

Reports from Other Journals

News from Online: Cleaning Up—Soap, Detergent, and More

by Carolyn Sweeney Judd

What do you want to clean—your hair? your carpet? your rusty lawn furniture? Special products have been developed for different tasks. We may wonder what product to use. Moreover, we may wonder about the environmental impact of our choices.

Shampoos

Let's start from the top—your hair. Go to "What's That Stuff: Shampoo" from *Chemical & Engineering News Online* <http://pubs.acs.org/cen/whatstuff/stuff/8015sci3.html>. Check the list of ingredients on a shampoo bottle. The Food and Drug Administration requires this comprehensive listing. Go to the FDA site <http://www.cfsan.fda.gov/~dms/cos-chem.html> for the chemical names and uses for some common cosmetic additives. Much of this concoction is to give you pleasant smelling and manageable hair. Go to the *Chemical & Engineering News* article at <http://pubs.acs.org/cen/coverstory/7916/7916personalcare.html> to learn more about some of these cosmetic additions.

Cleaning and foaming agents listed are surfactants. "What's That Stuff" gives us a good introduction to the types of surfactants: anionic, cationic, amphoteric, or nonionic. What they all have in common is a polar hydrophilic head with at least one long-chain hydrophobic tail.

The anionic surfactant is the primary foaming and cleansing component of a shampoo. Examples are sodium lauryl ether sulfate (also called sodium laureth sulfate), sodium lauryl sulfate, and the ammonium versions. Cationic surfactants provide some conditioning to the hair, while boosting the viscosity. Amphoteric surfactants provide foam stabilization and increased viscosity. Nonionic surfactants can play a number of roles in a shampoo system: mild cleansing, building viscosity, and foam stabilization.

Search out the comprehensive Surfactants Virtual Library by Paul Huibers at <http://www.surfactants.net/> for lots of links and also formulations for making your own shampoo.

Laundry Detergents

Now I am curious about my laundry detergent. The label reads: "Ingredients include biodegradable surfactants (anionic and nonionic) and enzymes. There are no phosphates." This is not a lot of detail about what is in that bottle.

Kevin M. Dunn (From Caveman to Chemist) has a comprehensive Web site, <http://cator.hsc.edu/~kmd/caveman/projects/soap/> that features history, excellent molecular models and chemical equations, and instructions for making soap. Where do we find out more about all these compounds? Go to the Northwest Fisheries Science Center and NOAA site to start your search for MSDS information: <http://www.nwafc.noaa.gov/msds.html>.

The Soap and Detergent Association has a Kids Corner for Chemistry of Soaps and Detergents: <http://www.cleaning101.com/cleaning/chemistry/>. Clever cartoons accompany descriptions about how soaps and detergents are made and how they work. The Kids Corner also traces the history of soaps and detergents: <http://www.cleaning101.com/cleaning/history/>. The year 1946 marked the introduction of the first "built" detergent for all-purpose laundry uses. A "built" detergent has a surfactant for basic cleaning and a builder, which helps the surfactant work more efficiently. Phosphate compounds were common builders.

Another comprehensive site is the Kiwi Web from Allan Campbell of New Zealand: <http://www.chemistry.co.nz/deterginfo.htm>. A surfactant is identified as a material that can greatly reduce the surface tension of water when used in very low concentrations. The history of detergents found at <http://www.chemistry.co.nz/deterghistory.htm> and <http://www.chemistry.co.nz/introduction.htm> includes a section on why soap has been displaced by detergents. Detergents are classified at http://www.chemistry.co.nz/detergent_class.htm and various additives are described at http://www.chemistry.co.nz/deterg_sundry.htm.

Builders are discussed at http://www.chemistry.co.nz/deterg_inorganic.htm. Here we find that phosphates have become out of favor biologically because of eutrophication, but suitable alternatives are hard to find that will completely replace them. Go to http://www.colorado.edu/conflict/full_text_search/AllCRCDocs/94-54.htm for an historical reference about the trouble with phosphates as builders.

Zeolites are used as one of the replacements for phosphate builders. Go to <http://jchemed.chem.wisc.edu/Journal/Issues/1999/Oct/abs1416A.html>, a Classroom Activity from the *Journal of Chemical Education*. Go to <http://www.bza.org/zeolites.html> for good discussions about zeolites. More on zeolites and detergents can be found at http://www.the-infoshop.com/study/ti7686_zeolites_industry.html.

