MINIMIZING OF SURFACE TENSION BETWEEN DIRT AND ADSORPTION SURFACE THROUGH DRY CLEANING AS WELL AS WET CLEANING AGENTS

*Prof. Dr. Dhrubo Jyoti Sen

D.Pharm., B.Sc. (Hons), B.Pharm. (Hons), M.Pharm., Ph.D., FICS, CChem FIC (India), CChem FRSC (UK), CSci (UK), AOM (USA)

Recipient of K.K. Acharjee Award, Recipient of Jewel of India Award, Recipient of Rashtriya Vidya Saraswati Puraskar, Recipient of Rashtriya Vidya Jyoti Award and Gold Medal, Recipient of Life Time Achievement Gold Medal Award, Recipient of Eminent Educationist Award, Recipient of International Gold Star Award, Recipient of Vidya Ratan Award, Recipient of Gyan Jyoti Gold Medal Award, Recipient of Bharat Excellence Award & Gold Medal, Recipient of India Inspiration Award & Gold Medal, Recipient of Seva Chakra Puraskar, Recipient of American Order of Merit, Recipient of Golden Educationist of India Award, Recipient of NEHS Global Award of Excellence and Gold Medal of Excellence, Recipient of NEHS Jewel of India Award and NEHS Gold Medal of Excellence, Recipient of Academician of the Year Award, Recipient of Outstanding Faculty of the Year Award, Recipient of Award for Special Achievement in Technology.

Head of the Department of Pharmaceutical Chemistry, Shri Sarvajanik Pharmacy College, Gujarat Technological University, Arvind Baug, Mehsana-384001, Gujarat, India

ABSTRACT

Dirt or soil comes from external sources and fits on the surface of fabrics or solid surface loosely bound by surface tension between two. This binding does not form any chemical bonding but the surface tension might be high enough to form a dirt layer which can be removed by dry or wet cleansing agents. The cleaning agents minimise the interfacial tension through hydrophilic lipophilic balance scale to make the fabrics or solid surface free from dirt. Dirt is unclean matter, especially when in contact with a person's clothes, skin or possessions when they are said to become dirty. Common types of dirt include:

- Dust — a general powder of organic or mineral matter
- Filth — foul matter such as excrement
- Grime — a black, ingrained dust such as soot
- Soil — the mix of clay, sand and humus which lies over the bedrock

When things are dirty they are usually cleaned with solutions like hard surface cleaner and other chemicals; much domestic activity is for this
purpose — washing, sweeping and so forth. In a commercial setting, a dirty appearance gives a bad impression. An example of such a place is a restaurant. The dirt in such cases may be classified as temporary, permanent and deliberate. Temporary dirt is streaks and detritus that may be removed by ordinary daily cleaning. Permanent dirt is ingrained stains or physical damage which requires major renovation to remove. Deliberate dirt is that which results from design decisions such as decor in dirty yellow or grunge styling.

**KEYWORDS:** Dirt, Filth, Grime, Soil, HLB scale, KB value, Surface tension, Interfacial tension.

**INTRODUCTION**

**Dry cleaning** is any cleaning process for clothing and textiles using a chemical solvent other than water. The solvent used is typically toxic tetrachloroethylene (perchloroethylene), which the industry calls "perc" or "PERC". It is used to clean delicate fabrics that cannot withstand the rough and tumble of a washing machine and clothes dryer; it can also eliminate labor-intensive hand washing. Modern dry cleaning use of non-water-based solvents to remove soil and stains from clothes was reported in 1855. The potential for using petroleum-based solvents such as gasoline and kerosene was recognized by French dye-works operator Jean Baptiste Jolly, who offered a new service that became known as nettoyage à sec—i.e., dry cleaning. Flammability concerns led William Joseph Stoddard, a dry cleaner from Atlanta, to develop Stoddard solvent (white spirit) as a slightly less flammable alternative to gasoline-based solvents. The use of highly flammable petroleum solvents caused many fires and explosions, resulting in government regulation of dry cleaners. After World War I, dry cleaners began using chlorinated solvents. These solvents were much less flammable than petroleum solvents and had improved cleaning power.

On March 3, 1821, Thomas L. Jennings became the first African-American to be granted a United States patent, for his cleaning process called "dry scouring," which was the precursor to dry cleaning.

