



# HAZARDS OF CARPET CLEANING

Health and Environmental Dangers Threatening Carpet Cleaning Workers

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## **Introduction**

The cleaning of carpet requires the removal of contaminants from the material to maintain or improve indoor environmental quality and improve the health and safety of humans who utilize the carpeted space. Neglected commercial and residential floor cleaning can lead to a devalue in property, an increases in hazards (dust, mold, allergens, bacteria) that are exposed to humans, lost production, absenteeism from employees and children that cannot attend school since they are adversely effected by the contaminated indoor environment.<sup>1</sup> According to the Institute of Inspection Cleaning and Restoration Certification (IICRC) proper maintenance such as vacuuming or having entry mats placed outside and inside of building entryways to limit contaminants can be effective at keeping a carpeted floor clean, but overtime the carpets can become saturated with soil and grease that will require professional cleaning to extract the contaminants matted into the carpets piling.<sup>2</sup> Professional methods of carpet maintenance include hot water extraction, commonly known as “steam cleaning”, and low moisture cleaning. In order to determine which method would be the most effective in ridding a carpet of contaminants the professional must know what the carpet is exposed to and how it has been maintained.

“The science of cleaning involves the evaluation of the carpet (fiber, construction, color, age, traffic patterns and soiling conditions) and cleaning (chemistry, temperature, pre-conditioning, water flow, speed of tool movement, and number of repetitions).”<sup>3</sup> The type of cleaning process conducted on commercial or residential carpets depends on an array of factors: What type and how often maintenance is performed? Type of contaminate(s) present? Are animals or food preparation contributing to the decline in the carpets quality? Is the carpet saturated with water or is mold present? What is the age of the carpet? Typically your average residential carpet should be professionally cleaned every 1-3 years, while commercial carpet

cleaning may be necessary every month or every year or two. Again, it depends on how the carpet is utilized. Depending on those factors a cleaning system can be developed and implemented to hopefully restore the carpet where contaminants pose no hazard to human health and perhaps be aesthetically pleasing to the customer.

According to a 2016 survey<sup>4</sup> of the carpet cleaning industry conducted by Cleanfax, fifty-five percent are certified cleaners or belong to industry associations or institutions. Typically these associations certify that the cleaners are knowledgeable of the nature of carpet contaminants and the cleaning process so that they can perform the service effectively and safely. Not understanding the nature of the hazards that can be exposed to these workers and clientele can result in injury or ailment. Workers are vulnerable to injury from repetitive movements, slipping, falling and both worker and customer are vulnerable to the health risk associated with dust, allergens, fungi, pesticides and chemicals that could be present in carpet. Common carpet cleaning chemicals contain surfactants, alkaline builders, solvents, and disinfectants. “During the performance of their job to improve the indoor environment of occupants, cleaners are potentially exposed to dust and cleaning agents. The cleaning agents also contribute to the contamination of the indoor environment after the cleaning. The degree of exposure of occupants depends on the amount of residue and the rate of off-gassing and particle release from surfaces. Thus, both cleaners and occupants are exposed to the same substances, but with a different weighting that depends on the time-dependent emission and removal of vapors, gases, and dust.”<sup>5</sup> Environmental concerns in the industry are becoming more popular as consumers are demanding environmentally friendly cleaning chemicals, or “green” chemicals which apparently are “safer” to humans and the environment.

In order for effective cleaning to take place the entire process must be viewed holistically. From the cleaning process chosen, to the chemicals used, to how the extracted contaminants are disposed of are all a matter of concern when attempting to improve indoor environmental quality. Steps also must be taken to not compromise worker and consumer health. Carpet cleaning chemicals have been known to contain surfactants which is known for causing skin problems among workers, fragrances and disinfectants may cause chronic respiratory problems. Asthma, or allergic reactions have been affiliated with dried detergent residues from carpet cleaning chemicals. “Cleaners represent a significant part of the working population worldwide, they remain a relatively understudied occupational group. Epidemiological studies have shown an association between cleaning work and asthma, but the risk factors are uncertain. Cleaning workers are exposed to a large variety of cleaning products containing both irritants and sensitizers, as well as to common indoor allergens and pollutants. Thus, the onset or aggravation of asthma in this group could be related to an irritant-induced mechanism or to specific sensitization. The main sensitizers contained in cleaning products are disinfectants, quaternary ammonium compounds (such as benzalkonium chloride), amine compounds, and fragrances. High-level exposure to irritants may induce reactive airways dysfunction syndrome. Cleaning workers may also have a greater relative risk of developing asthma due to prolonged low-to-moderate exposure to respiratory irritants. In addition, asthma-like symptoms without confirmed asthma are also common after exposure to cleaning agents.”<sup>6</sup> Residues of cleaning products can also absorb into the carpet to become volatile organic compounds and off-gas into the surrounding environment. Knowledge of chemical hazards and safety procedures are needed to ensure optimal occupational health and safety standards are met in the workplace.

## **Objectives:**

The objectives of this research project are to conduct a literature review of hazards and health effects in carpet cleaning, describe the carpet cleaning process and identify the most common cleaning chemicals used to see if they pose a health risk to carpet cleaning workers, those who use the carpeted space and if indoor environmental quality will suffer or improve.

