that provide little or no ingredient information while claiming to be green.

We welcome voluntary efforts by the industry to fully disclose product ingredients. However, consumers simply cannot wait for every company to take action on transparent labelling. We need government action on this crucial issue. Unfortunately, the federal government is dropping the ball when it comes to making full disclosure labelling mandatory. That's why Canadians have to look to their provincial governments for leadership in making ingredient disclosure on product labels a reality.

Recently, the Ontario government made a commitment to provide better information to Ontarians about chemicals linked to cancer, and to ensure that products on store shelves are as safe as those in other jurisdictions.[40]

We strongly recommend that this action should include tighter controls and full disclosure on fragrance ingredients.

We cannot ignore the potential risks of VOC exposure from the use of cleaning products.

Likewise, voluntary efforts by manufacturers to eliminate toxic chemicals from their products should be applauded. But again, these voluntary steps are not enough to protect consumers. Canadians deserve clear action from their federal and provincial governments to restrict, and where possible eliminate harmful chemicals in the products we use to clean our homes.

The federal government should also establish VOC guidelines for residential air, which would help guide businesses in making safer products.

Between full ingredient disclosure on product labels, reducing toxic chemicals in everyday products and establishing VOC guidelines for residential air, a lot needs to be done. Only then can Canadians be sure to breathe easy after cleaning their homes.

RECOMMENDATIONS

1 For Government Decision Makers/Regulators

Label consumer products
Regulators should introduce full mandatory on-label ingredient disclosure, including fragrance ingredients. When carcinogens or reproductive toxicants are present, consumer products need to carry additional warning labels.

Set VOC limits for residential and consumer products
The federal government should set guidelines for residential indoor air VOC levels and publish the planned regulation on consumer product VOC content without further delay. Such federal regulations are needed for the industry to make products safer.

Research VOCs from consumer products in residential air
More research is needed into residential indoor air quality, the potential of VOCs to react with other common indoor air pollutants, and the long-term health effects of these exposures, especially on pregnant women.

2 For Companies

Disclose ingredients
Fully disclose all ingredients of cleaning products, including those added as fragrances or fragrance additives.

Reduce VOCs in products
Lower the VOC content in consumer products to make them safer for Canadians.

3 For Consumers

Add your voice
Demand full disclosure of chemicals in everyday products by signing our petition at *environmentaldefence.ca/label.*

Choose safer products
Use products with fully disclosed ingredients on the label, especially by opting for green products. Find out which companies are coming clean on product ingredients, how to avoid toxic products and how to make your own low-VOC cleaning products at *environmentaldefence.ca/cleaning.*

Keep your home well ventilated while cleaning
Always keep windows open or ventilation fans running during and after cleaning (for 30 minutes to an hour) if fan exhausts outside. Keep children, especially babies and toddlers out of the room when using cleaning products.

APPENDIX A / LIST OF CLEANING PRODUCTS USED

Conventional —

- *Lysol All-Purpose Cleaner – Lemon*
- *Lysol Disinfecting Wipes – Spring Waterfall*
- *Lysol Power and Fresh – Fresh Orange*
- *Lysol Power and Fresh Multi-Surface – Lemon*
- *Mr. Clean Liquid Muscle – Crisp Lemon*
- *Mr. Clean Liquid Muscle – Meadows and Rain*
- *Mr. Clean Multi-Surface Cleaner – Summer Citrus*
- *Pinesol Multi-Surface Cleaner*
- *Windex Multi-Surface Cleaner*
- *Windex Original*

Green products with full ingredient disclosure —

- *Seventh Generation Dish Cleaner – Free and Clear*
- *Seventh Generation Disinfecting Wipes*
- *Seventh Generation Granite and Stone Cleaner – Mandarin Orange*
- *Seventh Generation All-Purpose Cleaner – Free and Clear*
- *Seventh Generation Wood Cleaner – Lemon and Chamomile*
- *Nature Clean Glass Cleaner*
- *Method All-Purpose Cleaner – Beach Sage*

Green claim on the label but did not disclose ingredients —

- *Clorox Greenworks All-Purpose Cleaner "98% naturally-derived"*
- *President's Choice GreenVert All-Purpose Cleaner – Fragrance Free – claim: "with no harsh chemical fumes or residues"*
- *CLR Bath and Kitchen Cleaner – claim: "biodegradable"*
- *Pledge Multi-Surface Cleaner – claim: "99% natural"*