By the mid-1930s, the dry cleaning industry had adopted tetrachloroethylene (perchloroethylene), or "perc" for short, as the solvent. It has excellent cleaning power and is stable, nonflammable, and gentle to most garments. Perc, however, was incidentally the first chemical to be classified as a carcinogen by the U.S. Consumer Product Safety Commission. In 1993, the California Air Resources Board adopted regulations to reduce perc emissions.
from dry cleaning operations; the same year, the U.S. Environmental Protection Agency (EPA) did the same. The U.S. EPA updated its regulation in 2006 to reflect the availability of improved emission controls.

The replacement of perc with other solvents remains of interest as perc will ultimately disappear from the market.\(^1\)

![Dirty clothes](image1.png)

![Clean clothes](image2.png)

**Figure-1: Difference between dirty & clean**

**Tetrachloroethylene**, also known under the systematic name tetrachloroethene, or perchloroethylene ("perc" or "PERC") and many other names, is a chlorocarbon with the formula $\text{Cl}_2\text{C}=\text{CCl}_2$. It is a colorless liquid widely used for dry cleaning of fabrics, hence it is sometimes called "dry-cleaning fluid." It has a sweet odor detectable by most people at a concentration of 1 part per million (1 ppm). Worldwide production was about one million metric tons in 1985.

**Production**

Michael Faraday first synthesized tetrachloroethylene in 1821 by thermal decomposition of hexachloroethane.

$$\text{C}_2\text{Cl}_6 \rightarrow \text{C}_2\text{Cl}_4 + \text{Cl}_2$$

Most tetrachloroethylene is produced by high temperature chlorinolysis of light hydrocarbons. The method is related to Faraday's discovery since hexachloroethane is
generated and thermally decomposes. Side products include carbon tetrachloride, hydrogen chloride and hexachlorobutadiene.

Several other methods have been developed. When 1,2-dichloroethane is heated to 400°C with chlorine, tetrachloroethylene is produced by the chemical reaction.

$$\text{CICH}_2\text{CH}_2\text{Cl} + 3 \text{Cl}_2 \rightarrow \text{Cl}_2\text{C}==\text{CCl}_2 + 4 \text{HCl}$$

This reaction can be catalyzed by a mixture of potassium chloride and aluminium chloride or by activated carbon. Trichloroethylene is a major byproduct, which is separated by distillation.

**Uses**

Tetrachloroethylene is an excellent solvent for organic materials. Otherwise it is volatile, highly stable and nonflammable. For these reasons, it is widely used in dry cleaning. It is also used to degrease metal parts in the automotive and other metalworking industries, usually as a mixture with other chlorocarbons. It appears in a few consumer products including paint strippers and spot removers. It is used in neutrino detectors where a neutrino interacts with a neutron in the chlorine atom and converts it to a proton to form argon.

**Historical applications**

Tetrachloroethylene was once extensively used as an intermediate in the manufacture of HFC-134a and related refrigerants. 1,1,1,2-tetrafluoroethane, R-134a, Forane 134a, Genetron 134a, Florasol 134a, Suva 134a or HFC-134a, also known as norflurane (INN), is a haloalkane refrigerant with thermodynamic properties similar to R-12 (dichlorodifluoromethane) but with insignificant ozone depletion potential. It has the formula $$\text{CH}_2\text{FCF}_3$$ and a boiling point of ~26.3°C (~15.34°F) at atmospheric pressure. R-134a cylinders are colored light blue. In the early 20th century, tetrachloroethylene was used for the treatment for hookworm infestation.

**Environmental contamination**

Tetrachloroethylene is a common soil contaminant. With a specific gravity greater than 1, tetrachloroethylene will be present as a dense non-aqueous phase liquid (DNAPL) if sufficient quantities are released. Because of its mobility in groundwater, its toxicity at low levels and its density (which causes it to sink below the water table), cleanup activities are more difficult than for oil spills (which has a specific gravity less than 1). Recent research has
focused on the in place remediation of soil and ground water pollution by tetrachloroethylene. Instead of excavation or extraction for above-ground treatment or disposal, tetrachloroethylene contamination has been successfully remediated by chemical treatment or bioremediation. Bioremediation has been successful under anaerobic conditions by reductive dechlorination by *Dehalococcoides* sp. and under aerobic conditions by cometabolism by *Pseudomonas* sp. Partial degradation daughter products include trichloroethylene, cis-1,2-dichloroethene and vinyl chloride; full degradation converts tetrachloroethylene to ethene and hydrogen chloride dissolved in water.