## **Methods**

### 1. Literature Review

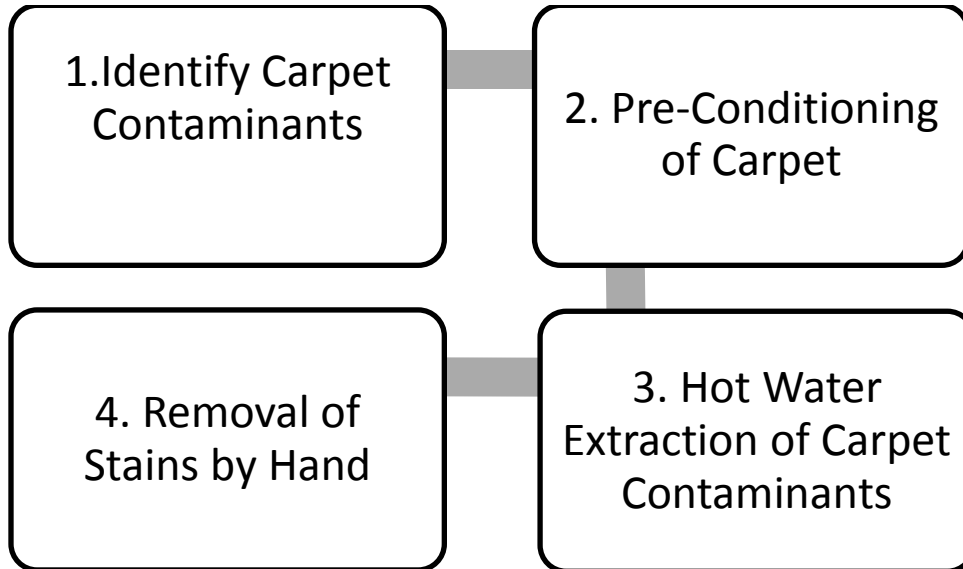
The literature review was conducted by using the search terms “carpet cleaning”, “carpet cleaning workers”, “carpet cleaning hazards”, “cleaning worker health”, “Carpet hazards” in search engines Google Scholar and PubMed. Roughly ten articles related to those searches I decided to use in my research on carpet cleaning and its health effects on workers and those exposed to the related phenomenon. Research ranging from ergonomics effecting workers, to VOC levels from off gassing of carpets effecting indoor air quality was used.

### 2. Analysis of the Carpet Cleaning Process and Common Chemicals Used

My four and one-half years of carpet cleaning experience allowed me to accurately describe the process of two-methods I have personally done many times: Hot Water Extraction/Steam Cleaning, and low-moisture cleaning. I have also identified the cleaning chemicals I most often work with when conducting the cleaning processes and how they are used in both cleaning processes.

## Carpet Cleaning Processes

### Methods of Carpet Cleaning: Hot Water Extraction for Commercial and Residential Carpets



**Figure 1. Process of Hot Water Extraction for Commercial and Residential Carpet Cleaning**

**Hot Water Extraction/Steam Cleaning:** When treating carpet, steam cleaning services are still considered by many home and business owners to be the go-to method of treatment. While there is technically a difference between this form of treatment and hot water extraction, many professionals refer to them interchangeably. In either case, a jet of extremely hot water is directed into the fibers that have been pretreated. It is an effective form of treatment that is particularly adept at removing suspended soils that have remained matted in the fibers for some time.<sup>7</sup>

1. **Identify Carpet Contaminants:** Unwanted deposits of soil, particles, foreign fibers, water-soluble or dry solvent-soluble substances (food, oil, and greases) primarily make up carpet contaminants. For cleaning to be effective physical and chemical properties of

contaminants must be understood. Water soluble contaminants easily dissolve in water; they include sugar, starches, salts and other fluidic residues. Dry solvent soluble contaminants include asphalt, tar, grease, animal or vegetable oils. Insoluble contaminants cannot be dissolved with chemicals from normal cleaning so they must be cleaned and extracted professionally. Insoluble contaminants include sand, quarts, clay, fibers from clothes and plants, protein fibers from humans, and animals. Contaminant build-up typically happens at entry ways and high traffic areas. Commercial carpet entry ways and traffic areas may require more chemical, water, and vacuuming as opposed to residential carpet. Residential carpets may have pet dander throughout the house, urine stains, or grease build-up from cooking, so proper chemical and cleaning techniques need to be implemented as to ensure maximum extraction of contaminants.

2. **Pre-Conditioning of Carpet:** Pre-conditioning the carpet can begin multiple ways.

Depending on the condition of the carpet it may need to be dry-vacuumed before chemical pre-conditioning. A residential carpet matted with pet dander, or a commercial building that recently was renovated may need to be dry-vacuumed of larger surface dwelling contaminants. Furniture on the carpeted area may need to be removed. A pre-spray is applied to the carpet with extra attention to stains, pivot points, and high traffic areas. The goal of the pre-spray is to separate soil and contaminants from the carpet fibers while also dissolving contaminants and reducing surface tension. We mix the cleaning chemicals into a 5 quartz jug inline injection sprayer with hot water from the truck mount. The water comes from the 100 gallon water tank and a 5 gallon solution tank which also contains cleaning chemicals (about 24oz worth). The Chemicals we use for



the pre-spray are Procyon (16oz) Powerburst (12-14oz), or Blitz with Greasebreaker. (12-14oz). The pre-spray sprays up to 10 gallons of water per container, with 8 parts of water and 1 part of chemical being sprayed. For residential use we typically use Procyon since it is marketed for being safe to humans and the environment, and cleans residential carpets effectively. Commercial buildings, especially restaurants, with high traffic and grease stains require us to use stronger chemicals with degreasers such as Powerburst or Blitz. Waiting 5-10 minutes for the chemical to soak into the carpet is recommended but not always necessary. If the carpet is being pre-conditioned for mold or water removal then disinfectants would be used on the areas of concern to kill or retard mold growth.

