Dirty Business: Laundry Comes Clean with Chemistry

By Brian Rohrig

It won't be long until you leave home and head off to college. One rite of passage for every freshman is doing laundry. If not done correctly, every article of clothing you own will have a pinkish hue. This article will not tell you how to actually *do* your laundry—but will discuss how laundry detergent cleans your clothes. If you take a close look at the label on your laundry package, you will notice a list of ingredients that may not seem too familiar. But as you will discover in this article, what they do is nothing more than putting chemistry into action.

Surfactants to the rescue

The most basic ingredient in doing laundry is, of course, water. But if you used only water, your clothes would not come out clean, and most stains would remain. And that sweaty shirt that has been in the bottom of your gym bag for the past month? Chances are water would do little to get rid of *that* odor.

The reason water alone cannot remove stains from clothes is that water molecules tend to attract other water molecules but not molecules of oil or grease that are present in most stains. This is due to a key difference between water and oil, called polarity. Water is polar, while oil is nonpolar.

A polar molecule contains regions of partial positive and negative charge that are due to the uneven distribution of electrical charge. In a water molecule, the electrons in the covalent bonds between oxygen and hydrogen are more strongly drawn to the oxygen side, giving it a slightly negative charge, while both hydrogen sides have a slightly positive charge.

When two water molecules are next to each other, the slightly positive end of one molecule is attracted to the slightly negative end of the other molecule through so-called intermolecular forces. The attraction of water molecules to one another contributes to the enormous surface tension of water—the force that holds the molecules in a liquid together.

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Laundry detergents contain substances called surfactants that reduce water's surface tension. These substances help water to spread on the surface of fabrics allowing fabrics to absorb water faster (Fig. 1).

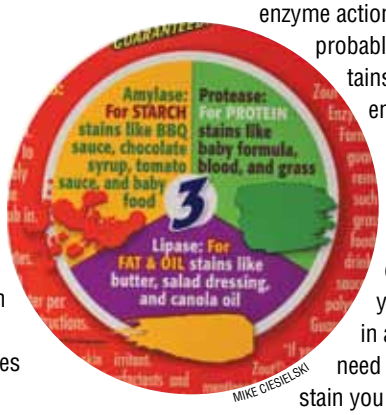
Surfactants are also the cleaning agents in detergent. A typical surfactant molecule has two parts—a polar and a nonpolar part. The polar part is attracted to water and is called hydrophilic, and the nonpolar part repels water but is attracted to a molecule of grease or oil.

After water has spread out on the surface of a piece of clothing, the surfactant molecules bind to molecules of

grease or oil present on the surface of the fabric. The nonpolar ends of the surfactant molecules bind to the nonpolar oil molecules present in the stain. Then, the surfactant molecules surround the stain, forming a cluster of molecules called a micelle. Fig. 2 shows how the stain at the center of a micelle is surrounded by surfactant molecules. This way, stains are removed from dirty clothes.

Removing the toughest stains

Many clothes that go in the wash have tough stains from sweat, grease, or food. To remove these stains, a little more kick is needed. Most laundry detergents contain enzymes, which are catalysts that work by speeding up the rate of a reaction without themselves being changed in the process.



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If you look at the list of ingredients on the laundry detergent label, you might notice one of the following enzymes: proteases, which attack protein stains; lipases, which attack lipids (fats); and amylases, which remove starch. If a stain remover advertises "triple-enzyme action," it probably contains all three enzymes.

Incidentally, your saliva contains many of these same enzymes; so, if you find yourself in a pinch and you need to remove that stain you got on your white shirt during lunch, a little saliva may be more effective than just plain water. Enzymes break down over time. So, if a detergent contains enzymes, its shelf life is between six months and one year. After this time, the detergent may become less effective.

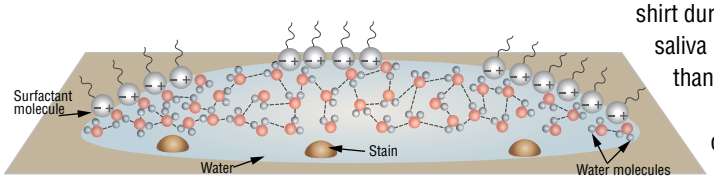

Figure 1. Surfactant molecules decrease the surface tension of a drop of water on a surface by spreading it on the surface.

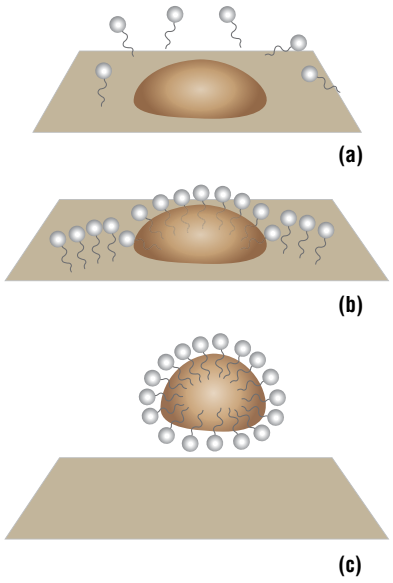

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Figure 2. A stain on a piece of fabric is removed by surfactant molecules in three steps: (a) The nonpolar side of the surfactant molecules (their tails) are attracted to nonpolar oil molecules present in the stain; (b) the surfactant molecules surround the outside part of the stain; (c) the surfactant molecules completely surround the stain and lift it out of the surface of the fabric.

More than chemicals

Chemical processes are only one aspect of cleaning clothes. Mechanical processes are also involved. The agitation of your washing machine provides mechanical energy to remove dirt from clothes. You can't just let your clothes soak in water. In the old days, people would beat clothes with rocks or use an old-fashioned wash board.


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Another key ingredient for doing laundry is heat, which is provided by hot water. In addition to speeding up the rates of chemical reactions and providing the necessary temperature for enzymes to work, thermal energy is an essential part of the washing process. Substances dissolve more readily in hot water than in cold, helping to lift dirt and stains.

Even though every container of laundry detergent contains quite an array of chemicals, there are still even more amazing products on the horizon. Chemists have begun developing technologies that may make today's laundry detergents obsolete. Through the use of nanoparticles, for instance, your clothes may soon be able to clean themselves!

A nanoparticle is any particle whose diameter is between a few nanometers and 100 nanometers. (A nanometer is one-billionth of a meter.) Nanoparticles have been incorporated into fabrics that repel stains—meaning the clothes will never need to be washed. One amazing such product, called Neverwet, can be sprayed on clothing, and any type of liquid will just roll right off (see photo).

As exciting as these new technologies sound, your traditional laundry detergent is probably not going away anytime soon. So when your dirty and smelly clothes come out of the washer smelling fresh and clean, remember it's only possible due to the wonders of chemistry! *CM*


HTTP://WWW.TECHERBLOG.COM/INDEX.PHP/TECH-GADGET/INCREDIBLE-NEVERWET-SUPER-HYDROPHOBIC-SPRAY-LETS-CHOCOLATE-SYRUP-SLIDE-RIGHT-OFF-YOUR-SHOES

A shoe that has been sprayed with a substance called Neverwet lets chocolate syrup slide right off of it. Neverwet was developed so that clothes and shoes repel water and other liquids, thus becoming stain-free.

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