

Health Issues and Environmental Impact of Cleaning Agents

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Abstract: When one buys commercial cleaning products, one expect them to do one thing: Clean! There are a wide variety of soaps, detergents, bleaching agents, softeners, polishes, and specialized cleaners for bathrooms, glass, drains, and ovens that keep our homes clean and pleasant-smelling. The chemicals in these cleaners foam, bleach, and disinfect our dishes, laundry, bathrooms and countertops. Alongside, they also contribute to indoor air pollution, are poisonous if ingested, and can be harmful if inhaled or touched. In fact, some cleaners are among the most toxic products found in the home. A few safe, simple ingredients like soap, water, baking soda, vinegar, lemon juice and a coarse sponge for scrubbing can take care of most household cleaning needs. And this can help save lots of money wasted on unnecessary, specialized cleaners! For this reason, recipes for Do-It-Yourself cleaners has also been shared.

However, if one needs the convenience or the added power of commercial cleaning products, or there is a need for the basics like laundry and dishwashing detergents, there are some guidelines to help one choose products with the lowest impact on one's health and the environment.

Keywords: Biodegradable, Bleach, Chlorofluorocarbons (CFCs), Diethanoalamine (DEA), Do-It-Yourself (DIY) green cleaners, Ethylene Glycol, Green Cleaning, Material Safety Data Sheet (MSDS), Oxidisers, Phenols, Triethanolamine (TEA), Volatile Organic Compounds (VOC).

1. INTRODUCTION

Cleaning is an activity performed to maintain a healthy, safe, and aesthetically pleasing environment. It involves the removal of dirt from objects and surfaces and is normally accomplished manually or mechanically using water with detergents or enzymatic products. It is a form of decontamination that makes the surface safe to handle or use by removing organic matter, salts, and visible soil, all of which interfere with disinfection.

Cleaning agents are complex mixture of chemicals which are usually liquids, powders, sprays or granules that are used to remove dirt including dust, stains, bad smells and grime on surfaces. Some cleaning agents kill bacteria and clean at the same time. They are called disinfectants. Cleaning and disinfecting agents have the same role of combating infection.

Traditionally, cleaning was not considered a dignified profession and till recently it was done by persons of lower social echelons using their bare hands or the basic broom. Majority of users still rely on the traditional manual cleaning methods. Mechanised cleaning was introduced in India in late 1990's, but is still in early stages of development. On the whole, the concept of cleaning seems to be transformed from a labour-led industry to a technology-led industry. Entry of multi-national companies into India as well as globalisation of Indian companies has been a major factor in this transformation. With this came a whole range of cleaning agents which were put on shelf by Hindustan Lever Limited, Godrej Consumer Products, Nirma, Reckitt Benckinsa and a number of other companies. These companies claim to be using latest technology where emphasis is on low toxicity and use of eco-friendly and biodegradable raw materials, besides overall quality and effectiveness. They also claim these products are multipurpose and user friendly.

2. ALARM!

There is evidence of an association of cleaning products with adverse health effects. In addition to this, environmental risks are also evident. Nearly all used cleaning products and wastewater are disposed into municipal sewers. Many cleaning agents released into the environment, biodegrade slowly or incompletely thus posing a risk of water supply contamination and/or impact on wildlife. Following are some reports regarding impact of cleaning agents on health and environment:

“According to American Water Works, traces of pharmaceuticals and personal care products have been found in tap water in both United States and Europe. They have no immediate effect on human health but may have a cumulative effect over a period of time.”

“Approximately one out of every three commercial cleaning products contain harmful chemicals that are linked to cancer, reproductive disorders, asthma and other respiratory ailments, or skin and major organ damage.”

“Cleaning solutions can also result in occupational hazards. About six out of every 100 janitors are injured each year, 20% of which are serious burns to the eyes or skin while 12% are resultant of chemical fumes.” On average, 25% of the 85-105 kg of cleaning chemicals each janitor handles annually are hazardous substances (weight did not include water for dilution in usage).”

“In a September 1999 study in New Scientist, researchers at Bristol University recommended caution in using aerosols and air fresheners, after finding that they might be making pregnant women and children sick. In their survey of 14,000 pregnant women, they found that in homes where aerosols and air fresheners were used frequently, mothers suffered from 25% more headaches and 19% more depression, and infants under six months had 30% more ear infections and 22% higher incidence of diarrhea.”

“In 2000, cleaning products were responsible for nearly 10% of all toxic exposures reported to U.S. Poison Control Centers, accounting for 206,636 calls. Of these, 120,434 exposures involved children under six, who can swallow or spill cleaners stored or left open inside the home.”