The role of additives on bubble longevity is explored in another *JCE* Classroom Activity: Bubble, Bubble, Toil and Trouble at <http://jchemed.chem.wisc.edu/Journal/Issues/2001/Jan/abs40A.html>.

Testing whether cloth is stronger when wet is the purpose of a wonderful experiment from a third grader. See science in action at <http://frugalliving.about.com/gil/dynamic/offsite.htm?site=http://www.fabrics.net/fabricca.htm>.

Soap Additives

Should we be concerned about any of these additives to the surfactants? Go to John Blake's site at the University of Alaska at Fairbanks to learn about the widely used hexachlorophene (pHisoHex) that was taken off the market: http://www.uaf.edu/iacucl/training/module_3/3_soap.html. Surfactants

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are used in medicine as antiseptics and disinfectants. Soaps are antibacterial against gram-positive and acid-fast organisms. Antibacterial activity of soaps can be enhanced by addition of certain antiseptics. Soap with hexachlorophene (pHisoHex) and soap with octyl phenoxyethyl ether sulfonate (pHisoderin) have been produced. However, concern over the toxicity of hexachlorophene caused the removal of pHisoHex from the market.

Several sites report on hexachlorophene: http://www.rxlist.com/cgi/generic2/hexchlorph_wcp.htm and <http://www.macmillan-reference.co.uk/Science/DictionaryofToxicSA-02.htm>.

The work done by Florabel Garcia Mullick, M.D., the first pathologist to link hexachlorophene with the development of brain lesions in humans, is reported at <http://www.usmedicine.com/article.cfm?articleID=238&issueID=29>.

This led to another FDA warning that changed the level of hexachlorophene dosages sold over the counter. Go to the FDA site <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPCD/ShowCFR.cfm?FR=250.250> to read the revised hexachlorophene report dated April 2002.

When the latest antibacterial hand soaps came on the market, there was concern about potential build up of immunity by bacteria. *C & E News* had a good summary article in 1999: <http://pubs.acs.org/subscribe/journals/cen/77/i05/html/7705prodbox1.html>.

Your students can test the efficacy of hand washing by following the experiments at the Access Excellence Web site of the National Health Museum, http://www.accessexcellence.org/AE/AEC/CC/hand_activity.html.

Cleaning Stains, Odors, Rust...

Now let's look at the carpet on the floor that needs cleaning. Go to <http://www.fabriclink.com/carpet/Carpetgeneral.html> for good help with all kinds of stains.

One of the really difficult stains is a rust stain. The advice given at <http://www.fabriclink.com/carpet/Rust.html> says to start with dilute lemon juice and then go on to hand dishwashing detergent that does not contain lanolin or bleach. So again knowing what is in your cleaning product is important.

What if the carpet is smelly? Getting rid of bad odors is another cleaning task. Cyclodextrins have been used to trap the molecules causing the odors. Go to <http://www.chem.ucla.edu/dept/Faculty/stoddart/research/cyclodextrins.htm> for good graphics. For specifics on a cyclodextrin, go to <http://www.researchd.com/janssen/410200.htm>. For a complete experiment with cyclodextrins, go to Theresa Zelinski's page at Monmouth University at <http://bluehawk.monmouth.edu/~tzielins/Cyclodextrin/background.htm>. And where will you and I find cyclodextrins in the grocery store? Well, in the cleaning aisle in fabric softeners and carpet deodorizers.

Let's go to the backyard for the next cleaning task. The site at <http://www.womentodaymagazine.com/family/springclean.html?a=767> will tell you about cleaning your lawn furniture using bleach and Coca Cola.

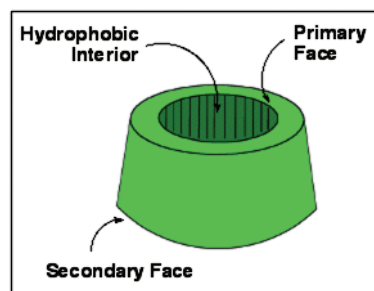
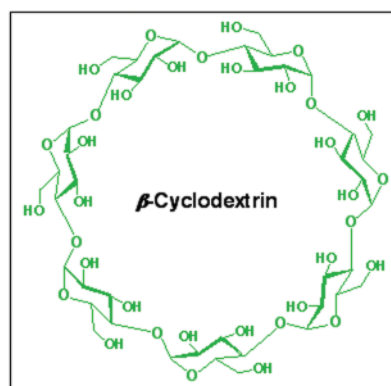


Figure 1. Cyclodextrins. The figures are from the research group of J. Fraser Stoddart at UCLA, <http://www.chem.ucla.edu/dept/Faculty/stoddart/research/cyclodextrins.htm>. Used with permission.