- 3. Hot Water Extraction of Carpet Contaminants:** Attach the vacuum hose and solution hose to carpet cleaning tool. Make sure the vacuum and solution hose are connected to the truck mount. With the carpet cleaning tool, as you would if you were vacuuming, go over the entire carpet while spraying water/chemical from the cleaning tool, via solution hose, at about 400-450psi for residential carpet and 450-500psi for commercial carpet at 220°F. Extra solution will come from the 5 gallon solution tank at 4gph. “As the extraction floor tool is moved over the application area, the injected solution, along with suspended soil, is removed through the lips of the vacuum extraction nozzle and eventually evacuated through vacuum hoses to a recovery tank.”<sup>8</sup> Extra attention should be given to entry ways, traffic areas, pivot points, and stains. Once the desired area is clean the machines can be packed up, furniture put back, and fans brought in to aid the carpet in drying. If the carpet was treated for mold only pre-spray and vacuuming is

required as to limit the amount of moisture on the affected area. Depending on the amount of water used, dry-vacuuming or use of fans, the carpet should dry in 2-24 hours.

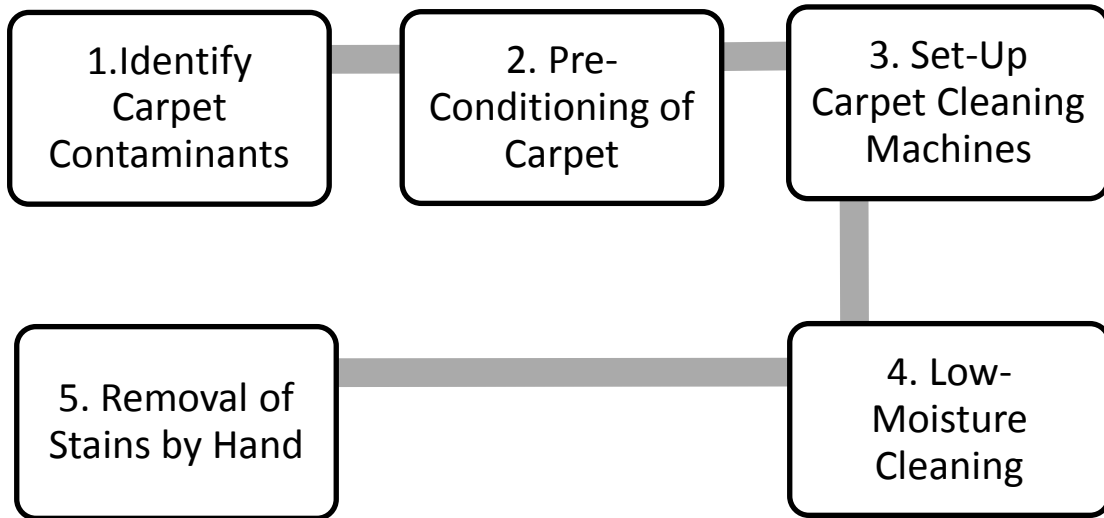
4. **Removal of Stains by Hand:** Not always needed, but hot water extraction does not always remove every visible contaminant. Inks, oils, gums, saliva and other tough stains may need to be removed by direct chemical application while scrubbing with a clean towel. We commonly use Citrusolv to remove gum or grease stains, and P.O.G (Paint, Oil & Grease) to remove ink stains. Not every stain may come out, and some areas of the carpet, especially high traffic areas, may be perceived as dirty but the deep cleaning power of hot water extraction and cleaning chemicals has certainly improved indoor environmental quality. Low-moisture cleaning may follow HWE to further extract contaminants and/or improve drying time.

### **Findings**

According to one study “HWE was greatly enhanced by the use of surfactant pre-sprays designed to aid in the suspension and removal of typical soils from carpet. Generally, the carpet cleaning process that employs a CRI (Carpet & Rug Institute) Green Label vacuum cleaner and HWE technology combined with chemical pre-spray can be expected to be more efficient in soil removal than other processes tested.”<sup>9</sup> HWE may be the best method of cleaning carpets and improving indoor environmental quality but there is still health risk from the cleaning process. Attention must be given to ensure all the area treated with chemical pre-spray is extracted thoroughly so it does not seep into the carpet and become a VOC. Pre-spray can also increase

chances of respiratory damage if inhaled, it can also drift beyond the carpeted area and settle on other surfaces where it can come in contact with peoples skin causing irritation.

**Methods of Carpet Cleaning: Low Moisture Cleaning for Commercial and Residential Carpets**



**Figure 2. Process of Low Moisture Cleaning for Commercial and Residential Carpets**

**Low Moisture Cleaning:** “Broadly defined in the industry as a method of carpet cleaning that limits drying to 1-2 hours. Low Moisture cleaning processes include encapsulation cleaning, ‘pad capping,’ bonnet cleaning and compound.”<sup>10</sup> Typically we use an oscillating pad machine to extract soil and grime from the carpet, or a floor scrubbing machine to encapsulate soil and other contaminants. Low moisture cleaning can be just as effective as steam cleaning and even preferred. Low moisture is good at getting to hard-to-reach places that a truck mount can’t reach, such as a second floor office building, or good to use after HWE to ensure maximum contaminant extraction and quick dry time.