Figure-2: Dry cleaning
Estimates state that 85% of tetrachloroethylene produced is released into the atmosphere; while models from OECD assumed that 90% is released into the air and 10% to water. Based on these models, its distribution in the environment is estimated to be in the air (76.39% - 99.69%), water (0.23% - 23.2%), soil (0.06%) with the remainder in the sediment and biota. Estimates of lifetime in the atmosphere vary, but a 1987 survey estimated the lifetime in the air has been estimated at about 2 months in the Southern Hemisphere and 5–6 months in the Northern Hemisphere. Degradation products observed in a laboratory include phosgene, trichloroacetyl chloride, hydrogen chloride, carbon dioxide and carbon monoxide. Tetrachloroethylene is degraded by hydrolysis and is also persistent under aerobic conditions. This compound is degraded by reductive dechlorination with anaerobic conditions present, with the degradation products such as trichloroethylene, dichloroethylene, vinyl chloride, ethylene and ethane.

**Process**

A dry-cleaning machine is similar to a combination of a domestic washing machine and clothes dryer. Garments are placed in the washing or extraction chamber (referred to as the "basket" or "drum"), which constitutes the core of the machine. The washing chamber contains a horizontal, perforated drum that rotates within an outer shell. The shell holds the solvent while the rotating drum holds the garment load. The basket capacity is between about 10 and 40 kg (20-80 lb). During the wash cycle, the chamber is filled approximately one-third full of solvent and begins to rotate, agitating the clothing. The solvent temperature is maintained at 30°C (86°F), as a higher temperature may damage it. During the wash cycle, the solvent in the chamber (commonly known as the "cage" or "tackle box") is passed through a filtration chamber and then fed back into the "cage". This is known as the cycle and is continued for the wash duration. The solvent is then removed and sent to a distillation unit consisting of a boiler and condenser. The condensed solvent is fed into a separator unit where any remaining water is separated from the solvent and then fed into the "clean solvent" tank. The ideal flow rate is roughly 8 liters of solvent per kilogram of garments per minute, depending on the size of the machine.

Garments are also checked for foreign objects. Items such as plastic pens will dissolve in the solvent bath and may damage textiles beyond recovery. Some textile dyes are "loose" (red being the main culprit) and will shed dye during solvent immersion. These will not be included in a load along with lighter-color textiles to avoid color transfer. The solvent used
must be distilled to remove impurities that may transfer to clothing. Garments are checked for
dry cleaning compatibility, including fasteners. Many decorative fasteners either are not
solvent proof or will not withstand the mechanical action of cleaning. These will be removed
and re-stitched after the cleaning, or protected with a small padded protector. Fragile items,
such as feather bedspreads or tasseled rugs or hangings, may be enclosed in a loose mesh bag.
The density of perchloroethylene is around 1.7g/cm$^3$ at room temperature (70% heavier
than water) and the sheer weight of absorbed solvent may cause the textile to fail under normal
force during the extraction cycle unless the mesh bag provides mechanical support.

Not all stains can be removed simply by dry cleaning. Some need to be treated with spotting
solvents—sometimes by steam jet or by soaking in special stain-remover liquids—before
garments are washed or dry cleaner. Also, garments stored in soiled condition for a long time
are difficult to bring back to their original color and texture. Natural fibers such as wool,
cotton and silk of lighter colors when left in dirty or soiled condition for long times are
unlikely to be restored to their original color and finish. A typical wash cycle lasts for 8–15
minutes depending on the type of garments and degree of soiling. During the first three
minutes, solvent-soluble soils dissolve into the perchloroethylene and loose, insoluble soil
comes off. It takes 10–12 minutes after the loose soil has come off to remove the ground-in
insoluble soil from garments. Machines using hydrocarbon solvents require a wash cycle of at
least 25 minutes because of the much slower rate of solvation of solvent-soluble soils. A dry
cleaning surfactant "soap" may also be added.

At the end of the wash cycle, the machine starts a rinse cycle wherein the garment load is
rinsed with fresh distilled solvent from the pure solvent tank. This pure solvent rinse prevents
discoloration caused by soil particles being absorbed back onto the garment surface from the
"dirty" working solvent.