“In addition to human health effects, chemicals in cleaning solutions can also detrimentally affect the quality of water resources and harm aquatic and terrestrial life. According to a 2002 United States Geological Survey study, 69% of streams sampled contained persistent detergent metabolites and 66% contained disinfectants.”

“In 2006, some 13,000 metric tons of oil were accidentally spilt from tankers and similar vessels. As the spills happened near tropical coral reefs or shoreline, government authorities used detergents to disperse the oil into smaller and less harmful droplets, just as soap helps break down dirt. Scientist from Israel’s National Institute of Oceanography in Haifa introduced two small clippings of coral nubbins found in Red Sea, to the dispersed oil droplets. The detergents and the dispersed oil droplets proved more toxic to the coral than crude oil itself. The scientists have banned the detergents from anywhere near the coral reef and to use them only in emergency.”

“In 2010, a twenty-hour patch test was carried out on a select group of patients with dermatitis. They were tested for irritability of skin by seventeen detergents commonly used by Indian household. It was done to educate the patients on what detergents to avoid and also bring down the total medication requirement and frequent hospital consultations.”

3. CLEANING AGENTS AND HEALTH HAZARDS

Cleaning ingredients vary in the type of health hazard they pose. Some cause acute, or immediate hazards such as skin or respiratory irritation, watery eyes, or chemical burns, while others are associated with chronic, or long-term effects of cancer.

Corrosive chemicals can cause severe burns on eyes, skin and if ingested, in throat and oesophagus. Certain chemical agents like chlorine bleach and ammonia have ingredients with high acute toxicity, which produce fumes that are highly irritating to eyes, nose, throat and lungs, and should not be used by people with asthma or lung or heart problems.

Fragrances added to many cleaners like laundry detergents and fabric softeners may cause acute effects such as respiratory irritation, headache, sneezing and watery eyes in sensitive individuals or may suffer from allergy or asthma. It

has been found that one-third of the substances used in the fragrance industry are toxic. But, because the chemical formulas of fragrances are considered trade secrets, companies aren't required to list their ingredients and merely label them as containing 'fragrances'.

Other ingredients in cleaners may have low acute toxicity but contribute to long term health effects such as cancer or hormone disruption. Most of the cleaners contain diethanolamine (DEA) and triethanolamine (TEA). When these substances come in contact with nitrites they react to form nitrosamine, a carcinogenic substance which penetrates the skin. Ethylene glycol ether may also be present in some cleaners and is neurotoxic.

TABLE: I HEALTH EFFECTS OF COMMON CHEMICALS IN CLEANING AGENTS

CHEMICAL	PURPOSE OF USE IN CLEANING AGENTS	HEALTH EFFECTS
Alcohol (Ethanol)	Used as solvent and disinfectant in cleaning agents.	Irritant to eye, skin, upper respiratory tract and throat.
Ammonia	Used in glass cleaners.	Highly irritating. Inhalation can irritate the nose, throat and lungs, causing wheezing and shortness of breath. Prolonged exposure can cause bronchitis.
Ethanolamine	Used in floor care products, glass and toilet cleaners.	Inhalation can irritate the nose, throat and lungs, causing wheezing and shortness of breath. It is also a skin irritant.
Ethylene glycol ethers	Used in degreasers.	Highly irritant to eyes, respiratory tract and skin.
Inorganic Chlorine compounds (Bleach)	When mixed with strong acids as in toilet cleaners, it forms chlorine gas.	Breathing high concentration of chlorine can irritate lungs. Concentrated bleach can cause corrosive damage to the skin.
Oxidisers (Hydrogen peroxide)	Concentrated solutions are highly reactive (but less than bleach).	It is corrosive to skin with over 50% concentration.
Phenols	Used as disinfectant - effective against tuberculosis.	Irritant to eyes and respiratory tract when inhaled, causing dryness, itching and redness of skin.

4. ENVIRONMENTAL IMPACT OF CLEANING AGENTS

Environmental Impact of cleaning agents is the effect of chemicals contained in the product that are essential for their cleaning effectiveness. Increased focus concerning this has emerged after scientific evidence linking developmental and endocrine disruptions in wildlife to the cleaning agents.

After the cleaning liquid flows down the drains, they are treated along with sewage and most other waste water at municipal treatment plants, and then discharged into a nearby water body. Most ingredients in the cleaning agents break down during treatment or soon afterwards, which then alters the water quality for human consumption and other wildlife. Stratospheric ozone depletion, bioaccumulation in plants and animals subsequently affecting the food chain are also some of the impact of cleaning agents on the environment.