1. **Identify Carpet Contaminants:** Residential and Commercial low moisture cleaning have the same processes, but like HWE we must identify the carpet contaminants. Low-moisture is best at cleaning light-medium soiled carpets such as office building traffic, soil and light grease. Heavy grease deposits can be removed, though that does take an excessive amount of time, water, pads and chemical so it's best to use low-moisture for carpets that are regularly maintained.
2. **Pre-Conditioning of Carpet:** First furniture on the carpet area will need to be removed. Dry-vacuuming is needed since surface contaminants would saturate the cotton pad making them less efficient. Dry-vacuuming is not needed for encapsulation cleaning unless there is excessive debris.
3. **Set-Up Carpet Cleaning Machines:** We will need to mix carpet cleaning chemicals into the machine(s) before they are started. The oscillating pad machine holds 3 gallons of water. We will mix 6oz of Procyon (2oz/gal) or 12oz of Releasit Encapsulation cleaner (4oz/gal) into the water jug. The Floor scrubbing/encapsulation machine holds 6 gallons of water and will have 24oz of Releasit Encapsulation cleaner added to it.
4. **Low-Moisture Cleaning:** For the oscillating pad machine place a cotton pad at the base of the machine. Start machine, while pushing forward spray the carpet cleaning solution onto the carpet. The oscillating and rotating cotton pad will absorb the water, dirt, grease and other stains from the carpet. Go over the entire carpeted area and change cotton pads at your own discretion. The encapsulation machine just needs to be pushed over the

carpeted area while a trigger releasing the encapsulation cleaning solution saturates polyester floor pads which rotate, scrubbing the solution into the carpet. The longer the trigger is held, the more cleaning solution will be released. The contaminants will be encapsulated and then extracted by vacuuming during regular maintenance.

5. **Removal of Stains by Hand:** Like HWE, low-moisture cleaning may not get every stain or contaminant out from the carpeted area. Using solvents or spotters on stains while scrubbing them with a towel may be needed. Furniture can be placed back and the carpets should be dry in 1-6 hours.

## **Findings**

Low-moisture may potentially increase overall VOC levels in a built-environment. Because the carpet contaminants are not being extracted like in HWE, although it may appear cleaner there may be chemical residue. In the case of Releasit, which is an encapsulate cleaner, the contaminants are purposefully left-behind to be extracted by regular vacuuming. If vacuuming does not take place, or fail to extract all of the encapsulated contaminants, the chemical residue can pose a threat to indoor environmental quality and according to its safety data sheet (SDS), a threat to the respiratory system if inhaled.

## Literature Review

For the purpose of this project a literature review was conducted on the occupational health hazards associated with carpet cleaning workers, and regular cleaning workers who are exposed to similar hazards such as cleaning chemicals. The literature searches are comprised of studies published between 1998 and 2010. Research on specific hazards associated with carpet cleaning is lacking, while those who have studied hazards associated with cleaning workers say more information is needed to accurately assess their hazardous exposure especially since they are more likely to suffer from chronic exposure than acute exposure.

**Table 1.Literature Review**

<b>Author</b>	<b>Findings</b>
Bishop, Jeff. "The Science of Carpet Cleaning." International E-Journal for Flooring Sciences 2004 (2004): 1-14.	This article describes the technical process of commercial and residential carpet cleaning. The author describes the types of contaminants that the workers will be exposed to and the process of remediating them. The need to see indoor environmental quality holistically is stressed by the need for routine cleaning, maintenance and restoration, if need be. Many of the hazards in carpet cleaning that the cleaning workers are exposed to are also exposed to their customers, their customers' employees, etc., so a compromised cleaning/maintenance system may result in customer/workplace ill-health. A professional and holistic approach is needed to ensure maximum environmental quality from the chemicals needed to properly clean, to the contaminants extracted.

<p>Wolkoff, Peder, et al. "Risk in cleaning: chemical and physical exposure." <i>Science of the total environment</i> 215.1 (1998): 135-156.</p>	<p>This article broadly describes "cleaning agents and the impact of cleaning on cleaners, occupants of indoor environments, and the quality of cleaning," especially VOC effects on workers and the indoor air quality. It seems after cases of worker health being compromised from cleaning agents there has been an effort to make the cleaning agents ecologically and environmentally friendly, biodegradable and minimally toxic. Surfactants, found in many of the carpet cleaning chemicals, is known for causing skin problems among workers. Fragrances have been linked to allergies, and disinfectants to chronic health problems. Generally it seems that the use of cleaning products will increase overall VOC levels while indoors, especially when fragrances are used. Deep cleaning (perhaps Hot Water Extraction) has been shown to reduce symptoms associated with sick building syndrome. Reduction in fungal spores, bacteria, VOCs, and dust have been reported.</p>
<p>Goggins, Rick. "Hazards of Cleaning." <i>Professional Safety</i> 52.3 (2007): 20.</p>	<p>This article discusses cleaning ergonomic hazards. Steam cleaning is mentioned to be an effective cleaning as it can reduce environmental hazards, and uses less chemical than traditional methods. The scrubbing tool, solution and vacuum hose help reduce awkward bodily positions for the worker. Because steam dries quickly there is low hazard for slip-and-fall incidences. Over-exertion may be the biggest hazard.</p>