After the rinse cycle, the machine begins the extraction process, which recovers the solvent
for reuse. Modern machines recover approximately 99.99% of the solvent employed. The
extraction cycle begins by draining the solvent from the washing chamber and accelerating
the basket to 350-450rpm, causing much of the solvent to spin free of the fabric. Until this
time, the cleaning is done in normal temperature, as the solvent is never heated in dry
cleaning process. When no more solvent can be spun out, the machine starts the drying cycle.
During the drying cycle, the garments are tumbled in a stream of warm air (60-63°C/140-
145°F) that circulates through the basket, evaporating traces of solvent left after the spin
cycle. The air temperature is controlled to prevent heat damage to the garments. The exhausted warm air from the machine then passes through a chiller unit where solvent vapors are condensed and returned to the distilled solvent tank. Modern dry cleaning machines use a closed-loop system in which the chilled air is reheated and re-circulated. This results in high solvent recovery rates and reduced air pollution. In the early days of dry cleaning, large amounts of perchlorethylene were vented to the atmosphere because it was regarded as cheap and believed to be harmless.

After the drying cycle is complete, a deodorizing (aeration) cycle cools the garments and removes further traces of solvent, by circulating cool outside air over the garments and then through a vapor recovery filter made from activated carbon and polymer resins. After the aeration cycle, the garments are clean and ready for pressing and finishing.\cite{2}

**Solvent processing**

Working solvent from the washing chamber passes through several filtration steps before it is returned to the washing chamber. The first step is a button trap, which prevents small objects such as lint, fasteners, buttons and coins from entering the solvent pump. Over time, a thin layer of filter cake (called "muck") accumulates on the lint filter. The muck is removed regularly (commonly once per day) and then processed to recover solvent trapped in the muck. Many machines use "spin disk filters", which remove the muck from the filter by centripetal force while it is back washed with solvent.

After the lint filter, the solvent passes through an absorptive cartridge filter. This filter is made from activated clays and charcoal and removes fine insoluble soil and non-volatile residues, along with dyes from the solvent. Finally, the solvent passes through a polishing filter, which removes any soil not previously removed. The clean solvent is then returned to the working solvent tank.

To enhance cleaning power, small amounts of detergent (0.5%-1.5%) are added to the working solvent and are essential to its functionality. These detergents emulsify hydrophobic soils and keep soil from re-depositing on garments. Depending on the machine's design, either an anionic or a cationic detergent is used. Since the solvent recovery is less than 100% and because dry cleaning does not remove water-based stains well, entrepreneurs have developed the wet cleaning process, which is, in essence, cold-water washing and air drying, using a computer-controlled washer and dryer. In general, wet cleaning is regarded as being in its infancy, although low-tech versions of it have been used for centuries.
Symbols
The international GINETEX laundry symbol for dry cleaning is a circle. It may have the letter P inside it to indicate perchloroethylene solvent, or the letter F to indicate a flammable solvent (Feuergefährliches Schwerbenzin). A bar underneath the circle indicates that only mild cleaning processes are recommended. A crossed-out empty circle indicates that dry cleaning is not permitted.

Professional cleaning symbol.  Dry clean, hydrocarbon solvent only (HCS).

Gentle cleaning with hydrocarbon solvents.  Very gentle cleaning with hydrocarbon solvents.

Dry clean, tetrachloroethylene (PCE) only.  Gentle cleaning with PCE.

Very gentle cleaning with PCE.  Do not dry clean.

Figure-3: Symbols of different dry cleaning

Dry-cleaning waste
Wastes are potentially a hazardous and restrictions often apply to disposal. Cooked powder residue is the name for the waste material generated by cooking down or distilling muck. It will contain solvent, powdered filter material (diatomite), carbon, non-volatile residues, lint, dyes, grease, soils and water. The waste sludge or solid residue from the still contains solvent, water, soils, carbon and other non-volatile residues. Used filters are another form of waste as is waste water.\cite{3}

Solvents
Perchloroethylene (tetrachloroethylene) has been in use since the 1940s. Perc is the most common solvent, the "standard" for cleaning performance. It is a most aggressive cleaner. It can cause color bleeding/loss, especially at higher temperatures, and may damage special
trims, buttons, and beads on some garments. Better for oil-based stains (which account for about 10% of stains) than more common water-soluble stains (coffee, wine, blood, etc.). Known for leaving a characteristic chemical smell on garments. Nonflammable. Perc is becoming less popular due to its ground contamination problems and potential health effects.

