Periodic graphics

A collaboration between C&EN and Andy Brunning, author of the popular graphics blog Compound Interest

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To see more of Brunning's work, go to **compoundchem.com.** To see all of C&EN's Periodic Graphics, visit **cenm.ag/periodicgraphics.**

THE CHEMISTRY OF DRY CLEANING

Washing with water can shrink or damage some garments. These fabrics require dry cleaning. Here, we explain how the process works and what chemicals are involved.

HOW DRY CLEANING WORKS

Dry cleaning isn't dry. It simply uses solvents other than water to clean clothes. To use these chemicals, professional facilities and equipment are needed.

1. First, dry-cleaning staff tag and sort items, then pretreat tough stains if needed.

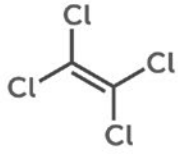
2. The clothes are washed with a solvent in the machine's drum. Soaps are added to remove stains.

3. At the end of the cycle, the machine applies high temperatures to evaporate the solvent.

4. Additional spot cleaning removes tough stains. Garments are pressed, bagged, and hung.

PERCHLOROETHENE

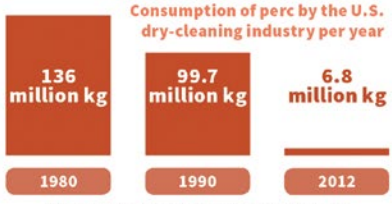
About 70% of dry-cleaning stores in the U.S. use the solvent perchloroethene, according to the Halogenated Solvents Industry Alliance.



PERCHLOROETHENE

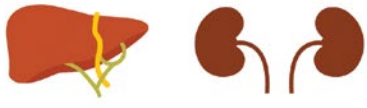
Referred to as "perc" by the dry-cleaning industry

Consumption of perc by the U.S. dry-cleaning industry per year



(According to American Drycleaner)

The amount of perc that dry cleaners use has decreased because of improved solvent recycling methods and equipment. Still, many worry about chronic health problems linked to perc exposure.



Perc is classified as a probable carcinogen by IARC. Exposure can affect the liver and kidneys.

PERC ALTERNATIVES

Worries over perc mean some dry cleaners have replaced it with different solvents, including carbon dioxide, which has fewer health concerns.

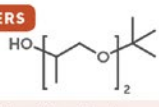
1-BROMOPROPANE

Also known as *n*-propyl bromide

- ⊕ Shorter cycle times than perc.
- ⊖ Concerns about health effects remain.

PROPYLENE GLYCOL ETHERS

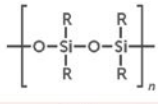
e.g., Di(propylene glycol) *tert*-butyl ether



- ⊕ Only linked to mild health effects.
- ⊖ Higher operating costs than perc.

SILICONES

Also known as polysiloxanes



- ⊕ Nontoxic; low environmental impact.
- ⊖ More expensive than perc.

CARBON DIOXIDE

High-pressure liquid carbon dioxide

- ⊕ Nontoxic; 98% recycle rate.
- ⊖ High cost to convert perc machines.