<p>Liroy, Paul J., Natalie CG Freeman, and James R. Millette. "Dust: a metric for use in residential and building exposure assessment and source characterization." <i>Environmental Health Perspectives</i> 110.10 (2002): 969.</p>	<p>This article discusses the composition and toxic contaminants found in residential and commercial dust. Homes can be exposed to dust fragments containing pesticides, heavy metals, mites, asbestos, or polycyclic aromatic hydrocarbons. Depending on what type of carpet, how it has been used, and what has been exposed to it, a hazard risk may exist to whoever is using the carpet and whoever has to clean it. Failure to clean properly can result in the spreading of contaminants via chemical sprayers, ineffective dry vacuuming, etc., in a home or business which can lead to health problems for people as a result of inhalation.</p>
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<p>Clark, N. M., et al. "Damp indoor spaces and health." Washington, DC: Institute of Medicine of the National Academies (2004).</p>	<p>Exposure from damp environments can put cleaning workers at risk by exposing them to mold. Chronic exposure may lead to asthma, skin problems, or other respiratory problems. When dealing with damp environments it is best to utilize personal protection equipment since some molds can enter through the skin if contact is made. Because humidity is a factor while cleaning carpets, it is important to know that a properly functioning HVAC system is available, to dry the carpets quickly, otherwise a threat of bacteria, fungal, or mold growth exist. Headaches, nausea, fatigue are just some examples of what workers can experience when dealing with damp environments. Proper remediation must be conducted to limit harm to workers and occupants since active fungal/mold spores can survive in dry carpet. Proper chemicals/disinfectants should be used, but proper safety direction should be followed to limit hazards to human health.</p>
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<p>Nazaroff, William W., and Charles J. Weschler. "Cleaning products and air fresheners: exposure to primary and secondary air pollutants." <i>Atmospheric Environment</i> 38.18 (2004): 2841-2865.</p>	<p>According to California regulators, many cleaning chemicals contain VOCs which contribute photochemical smog. Volatile and non-volatile constituents of cleaning products can be inhaled or residues can be suspended in the air. Spraying down carpet cleaning chemicals can create airborne droplets which can be inhaled. Documented cases of asthma, or allergic reactions have been affiliated with dried detergent residues from carpet shampoos. Cleaning chemicals that can absorb into the carpet or other surfaces include: Diethylene glycol monobutyl ether, Ethylene glycol monobutyl ether, benzene, toluene, xylene, Tetrachloroethylene, 1,1,1-Trichloroethane, Limonene, alpha/beta-pinene.</p>
<p>Rosenman, Kenneth D., et al. "Cleaning products and work-related asthma." <i>Journal of Occupational and Environmental Medicine</i> 45.5 (2003): 556-563.</p>	<p>Many workplace chemicals lack proper safety data information. This has resulted in workers developing workplace related asthma, during or after being exposed to asthma causing chemicals, especially among custodians and cleaners. Carpet cleaners containing fungicides and other disinfectants, have caused acute respiratory problems in workers. The EPA estimates that custodians use 58 pounds of chemicals deemed "hazardous" per year. Nearly 1/3 of cases of workplace related asthma (conducted in: NJ, CA, MI, MA) could not identify the specific product or ingredient associated with their symptoms. Basically, cleaning chemical manufactures require more testing to be done to determine the risk their products pose to those who use them,</p>

<p>Goggins, Rick. "Hazards of Cleaning." Professional Safety 52.3 (2007): 20.</p>	<p>Disinfectants used to destroy bacteria and other microorganisms are identified as the most hazardous groups of cleaning agents. Some detergents and their surfactants are believed to interfere with immunological function. Alkaline agents in aerosol form, such as carpet pre-spray, can cause skin and mucous membrane irritation. Solvents, especially 2-Butoxyethanol can cause skin and sensory irritation. Perfumes such as pine scent and limonene (Which I use fairly often when cleaning carpets) can act as sensitizers.</p>
<p>Williams, Rose Marie. "Carpet Politics and Alternatives." Townsend Letter for Doctors and Patients (2001): 172-172.</p>	<p>Before the cleaning process even begins the hazards of chemical exposure exist. Off-gassing from the carpet (especially from new carpeting), the padding, the dyes, plus pesticides and fungicides on the carpet can cause respiratory problems ranging from wheezing to lung cancer if one is exposed to it long enough. "Green" labeling is largely done and controlled by the carpet manufacturing industry where standards can easily be manipulated to their benefit. Cleaning a carpet immediately after installation can reduce outgassing of toxic VOCs, but I assume until that is complete the workers are exposed to all of the hazards the installers were exposed to such as 4-phenylcyclohexene, fumes and adhesives from the seaming process, solvents, etc.</p>