**Hydrocarbon** is most like standard dry cleaning but the processes use hydrocarbon solvents such as Exxon-Mobil's DF-2000 or Chevron Phillips' EcoSolv. These petroleum-based solvents are less aggressive than perc and require a longer cleaning cycle.

Although combustible, these solvents do not present a high risk of fire or explosion when used properly. Hydrocarbon also contains volatile organic compounds (VOCs) that contribute to smog. Pure Dry is another brand.

**Dibutoxymethane** is a product offered by Kreussler. It is sold under the trade name SolvonK4. It is a Bi Polar solvent that removes water based stains and oil based stains.

![Structures of dry cleaners](image)

**Liquid silicone** (decamethylcyclopentasiloxane or D5) is gentler on garments than perc and does not cause color loss. It is licensed by GreenEarth Cleaning. Though more environmentally friendly, it is more expensive. Degrades within days in the environment to silicon dioxide and trace amounts of water and CO₂. Produces nontoxic, nonhazardous waste. Toxicity tests by Dow Corning shows the solvent to increase the incidence of tumors in female rats (no effects were seen in male rats), but further research concluded that the effects observed in rats are not relevant to humans because the biological pathway that results in tumor formation is unique to rats. (170.6°F/77°C flash point). Decamethylcyclopentasiloxane
(D5) is an organo silicon compound with the formula \([(CH_3)_2SiO]_5\). It is a colorless and odorless liquid that is slightly volatile. The compound is classified as a cyclomethicone. Such fluids are commonly used in cosmetics, such as deodorants, sunblocks, hair sprays and skin care products. It is becoming more common in hair conditioners, as it makes the hair easier to brush without breakage. It is also used as part of silicone based personal lubricants. D5 is considered an emollient.

**Brominated solvents** n-Propyl bromide (Fabrisolv, DrySolv) is a solvent with a higher KB-value than Perc. The Kauri-butanol value ("Kb value") is an international, standardized measure of solvent power for a hydrocarbon solvent and is governed by an ASTM standardized test, ASTM D1133. The result of this test is a scaleless index, usually referred to as the "Kb value". A higher Kb value means the solvent is more aggressive or active in the ability to dissolve certain materials. Mild solvents have low scores in the tens and twenties; powerful solvents like chlorinated solvents and "High Sol 10" or "High Sol 15" (naphthenic aromatic solvents) have ratings in that are in the low hundreds. In terms of the test itself, the kauri-butanol value (Kb) of a chemical shows the maximum amount of the hydrocarbon that can be added to a solution of kauri resin (a thick, gum-like material) in butyl alcohol without causing cloudiness. Since kauri resin is readily soluble in butyl alcohol but not in most hydrocarbon solvents, the resin solution will tolerate only a certain amount of dilution. "Stronger" solvents such as benzene can be added in a greater amount (and thus have a higher Kb value) than "weaker" solvents like mineral spirits. This allows it to clean faster, but it can damage some synthetic beads and sequins if not used correctly. Health-wise, there are reported risks associated with nPB such as numbness of nerves. The exposure to the solvents in a typical dry cleaner is considered far below the levels required to cause any risk. Environmentally, it is approved by the U.S. EPA as a Significant New Alternative to hazardous solvents used in the past. It is among the more expensive solvents, but due its faster cleaning, lower temperatures and quick dry times, it's considered to have the same or lower costs overall for the entire process.\(^4\)

**Supercritical CO\(_2\)** - Consumer Reports rated this method superior to conventional methods, but the Dry cleaning and Laundry Institute commented on its "fairly low cleaning ability" in a 2007 report. Another industry certification group, America's Best Cleaners, counts CO\(_2\) cleaners among its members. Machinery is expensive—up to $90,000 more than a perc machine, making affordability difficult for small businesses. Some cleaners with these
machines keep traditional machines on-site for the heavier soiled textiles, but others find plant enzymes to be equally effective and more environmentally sustainable. CO₂-cleaned clothing does not off-gas volatile compounds. CO₂ cleaning is also used for fire- and water-damage restoration due to its effectiveness in removing toxic residues, soot and associated odors of fire. The environmental impact is very low. Carbon dioxide is almost entirely nontoxic, it does not persist in clothing or in the environment and its greenhouse gas potential is lower than that of many organic solvents.