How about using one of the rust-removing products? Go to <http://www.zero-rust.com/zero-rust-prep-step.html> for Zero Rust Prep Step. Here you will learn that this product is a combination of complex phosphate salts, esters, and wetting agents. Now this is again not a lot of information. At his Web site Bob Vila recommends a wire brush and maybe sandpaper to remove rust: <http://www.bobvila.com/BVTV/index.html?BVTVCBS/SpringCleaning.html>.

I think that I get the message: elbow grease is the ultimate environmentally friendly cleaner!

Look at the WalMart site for how to clean up your house with baking soda and vinegar. Helpful hints include using washing soda and making your own laundry soap. This site at <http://frugalliving.about.com/library/weekly/aa082801a.htm> is environmentally friendly for the home.

One of the most important things we can do while cleaning is to make sure we only use the amount of cleaning product that is needed. Excesses do not have any beneficial effect for cleaning or for the environment.

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Chemical & Engineering News

"What's That Stuff: Shampoo" from *Chemical & Engineering News Online*
<http://pubs.acs.org/cen/whatstuff/stuff/8015sci3.html>

Personal Care
<http://pubs.acs.org/cen/coverstory/7916/7916personalcare.html>

Antibacterial Products
<http://pubs.acs.org/isubscribe/journals/cen/77/i05/html/7705prodbox1.html>

Journal of Chemical Education

Cleaning Up with Chemistry: Investigating the Action of Zeolite in Laundry Detergent, *JCE Classroom Activity*
<http://jchemed.chem.wisc.edu/Journal/Issues/1999/Oct/abs1416A.html>

Bubble, Bubble, Toil and Trouble, *JCE Classroom Activity*
<http://jchemed.chem.wisc.edu/Journal/Issues/2001/Jan/abs40A.html>

Food and Drug Administration

Cosmetic Ingredients
<http://www.cfsan.fda.gov/~dms/cos-chem.html>

Report on Hexachlorophene
<http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPCD/ShowCFR.cfm?FR=250.250>

MSDS

Northwest Fisheries Science Center and NOAA
<http://www.nwfsc.noaa.gov/msds.html>

Collections

Surfactants Virtual Library by Paul Huibers
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Comprehensive Sites

Kevin M. Dunn of From Caveman to Chemist
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Kiwi Web from Allan Campbell in New Zealand
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Detergent Builders

Phosphate Builder History
http://www.colorado.edu/conflict/full_text_search/AllCRCDocs/94-54.htm

Zeolites

British Zeolite Association
<http://www.bza.org/zeolites.html>

Global Information
http://www.the-infoshop.com/study/ti7686_zeolites_industry.html

Hands-on Activities

Strength of Wet Cloth
<http://frugalliving.about.com/gi/dynamic/offsite.htm?site=http://www.fabrics.net/fabricca.htm>

Hand Washing Access Excellence Site of the National Health Museum
http://www.accessexcellence.org/AE/AEC/CC/hand_activity.html

Hexachlorophene

John Blake, University of Alaska at Fairbanks
http://www.uaf.edu/iacuc/training/module_3/3_soap.html

Rx List

http://www.rxlist.com/cgi/generic2/hexchlorph_wcp.htm

Macmillan Reference Ltd.

<http://www.macmillan-reference.co.uk/Science/DictionaryofToxicSA-02.htm>

U. S. Medicine

<http://www.usmedicine.com/article.cfm?articleID=238&issueID=29>

Carpet Cleaning

From Solutia, Inc.
<http://www.fabriclink.com/carpet/Carpetgeneral.html>

Cyclodextrins

From UCLA
<http://www.chem.ucla.edu/dept/Faculty/stoddart/research/cyclodextrins.htm>

From Research Diagnostics
<http://www.researchd.com/janssen/410200.htm>

Theresa Zelinski's page at Monmouth University
<http://bluehawk.monmouth.edu/~tzielins/Cyclodextrin/background.htm>

Lawn Furniture

From *Women Today Magazine*
<http://www.womentodaymagazine.com/family/springclean.html?a=767>

For Zero Rust Prep
<http://www.zero-rust.com/zero-rust-prep-step.html>

Bob Vila
<http://www.bobvila.com/BVTV/index.html?/BVTV/CBS/SpringCleaning.html>

Waste Reduction

WalMart
<http://frugalliving.about.com/library/weekly/aa082801a.htm>

access date for all sites July 2002