The surface active agents belong to a class of chemicals called alkylphenol ethoxylates (APES). They are added to some laundry detergents, disinfectants, stain removers and degreasers. APES have been shown to cause endocrine disruption by mimicking the hormone estrogen. Their presence in water is harming the reproduction and survival of aquatic animals. APES, on treatment, also breaks down into molecules which are more toxic and not readily biodegradable.

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Another famous water pollutant is phosphate, a water-softening mineral that was once widely used in laundry detergents and other cleaners. When phosphate enters water body, they act as a fertiliser for algae and causes its overgrowth resulting in algal bloom. This algal bloom depletes the water's oxygen supply, killing off aquatic life.

Another environmental concern with cleaning products is that many use chemicals that are petroleum based, hence contributing to the depletion of non-renewable resources and increasing our nation's dependence on imported oil.

The plastic bottles used to package cleaning agents pose another environmental problem by contributing to the heaps of solid waste. Most cleaners are bottled in high-density polyethylene (HDPE, denoted by #2 inside the recycling triangle) or polyethylene terephthalate (PETE, #1), used to enhance plastic flexibility and durability of the containers, are mostly recycled. Molecules of phthalates have a negative effect on male showing the phthalate syndrome – demasculinisation of male reproductive tract, undescended testis, lowered sperm count and testicular tumour. Some cleaning agents are also bottled in polyvinyl chloride (PVC, #3) which is made from cancer causing chemicals such as vinyl chloride, and it forms dioxin, a potent carcinogen, as a by-product during its production and incineration.

5. WATCH-GUARD

In February 1993, Cleaning Product Pilot Project (CPPP), the first pilot project was established as an interagency effort between US General Services Administration (GSA) and the US Environmental Protection Agency (EPA). Its aim was to establish a framework for identifying and comparing environmentally preferable commercial cleaning products. They have recommended attributes for selecting the commercially available cleaning products taking into account both health and environmental attributes. They have made it mandatory to label the composition of cleaning agents, on the product along with the cautions to be taken while using it.

The label or the Material Safety Data Sheet (MSDS) must contain:

- The name of the manufacturer.
- Weight or measure in the container.
- List of ingredients- active and inert.
- List of warnings and first-aid instructions.
- Measure to be taken if the product is swallowed or spilled on skin/cloth.
- Registration No. with Environmental Protection Agency(EPA).
- Direction of use:
- Dilution ratio
- How to apply
- Whether rinsing is necessary or not
- How long to be left on the surface
- Where not to use

With the market flooded with a huge range of cleaning agents one needs to be careful in choosing and picking up these products especially for laundry and dishwashing detergents. Here are some shopping guidelines to help one choose products with the lowest impact on one's health and environment:

1. Although most cleaners don't list ingredients, one can learn something about a product's hazards by reading its label. Danger, Warning or Caution are some words seen on the label that provides some indication of a product's toxicity. Products labelled Danger or Poison are most hazardous; those bearing a Warning label are moderately hazardous, and those with a Caution label are considered slightly toxic. Nontoxic products do not require any signal word on their label, try and look for such products. Besides the signal word usually there is a phrase that describes the nature of the hazard, such as 'may cause skin irritation', 'flammable', 'vapours harmful', or 'may cause burns on contact'. Look for

instructions on how to use the product, which may help you avoid injury. Some labels do list active ingredients, which may assist you in detecting caustic or irritating ingredients you may wish to avoid, such as ammonia. A few manufacturers voluntarily list all ingredients.

2. When checking ecological claims, look for 'biodegradable' meaning that most substances will eventually breakdown if given enough time and right ecological conditions. Claims like 'no solvents', 'no phosphates', 'plant-based', 'ecologically-friendly' or 'natural' are not meaningful unless a recognised authority has verified this claim.
3. When ingredients are listed, choose products made with plant-based, instead of petroleum-based ingredients. And don't believe that 'organic' ingredients in cleaning agents are safer than other substances. The term 'organic' in the grocery store refers to food grown without synthetic pesticides, in chemistry it refers to chemicals that are carbon-based, including Volatile Organic Compounds (VOC) that release harmful fumes and may cause severe health hazards. Beware of labels that may make the product eco-friendly especially aerosol sprays labelled 'no CFCs' (chlorofluorocarbons, which deplete the ozone layer). In reality, CFCs have been banned from aerosols since 1978, so none are permitted to contain it.
4. To reduce packaging waste, choose cleaners in the largest container sizes available; especially seek out bulk sizes. Select products in bottles made with recycled plastic. By doing so, one will be supporting companies that are providing a market for recycled plastic (without this market, recycling would not be possible). Also, choose concentrated formulas, which contain only 20% or less water. Because dilution with water is done at home and not at the factory, and moreover concentrated cleaners require less packaging and fuel for transportation.
5. Presence of cosmetic additives (e.g. fragrances and dyes) is considered to increase health and environmental problems.
6. Products that work efficiently in cold water reduce energy consumption.