<p>Lynch, Richard M.  "Modeling of exposure to carpet-cleaning chemicals preceding irritant-induced asthma in one patient."  Environmental health perspectives 108.9 (2000): 911.</p>	<p>If the carpet cleaner's aren't asthmatics themselves, then a warning must be given to asthmatics especially if they are prone to irritant induced attacks. Not following proper labeling of cleaning chemicals specified by manufactures, or following perceived directions of poorly labeled direction can lead to improper uses of chemicals resulting in health hazards. Improperly mixing cleaning chemicals, and applying detergents with VOCs can cause irritate based asthma attacks in those prone to them. The levels at which chemicals and VOCs reach could be dangerous to worker health, but if they are not susceptible to asthma attacks the high concentrations may go unnoticed, while those at risk, especially infants and the elderly, can suffer.</p>
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What I found in the literature review is that indoor air and environmental quality can be improved with professional carpet cleaning, though attention must be given to the types of cleaning chemicals chosen and how they are used. Aerosol droplets from cleaning pre-spray can be inhaled and migrate outside the carpeted area where they can attach to other surfaces, increasing chances of contact with people which can cause asthma or adverse skin conditions.<sup>11</sup> Disinfectants, solvents and perfumes can have potential health impacts on those with respiratory problems. Improperly handling various cleaning chemicals (failure to mix properly, not wear personnel protective equipment) can result in ill-health effects. It seems little data exist on hazards facing carpet cleaning workers and cleaning workers in general, so more studies must be done. Because so many workers are exposed relatively little of the cleaning chemicals over the

course of their employment chronic health threats must be understood to adequately address the health threats facing the workforce.

**Table 2. Analysis of Safety Data Sheets for Common Carpet Cleaning Chemicals**

<b>Products/SDS</b>	<b>Composition/Information on Ingredients</b>	<b>Health Hazard Information/Toxicological Information</b>
<p><b><u>BLAZIN' BLUE</u></b></p>	<p>Sodium Tripolyphosphate, Sodium Carbonate, Sodium Bicarbonate, Glycol Ether DB</p> <p>There are no components contained in this material &gt;0.20% that are considered hazardous under the Hazard Communication Standard</p>	<p>ACUTE HAZARDS, Eye &amp; Skin Contact: Primary irritation to skin, defatting, dermatitis. Primary irritation to eyes, redness, tearing, blurred vision. Liquid can cause eye irritation. Inhalation: Anesthetic. Irritates respiratory tract. Acute overexposure can cause serious nervous system depression. Vapor Harmful. Swallowing: Swallowing can cause abdominal irritation, nausea, vomiting &amp; diarrhea</p> <p>CHRONIC HAZARDS, Cancer, Reproductive &amp; Other Chronic Hazards: This product has no carcinogens listed by IARC, NTP, NIOSH, OSHA or ACGIH, as of 4/20/2014. Target Organs: May cause damage to target organs, based on animal data. Irritancy: Irritating to contaminated tissue. Sensitization: No component is known as a sensitizer. Mutagenicity: No known reports of mutagenic effects in humans. Embryotoxicity: No known reports of embryotoxicity effects in humans. Teratogenicity: No known reports of teratogenic effects in humans. Reproductive Toxicity: No known reports of reproductive effects in humans.</p>