APPENDIX B / RESULTS COMPARISON

Comparison of Total VOC Concentration Before and After Cleaning

Name	Total VOC Before (µg/m³)	Increase in µg/m³	% Increase	Product Type
Shaun	880	820	93%	Conventional
Julia	1,500	1,100	73%	Conventional
Rebecca	350	1,350	386%	Conventional
François B.	1,400	400	29%	Conventional
Nabil	1,200	800	67%	Conventional
Samantha	710	590	83%	Conventional
Stefan	670	330	49%	Conventional
François J.	1,400	1,000	71%	Conventional
Marty	800	1,900	238%	Conventional
Lief	140	60	43%	Green (full disclosure)
John P.	280	90	32%	Green (full disclosure)
Jenny	980	320	33%	Green (full disclosure)
John C.	440	660	150%	Green (partial disclosure)
John A.	930	470	51%	Green (partial disclosure)

Comparison of Total Selected Terpenoid Concentration Before and After Cleaning

(limonene, linalool, dihydromercenol, eucalyptol and alpha-pinene)

Name	Selected Total Terpenes Before	Selected Terpenes Total After	Absolute Increase Selected Terpenes	Relative Increase Selected Terpenes	Product Type
Shaun	17	336	319	1876%	Conventional
Julia	38	136	98	258%	Conventional
Rebecca	36	245	209	581%	Conventional
François B.	49	289	240	490%	Conventional
Nabil	29	71	42	145%	Conventional
Samantha	21	137	116	552%	Conventional
Stefan	30	103	73	243%	Conventional
François J.	24	129	105	438%	Conventional
Marty	2	2	0	0%	Conventional
Lief	8	16	8	100%	Green (full disclosure)
John P.	13	38	25	192%	Green (full disclosure)
Jenny	24	117	93	388%	Green (full disclosure)
John C.	17	45	28	165%	Green (partial disclosure)
John A.	128	367	239	187%	Green (partial disclosure)

APPENDIX C / METHODOLOGY

Materials and Preparation

ENVIRONMENTAL DEFENCE used market research data and shelf space assessments in major retailers, as well as consulting "most popular" product lists on major retailer websites to identify the top-selling conventional cleaning products in Canada. We then created a list of 21 popular products, which we purchased off the shelf from two major retailers in January 2015. We then provided nine volunteers with a mix of these popular conventional products. Three additional volunteers were provided with green products with ingredients fully disclosed, and two volunteers were provided with products that are marketed as green but do not disclose ingredients on their labels. (See page 8 for a full list of materials.)

Sampling Activity

An ENVIRONMENTAL DEFENCE staff member took two air samples, one per day on two consecutive days, in the kitchen of each volunteer. The first air sample was taken on the day before cleaning was to begin, to measure their baseline indoor air levels of VOCs. The second sample, taken the next day, was commenced when volunteers started cleaning. The volunteers cleaned their kitchens using only the products we had supplied. The cleaning activity lasted approximately 30 minutes. On both days, the air sampling began at the same time (within 15 minutes of the previous day's start time) and lasted for the same time duration, approximately two hours. For the samples, air pumps provided by CASSEN Testing Laboratories drew air into stainless steel sorbent tubes. Following the cleaning, the air samples were sent to CASSEN in Toronto for analysis. (For additional details regarding the cleaning activity, please see page 7-9.)

Sample Analysis

Sorbent tube samples were analyzed using thermal desorption gas chromatography/mass spectrometry. Prior to sample analysis, the headspace samples of cleaning products, as supplied by ENVIRONMENTAL DEFENCE and used in the homes during sampling were characterized for the volatile organic emissions. Only these compounds found in the cleaners were reported in both "before" and "after" samples to avoid confusion with other background VOCs present in the residences.

PerkinElmer Thermal Desorption Air Toxic Sorbent Tubes, (PerkinElmer, Inc., Shelton, CT, USA) with a dimension of 3.5 inch (89 mm) in length x ¼ inch (6.4 mm) in diameter were used for sampling.

The instruments used are presented below:

- GC System: Agilent Model 7890 Gas Chromatograph
- MS Detector: Agilent Model 5973Network Mass Selective Detector
- Thermal Desorber: PerkinElmer ATD650 Thermal Desorber with Robotic Arm Auto-sampler with re-analysis capability

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