6. GO GREEN WITH GREEN CLEANING

Green cleaning refers to cleaning methods and cleaning products with environmentally friendly ingredients designed to preserve human health and environmental quality. It avoids the use of chemically reactive toxins. Green cleaning also refers to the way cleaning products are manufactured, packaged and distributed. If the manufacturing process is environmentally friendly and the products are biodegradable, then the term 'green' may apply.

HOW TO GO GREEN?

Most of the conventional cleaning products we all grew up with are petroleum-based and have serious health and environmental implications. Instead of opting for cleaning products that annihilate everything in their path, there are plenty of natural products and methods that keep a house clean and fresh-smelling without toxic side effects.

Employ green cleaning products. As the health and environmental impact of conventional cleaning products become more thoroughly understood, more and more brands of healthy, green, and effective cleaning products have started hitting the market. Many of these products are non-toxic, biodegradable, and made from renewable resources (not petroleum). But if you don't believe in brand labels, home-mixed cleaners can do the job. Vinegar and baking soda can be used to clean almost anything.

Avoid poor indoor air quality. It is well known that the air inside a home or office is more toxic than the air outside. This is because of the presence of toxic materials and substances and also the fact that homes and buildings are better insulated than ever before (which is a good thing from energy standpoint).

Make your home smell better. Baking soda not only removes those strange smells coming from the fridge, it's also a great odour-eliminator for the carpets. Just sprinkle on a little baking soda on the carpet, allow it to soak up some of the odours and then vacuum clean it. Avoid the air fresheners bought off the store shelf and instead try boiling cinnamon, cloves or any other herbs or incense stick one is fond of. Coffee beans and fresh chocolate chip cookies also have been known to create a friendly aroma.

Clean the indoor air naturally. Plants may not make your house smell different but are good for filtering interior air. Keeping windows open as often as possible allows fresh air in and keep toxins flowing out.

Be careful with sanitizers. Sanitizers are antibacterial and antimicrobial cleaners that many people think are necessary, especially during cold season and while travelling. One needs to be careful as they add to the risk of breeding 'super germs' bacteria that survive the chemical onslaught and have resistant offspring. It has been found that antibacterial soaps and hand cleansers do not work better than regular soap and water, and therefore should be avoided.

Dispose of toxic cleaners carefully. When disposing the cleaning products, don't just throw them in the trash. They are toxic for home, for the one who will be handling it, and are also not good for the drain or landfill. Throwing them in trash or down the drain means they might end up back in your water supply.

Avoid conventional dry cleaners. Conventional dry cleaners are largest users of the industrial solvent called perchloroethylene which is toxic to humans and also creates smog. If one does take clothes to the dry cleaners, be sure to air them outside before wearing them or putting them in the cupboard.

Leave toxins at the door. Imagine what's on your shoes at the end of the day. Bringing that oil, grease, animal waste, particulate pollution, pollen and who knows what else into the house is not good, especially for kids and pets who spend time on the floor. Keep them out of the home with a good doormat or a shoeless house policy. Less dirt also means less sweeping, mopping and vacuuming, which means less work, water, energy and fewer chemicals.

Design with 'clean' in mind. Designing houses and other buildings with clean ability in mind can create spaces that are cleaner, healthier, and require less cleaning and cleaning products to maintain.

DO IT YOURSELF (DIY) GREEN CLEANING AGENTS:

When it comes to cleaning house, it is tempting to pick up products with ingredients like bleach and ammonia. They do a great job but alongside effect the eyes, respiratory tract and nervous system and ironically these cleaners pollute our environment. But you don't have to sacrifice health and environment for cleaning home. Nontoxic DIY cleaners deliver considerable power at minimal cost. Annie Bond, the author of 'Better Basics for the Home' says, "all you need is a little trust in yourself and six ingredients: Baking soda, white vinegar, olive oil, essential oil of your choice, lemon and plant based liquid soap". Here are some recipes of DIY cleaners:

All-purpose cleaner. Most household cleaning like scrubbing grease and grime can be done safely and inexpensively with a scrubber/sponge and simple ingredients like water, liquid soap, vinegar, lemon juice or baking soda. Form a paste of baking soda and liquid soap and spread this on the flat side of half a lemon and scrub. Use a damp cloth or sponge to wipe away residue. This paste stays moist for a few hours.