<p><u>Citrus Solv</u></p>	<p>DeLimonene, Paradin Distillate, Orange Terpenes</p>	<p>ACUTE EFFECTS, Orange terpenes have been shown to have low oral toxicity (LD50&gt;5 g/kg) and low dermal toxicity (LD50&gt; 5g/kg) when tested on rabbits. Orange terpenes also showed low toxicity by inhalation (RD50&gt;1 g/kg) when tested on mice. Inhalation may cause irritation of the nose, throat, and respiratory tract. Petroleum Spirits are minimally toxic orally (LD50&gt; 1000 mg/kg) and are minimally toxic on skin (LD50&gt; 3160 mg/kg).</p> <p>CHRONIC EFFECTS, D-Limonene is not classified as a carcinogen by OSHA, IARC, ACGIH or NTP. Prolonged or repeated exposure can cause drying or dermatitis of skin. Improper storage and handling may lead to the formation of a possible skin sensitizer. Vapor/aerosol concentrations for petroleum spirits above recommended exposure levels are irritating to the eyes and respiratory tract, may cause headaches, dizziness, anesthesia, drowsiness, unconsciousness and other central nervous system effects including death. Prolonged and/or repeated skin contact with low viscosity materials may defat the skin resulting in possible irritation and dermatitis. Small amounts of liquid aspirated into the lungs during ingestion or from vomiting may cause chemical pneumonitis or pulmonary edema.</p>
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<p><u>Power Burst</u></p>	<p>Sodium Tripolyphosphate, Sodium Carbonate, Sodium Metasilicate, Sodium Phosphate tribasic, Ethylene Glycol Butyl Ether</p>	<p>Sodium Carbonate Oral ( LD 50): 4090 mg/kg - Rat Inhalation ( LC 50): 2300 mg/m<sup>3</sup>/2H - Rat Skin irritation: Mild - Rabbit Eye irritation: Moderate - Rabbit Sensitation: Not considered an occupational sensitizer</p> <p>Sodium Metasilicate Oral ( LD 50): 1153 mg/kg - Rat Inhalation ( LC 50): Not listed on RTECS Skin irritation: Severe Eye irritation: Severe Sensitation: Not considered an occupational sensitizer</p> <p>Sodium Phosphate Tribasic Oral ( LD 50): No information on RTECS Inhalation ( LC 50): No information on RTECS Skin irritation: Moderate Eye irritation: Severe - Rabbit Sensitation: Not considered an occupational sensitizer</p> <p>Ethylene glycol butyl ether Oral ( LD 50): 917 mg/kg - Rat Inhalation ( LC 50): 2900 mg/m<sup>3</sup>/7H - Rat Skin irritation: Mild Eye irritation: Mild Sensitation: Not considered sensitize</p>
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<p><b><u>BLITZ WITH GREASEBREAKER</u></b></p>	<p>Sodium Tripolyphosphate, Sodium Carbonate, Sodium Sulfate, Glycol Ether DPM, Sodium Metasilicate, Tetrasodium, Delimonene, Glycol Ether PNB, Ethylenediamine Tetraacetate NA salt, Alcohol Ethoxylate</p>	<p>Harmful if swallowed. Causes skin irritation. Causes serious eye irritation.</p> <p><b>TOXICOLOGICAL INFORMATION:</b> Dipropylene Glycol Methyl Ether <b>ACUTE TOXICITY:</b> LD50 values: Oral LD50: 5152 mg/kg (rat). LC50 dermal and inhalation: Not listed. Eyes: Rabbit: Mild Irritation: 25 hours.</p> <p><b>CARCINOGENICITY:</b> No component of this product present at levels greater than or equal to 0.1% is identified as probable or confirmed human carcinogen by IARC, ACGIH, NTP, and OSHA.</p> <p><b>TOXICOLOGICAL INFORMATION:</b> Sodium Carbonate <b>ACUTE TOXICITY:</b> Not Classified. LD50 values: Oral LD50: 4090mg/kg (rat).<b>SKIN</b> <b>CORROSION/IRRITATION:</b> Causes skin irritation. <b>SERIOUS EYE DAMAGE/IRRITATION:</b> Causes serious eye irritation.</p> <p><b>TOXICOLOGICAL INFORMATION:</b> Sodium Metasilicate <b>ACUTE TOXICITY:</b> LD50 Oral: 1280mg/kg (Rat), 2400mg/kg (mouse) <b>CHRONIC TOXICITY:</b> No data were available regarding chronic exposure, reproductive or teratological effects, or carcinogenicity for sodium metasilicate. <b>CARCINOGENICITY:</b> This product is not classified as a carcinogen by NTP, IARC or OSHA.</p> <p><b>TOXICOLOGICAL INFORMATION:</b> Propylene Glycol Butyl Ether <b>ACUTE TOXICITY:</b> LD 50 Rat: 2,200 mg/kg <b>ACUTE INHALATION TOXICITY:</b> No data available <b>ACUTE DERMAL TOXICITY:</b> LD 50 Rabbit: 3,100 mg/kg</p> <p><b>TOXICOLOGICAL INFORMATION:</b> Ethylenediamine Tetraacetate <b>ACUTE TOXICITY:</b> LD50 Oral (rat): 630 -1,260 mg/kg,</p>
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		<p>INHALATION LC50: No data available  DERMAL LD50: No data available  OTHER INFORMATION ON ACUTE TOXICITY: No data available  TOXICOLOGICAL INFORMATION: Sodium Dodecylbenzenesulfonate  ACUTE TOXICITY: LD50 Oral rat: 438 mg/kg.  INHALATION TOXICITY: No data available  DERMAL TOXICITY: No data available  SKIN CORROSION/IRRITATION: Skin-rabbit Result: Skin irritation-24 h  SERIOUS EYE DAMAGE/IRRITATION: Eyes- rabbit Result: severe eye irritation- 24hr</p>
<p><a href="#"><u>P.O.G (Paint, Oil &amp; Grease)</u></a></p>	<p>AMYL ACETATE, Petroleum Naphtha, Heavy Alkylate, Alcohols, C6-C12, Ethoxylated, propoxylated, 2-METHYLBUTYL ACETATE, Alcohols, C10-C16, ethoxylated, propoxylated, Ethylene glycol monobutyl ether</p>	<p>Skin Corrosion/irritation: No information available  Eye Damage/irritation: No information available  Respiratory or skin sensitization: No information available  Germ Cell Mutagenicity: No information available  Carcinogenicity: This product contains one or more substances which are classified by IARC as carcinogenic to humans (Group 1), probably carcinogenic to humans (Group 2A), or possibly carcinogenic to humans (Group 2B)  Reproductive Toxicity: No information available  Single Exposure: No information available  Repeated Exposure: May cause adverse liver effects. Laboratory studies of Ethylene glycol monobutyl ether used on animals indicate that exposure may cause red blood cell damage and</p>

		<p>damage to the kidney and liver.  Aspiration Hazard: No information available</p>
<p><b><u>INDUSTRIAL</u></b>  <b><u>PURPLE</u></b></p>	<p>Sodium Hydroxide, 2-butoxyethanol, Sulfonic acids, C14-16 alkane hydroxy and C14-16 alkene, sodium salts, Alcohols, C9-11, ethoxylated</p>	<p>Carcinogenicity: IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC ACGIH:  Confirmed animal carcinogen with unknown relevance to humans, 2-butoxyethanol OSHA: No component of this product present at levels greater than or equal to 0.1% is identified as a carcinogen or potential carcinogen by OSHA NTP: No component of this product present at levels greater than or equal to 0.1% is identified as known or anticipated by NTP Acute Oral Toxicity: &gt;5,000 mg/kg Acute Inhalation Toxicity: &gt;200 mg/l Acute Dermal Toxicity: &gt; 5,000 mg/kg  Components:  Sodium Hydroxide: Acute dermal toxicity: 1,350 mg/kg (Rabbit)  2-Butoxyethanol: Acute oral toxicity: LD50 Oral Rat: 880 mg/kg, Acute dermal toxicity: LD50 Dermal Rabbit: 1,060 mg/kg Alcohols, C9-11, ethoxylated: Acute oral toxicity: LD50 Oral Rat: 1,400mg/kg  Skin corrosion/irritation: extremely corrosive and destructive to tissue  Serious eye damage/ eye irritation: may cause irreversible eye damage.</p>