**Glycol ethers** (dipropylene glycol tertiary-butyl ether) (Rynex, Solvair, Caled Impress) is proposed an environmentally friendly competitor with perc with processing advantaged. However these solvents are generally a blended product and not pure like GreenEarth or Solvon K4.

Carbon tetrachloride — Highly toxic. Trichloroethane — Overly aggressive and harsh. Stoddard solvent — Very flammable and explosive, 100°F/38°C flash point. CFC-113 - Freon — Ozone destroying CFC.

**Figure-5: Dry cleaning machine and Wet cleaning machine**

**Home dry cleaning**

Various consumer-grade products in the marketplace today, such as Procter & Gamble's Dryel, allow portions of the dry cleaning process to be performed at home using home laundry machines. Even though the use of these products does not follow all the steps of the commercial process, such use does work for certain types of garments. However this is not at all similar to professional dry cleaning and will not clean the garment properly.
Wet cleaning

Figur e-6: Symbols of different wet cleaning

Wet cleaning (green cleansing) is a method in garment cleaning, utilizing a gentle washing machine, biodegradable soaps and conditioners, and various types of pressing and re-shaping equipment that may be specialized for many different fabric and fiber types. The most important aspect of successful wet cleaning is experience and knowledge of different types of fabrics and proper ways to finish garments by operators.

According to the Environmental Protection Agency (EPA), wet cleaning is the safest professional method of garment cleaning. It does not use hazardous chemicals, it does not generate hazardous waste, nor does the process create air pollution and it reduces the potential for water and soil contamination. The specialized detergents and conditioner used in the wet clean process are milder than home laundry products. All of the products are disposed of down the drain and easily handled by the local waste water treatment facility.

For professional cleaners, wet-cleaning offers several advantages, such as lowered costs for start-up capital, supplies, equipment and hazardous waste disposal, as well as less reliance on skilled labor Dry-cleaners Costs of energy and chemicals increase due to raised taxes to promote less use of environmentally dangerous chemicals.

Tailors have generally recommended that garments be returned to them once a year for wet cleaning and dry-cleaned in between. These tailors are also careful to choose materials that will not be destroyed by water, even if they later sew in the usual "Dry Clean Only" label. Some clothing manufacturers may mislabel their clothing "Dry Clean Only", even though there is no "reasonable basis" for making the claim that the garment will be harmed if it is not dry cleaned. [5]

CONCLUSION

You go into your local dry cleaning store, drop off your clothes, get your ticket, then drive away. A few days later, you return, pick up your clothes, pay the customer service
representative and drive away again. But, do you know what happened to your clothes while they were at the dry cleaning shop? Do you know what dry cleaning is and how it works?.

**Dry cleaning** dates back to ancient times, probably beginning with the advent of textile clothing itself. The ruins of Pompeii give a record of a highly developed trade of "fullers" who were professional clothes cleaners. Lye and ammonia were used in early laundering and a type of clay known as "fuller's earth" was used to absorb soils and grease from clothing too delicate for laundering. There are many stories about the origin of dry cleaning, all centering on a surprise discovery when a petroleum-type fluid was accidentally spilled on a greasy fabric. It quickly evaporated and the stains were miraculously removed. The firm of Jolly-Belin, opening in Paris in the 1840s, is credited as the first dry cleaning firm.

**Solvents**

In spite of the name, dry cleaning is not completely dry. Fluids are used in the dry cleaning process. In the early days, garment scourers and dryers found several fluids that could be used as dry cleaning solvents, including camphene, benzene, kerosene and gasoline. These fluids are all dangerously flammable, so dry cleaning was a hazardous business until safer solvents were developed. In the 1930s, perchloroethylene or perc (a nonflammable, synthetic solvent) was introduced and is used today in many dry cleaning plants. Other cleaning solvents have been added, these include most predominantly hydrocarbon, Green Earth and others are currently being introduced and tested.

Dry cleaning is not the answer to all soil and stain removal problems. Sometimes, stains become permanently embedded in the fiber, or fabrics cannot withstand normal cleaning and stain removal procedures, or decorative trim is not compatible with dry cleaning solvent. It is important that consumers as well as drycleaners read all care labels and follow the instructions.