Laundry cleaner. Soap nut is the fruit of the Ritha tree. It is completely natural, renewable and biodegradable. The shell contains saponin, a natural surfactant. Put six to eight shells of soap nut into a cotton bag and place it in the washing machine. This should last for four-six washes. Remove them when they look dark and soft. The shells can be ground to make washing powder. This is also good for washing hair.

Bathroom and toilet cleaner. Soap and water, or baking soda can be used for scrubbing soap scum and flushes of bathroom. Scrubbing shower tiles with a toothbrush and baking soda-water paste will help remove mildew and stains. For tougher toilet stains, pour one cup of borax and quarter cup white vinegar or lemon juice into a bowl, mix and apply where needed. Let it sit for a few hours, then scrub with a toilet brush and flush with water.

Glass cleaners. Plain water is just as effective as some commercial glass cleaners. Fill spray bottle with half teaspoon liquid soap, three tablespoons of white vinegar and two cups of water and shake. Spray onto window and wipe clean with newspaper.

Drain cleaners. Prevent drains from becoming blocked in the first place by capturing hair and other drain-clogging substances with inexpensive metal or plastic drain screens available at the hardware stores. Regularly collect and dispose of hair that collects around shower or sink drains and do not allow large food scraps to wash down the kitchen sink. When clogs occur, use a plumbing tool to manually remove blockage, or try suction removal with a plunger.

Cooking Stove and Oven cleaner. Prevent food spills from being cooked/baked onto the stove/oven floor by cleaning them up before they dry and cook. To remove grease and charred food residues, soak the surfaces overnight with mixture of water, baking soda, and soap, then scrubbing off with baking soda and a soapy sponge. One can also use a paste of washing soda and water(wear gloves when handling washing soda).

Furniture polishes. For polishing furniture, combine a mixture of half cup white vinegar and one teaspoon olive oil and using a soft duster polish and shine the furniture.

Metal polishes. Scrub silver with toothpaste to remove tarnish. For copper, dissolve salt in white vinegar/lemon juice and rub it with a cloth and rinse with water. Unlacquered brass may be scrubbed clean with a paste of one teaspoon salt, one cup white vinegar and half cup flour.

Disinfectants. Unless one has a compromised immune system illness that may make one especially vulnerable to infection from microbes and bacteria, one probably does not need a disinfectant for most household needs. Household surfaces can be properly cleaned using hot, soapy water. To avoid food-borne illness, wash all foods thoroughly before preparation, and be sure to soak leafy greens and rinse at least three times.

Air freshener. To clear out odours, improve ventilation by opening windows and using fans. Baking soda is good at removing odours, and spritzers of lemon or any citrus fruit freshens the air. Wooden cedar blocks, pure essential oils, or sachets of natural dried flowers or herbs provide gentle fragrance.

7. CONCLUSION

Since the late 1990's, the concept of cleaning seems to have been transformed from a labour-led industry to a technology-led industry. Entry of multi-national companies into India as well as globalisation of Indian companies has been a major factor in this transformation. With this came a whole range of cleaning agents which were put on shelf by a number of companies. Cleaning products are everywhere in our homes and offices; on dishes and utensils, furniture, countertops, clothes, floors, windows and floating through the air. We are constantly bombarded with clever marketing campaigns that promise a sparkling home with a liberal use of whatever cleaning products are being promoted. With the market flooded with a huge range of cleaning agents one needs to be careful and choosy when picking up these products especially for laundry and dishwashing detergents. Shopping guidelines given above will help one choose products with the lowest impact on one's health and environment.

Green cleaning techniques and products are environment friendly and are designed to preserve human health and environmental quality as they avoid the use of chemically reactive toxins. A little trust in yourself and some basic ingredients from the kitchen shelf make up the nontoxic DIY green cleaners which also deliver considerable cleaning power at minimal cost.

We all want our homes to be clean and free of germs so we can live in a safe and healthy environment. In our war on dirt and germs we may often actually be making things worse. In the quest for a clean and fragrant home, let us not make our homes a chemistry laboratory but instead pick up natural things from our kitchen shelves and try the DIY recipes for a healthier and cleaner environment.

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