<u><b>RELEASIT ENCAP-CLEAN</b></u>	Isopropyl alcohol	Causes Serious eye irritation Inhalation: Inhalation of vapors in high concentration may cause irritation of the respiratory system. May cause drowsiness and dizziness. Eye Contact: Severely irritating to eyes Skin Contact: Prolonged contact may cause irritation. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea
<u><b>PROCYON</b></u>	Phosphoric Acid Anhydrous, Tetrasodium Pyrophosphate There are no known hazardous/toxic components in this product	Acute Toxicity: none Description of Symptoms of Exposure: mild irritant to skin of hypersensitive individuals; mild irritant to eyes and mucous membranes of hypersensitive individuals.

Some of these OSHA safety data sheets fail to adequately describe the toxicological potential these carpet cleaning chemicals may possess. Some SDS lack the chemical ingredients making the carcinogenic effects of exposure unknown, and some have written “no data/information available” on other areas of the toxicological section which simply means test were not conducted. Some of these chemicals have been toxic to lab animals so a threat to human beings is most likely to exist. Overexposure to some chemicals can cause acute health risk such as nervous system damage, or chronic respiratory damage and skin irritation. More test will need to be done by the manufacturers, preferably under the guidelines of the United Nations Globally Harmonized System of Classification and Labeling of Chemicals, which has been adopted by European regulators. Many American chemical products are not be allowed in the EU under current OSHA SDS guidelines.

## **Conclusion and Recommendations**

To minimize the hazards of associated with indoor environmental quality a holistic cleaning approach must be implemented to ensure contaminants are extracted, cleaning products with little to no hazard to humans are used, and to make sure that there are no residues from cleaning agents. Hot water extraction might be the best system at improving indoor air quality since it is most likely to extract all or most of the carpet contaminants and cleaning chemicals. Low moisture cleaning may potentially leave chemical residues behind since they are not being extracted outright. Failure to vacuum carpet that was cleaned by low-moisture after cleaning can result in contaminants resettling into the carpet pile along with the chemical residues. More adequate test need to be done to ensure these systems improve indoor air/environmental quality. Holistic cleaning systems must be applied when cleaning carpets since all people, workers, children, and the elderly come in contact with carpeted floors in either private residencies, public or commercial buildings. Workers exposed to carpet cleaning chemicals should be cautious, be aware of what chemicals they are dealing with, and make efforts to wear proper personal protective equipment. A 1993-1997 study found dozens of workers across five states who dealt with cleaning chemicals develop work-related asthma. Some of the chemicals studied were simply labeled “carpet cleaner”, “disinfectants”, “acids, bases, and oxidizers”, more information is needed to accurately assess the chemicals potentially causing harm, but there were cases of limonene and ethylene glycol monobutylether causing asthma, chemicals which I use regularly.<sup>12</sup>

**Table 3.**

Number of Cases of Work-Related Asthma Associated with Different Types of Cleaning Products: California, Massachusetts, Michigan, and New Jersey, 1993–1997

Agent	Number of Cases
Cleaning materials, household cleaners (not specified)	107
Bleach	43
Acids, bases, oxidizers	23
Disinfectants (not specified)	20
Carpet cleaner	17
Floor Stripper/waxes	16
Ammonia	14
Mixing bleach and acid or ammonia	11
Glutaraldehyde	8
Graffiti remover	8
Soaps	5
Ethanol	4
Quaternary ammonia	3
Formaldehyde	3
Ethylene glycol monobutylether	3
Ethanolamines	3
Oven cleaner	2
Sulfonates	2
Caustic	2
Phenols	2
Limonene	2
Glass cleaner	2
Copier cleaner	1
Iodophors	1
Total	300 <sup>a</sup>

<sup>a</sup> 182 individuals had exposure to 1, 44 to 2, and 10 to 3 cleaning products.

United States chemical product safety data sheets may fail to communicate proper toxicological information, opting instead for “no data available”, or outright ignore toxicity information that would need to be listed if the U.N. Globally Harmonized System were the current national standard for safety data sheets. Adopting the U.N GHS SDS would require the section 11 toxicological information to list 10 toxicity test<sup>13</sup> and their results:

- Acute toxicity (ingestion, skin contact, inhalation)
- Skin corrosion/irritation

- Serious eye damage/irritation
- Respiratory or skin sensitization
- Germ cell mutagenicity
- Carcinogenicity
- Reproductive toxicity
- Acute Specific Target Organ System Toxicity exposure
- Chronic Specific Target Organ System Toxicity exposure
- Aspiration hazard

Professionally cleaning carpets by either hot water extraction or low-moisture cleaning may reduce overall VOC levels and improve indoor air quality. More test and research is needed to better assess the impact of carpet cleaning chemicals on workers and customer health. Since workers and consumers will be exposed to potential chemical hazards, the burden of providing evidence to support the use of cleaning agents must be put on the manufactures. It is their responsibility to provide the public with safe and healthy products. The largest obstacle in this case is political organizing, but having workers and consumers understand the potential hazards of cleaning chemicals by simply referring them to OSHA safety data sheets can be a progressive step in occupational health and safety.

## Endnotes

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