Dry cleaning Machines: There are various makes/models of dry cleaning machines. Despite the differences, all dry cleaning machines work on the same principle. A dry cleaning machine consists of four basic components: Holding or base tank, Pump, Filter, Cylinder or wheel. The holding tank holds the dry cleaning solvent. A pump is used to circulate the solvent through the machine during the cleaning process. Filters are used to trap solid impurities. A cylinder or wheel is where the garments are placed to be cleaned. The cylinder has ribs to help lift and drop the garments. The operation of the dry cleaning machine is easy
to understand. The solvent is drawn from the tank by the pump. The pump sends the solvent through the filters to trap any impurities. The filtered solvent then enters the cylinder to flush soil from the clothes. The solvent leaves the cylinder button trap and goes back to the holding tank. This process is repeated throughout the entire cleaning cycle, ensuring that the solvent is maintained to give effective cleaning at all times.

After the cleaning cycle, the solvent is drained and an extract cycle is run to remove the excess solvent from the clothes. This solvent is drained back to the bare tank. During extraction, the rotation of the cylinder increases in order to use centrifugal force to remove the solvent from the clothes.

Once the clothes have finished extracting, the cylinder stops. At this time, clothes are either transferred to a separate dryer or, on most machines, dried in the same unit, a closed system. The drying process uses warm air circulated through the cylinder to vaporize the solvent left on the clothes. The solvent is purified in a still. Here the solvent is heated. The vapors are then condensed back to a liquid leaving behind all impurities in the still. This clean solvent is then pumped back into the holding/base tank.

Benefits of Dry cleaning
Alterations: Professional dry cleaners are full-service clothing care specialists. Alterations are one of the many services they may offer in addition to dry cleaning. From a simple shortening, lengthening, take waist in or let seat out; to a full reline of a coat, suit, dress, or skirt; to a panel replacement of a natural skin; your professional dry cleaner has a seamstress/tailor for every circumstance.

Buttons
Dry cleaners repair loose buttons or sew on new ones, whether or not they were damaged or missing when they arrived at the plant.

Convenience
All you have to do is give your clothes to your route representative. Your cleaner takes care of the rest. Why waste hours doing laundry and ironing when you get quality and convenience with dry cleaning?.

Dry cleaning, the process itself: Dry cleaning uses fluids to remove soils and stains from fabrics. Among the advantages of dry cleaning is its ability to dissolve grease and oils in a
way that water cannot. Natural fibers such as wools and silks dry clean beautifully, but can shrink, distort and lose color when washed in water. Synthetic fibers like polyester also respond well to dry cleaning, whereas they can retain oily stains after washing. Dry cleaning helps to return garments to a “like-new” condition using precautions to prevent shrinkage, loss of color and change of texture or finish.

Expertise: From fashions and fabrics to stain removal to the latest cleaning technologies, drycleaners have the expertise to clean your clothes right. Why do it yourself or settle for a second-rate job from a so-called “home dry cleaning kit” when you could trust it to an expert?

Finishing: Thanks to special pressing equipment, professional finishing gives garments a crisp, wrinkle-free, like-new appearance that can’t be beat. There are no rumpled or creases out of place. Plus, by taking your clothes to the drycleaner, you don’t have to spend your weekend standing over an ironing board and a hot iron.

Garment storage: Have you got too many clothes and too little space? Some cleaners provide garment storage for out-of-season items. The garments are stored in a vault, which offers protection from insects, fire, burglary, flood and mildew damage. Furs used to be the primary storage item, but today cleaners receive woolens, household items and other items to store too.

Household textiles: Cleaners don’t just clean clothes. Many cleaners also process household items such as blankets, comforters, decorative pillows, rug and even draperies.

Inspection: Before they return a garment to you, quality cleaners conduct an inspection to make sure your order has met their own and your expectations. If they spot a problem, the garment gets sent back to receive further attention. Safeguards like this help ensure that your clothes will look their best.

Knowledge of fabrics and fashions: You may know what rayon, silk and cotton are, but what about angora, faille or seersucker? There are numerous fabrics and fibers that dry cleaners must know about in order to provide the best care for your garments.

Laundry: Dry cleaners also have commercial laundry departments where they process shirts, cotton pants and bulk goods. With the convenience and superior level of pressing that comes with commercial laundry, your business casual and casual attire will look their best.
Moth Damage: Clean clothes are the first step to preventing insect damage from moths, as well as silverfish, crickets and ants. Insects will feed on any fiber, especially if stains are present.

Neckties: Ties are often made of delicate fabrics, such as silk, as well as various other components. Due to the nature of the tie construction, this item should only be cared for by a professional; cleaned in a net bag and hand pressed.

Odor removal: Some cleaners specialize in odor removal and flood and fire restoration of water- or smoke-damaged items. These cleaners use ozone generators to do an ozone treatment. The contact between ozone and the odors embedded in the textiles causes oxidation to reoccur, resulting in the elimination of the odors and the release of oxygen. This is a safe and effective process.

Preservation: Many cleaners specialize in the preservation of wedding gowns, christening gowns and other family heirlooms. Preservation is a special type of storage that helps prolong the life of a garment for years and years. There are two different levels of preservation; and a special designation as a preservation specialist.

Stain removal: Dry cleaners use complex procedures and special stain removal chemicals to remove stains. Stains are divided into two major categories: solvent-soluble and water-soluble. Different stains require different treatments, which stain removal technicians are trained to administer. Why risk a disaster using an over-the-counter “all-purpose” stain removal product or trying a “home remedy” when you could rely on your drycleaner’s expert stain removal abilities?

Value: Cleaners provide a good value to their customers through quality workmanship and excellent customer service. By providing our professional services, we also give you extra free time to do the things you’d rather be doing instead of washing, drying and ironing your clothes.

Wet cleaning: Wet cleaning is a gentle form of cleaning that cleaners may choose to process sensitive textiles such as wool, silk, rayon and linen. It gives dry cleaners more flexibility in processing items that may not withstand a dry cleaning process or that have soils that would be better removed in water. For example, many items, such as wedding gowns, are often trimmed with plastic beads or sequins that may dissolve or discolor in dry cleaning but
generally perform well in wet cleaning. Items with large beverage stains or hem dirt & grime are also more likely to come clean in a wet cleaning process.

Extend the life of your garments: Contrary to the belief of some, frequent cleaning does not damage clothes. Frequent cleaning extends the life of a garment by removing stains and ground-in dirt and soils that can cause fiber abrasion and deterioration.

Yellowing: Frequent cleaning removes stains that, if left untreated, could oxidize and yellow. Exposure to heat or the passage of time can cause stains from food, beverages and other oily substances to oxidize and turn yellow or brown, much the way a peeled apple turns brown after exposure to air. Once they become yellow or brown, these stains become much more difficult to remove and often cannot be removed.

Dry cleaning machines are rated in pounds of fabric (dry weight) the machine can hold. Machine sizes vary from very small (20 pounds) to large (100 pounds) capacity of clothes cleaned per cycle. Before cleaning, garments are inspected and classified. The length of the cleaning cycle is dependent upon the type of article cleaned and the degree of soiling. Some heavily stained garments may go through a stain removal process prior to cleaning to aid in better soil and stain removal. A stain removal technician will treat specific items just prior to cleaning. A lot of effort goes into the process and there are many skilled technicians involved in caring for your garments.

**Wet cleaning** is a non-toxic, environmentally safe alternative to dry cleaning. It utilizes computer-controlled washing machines, biodegradable soaps and conditioners and finishes the drying process by using special moisture sensitive dryers. Wet cleaning is not the same as laundry and is perfect for using on any garment such as: silk, cashmere, woollens and other fine delicates. Wet cleaning uses water, a universal solvent and does not use hazardous chemicals, generate harmful wastes, or contribute pollution.


Traditional dry cleaners utilize perchloroethylene, a toxic solvent commonly known as “perc.” This chemical is used throughout many cycles of dry cleaning and can be very
harmful to the environment if not disposed of properly. It is 1.5 times heavier than water and requires extreme temperatures to be completely removed from one’s clothing.

Dry cleaners that generically advertise not using perc for ‘greener,’ ‘organic,’ or ‘natural’ solvents, are usually referring to the chemical DF2000. Although less toxic than perc, this is a chemical normally found in gasoline for automobiles. Wet cleaning on the other hand, uses no chemicals and is different because it refers to a truly eco-friendly way of cleaning one’s garments and textiles. This method of cleaning is not only safe for the environment but to people as well.

REFERENCES
3. IARC monograph. Tetrachloroethylene, 63: 159.