Chemistry and nanotech work to make carefree clothing

One of the presents I unwrapped this year was a dress shirt from Van Heusen. It's supposed to be wrinkle-free and stain-proof, so naturally I put it to the test. Nothing would stick to it — liquids rolled right off. Cool.

Score one for the manufacturer's claim.

Something like 25% of the clothing sold today is treated to be at least wrinkle-resistant if not wrinkle- and stain-proof. "Easy care" is the name of the game, and companies have been turning on the tech to cater to the lazy people (like me) who want true wash-and-wear.

You might notice that most clothes washers have a "Permanent Press" setting, which I've always taken to mean "not quite as sturdy as jeans." Of course, Permanent Press (or "durable press") was the 1960s and '70s version of wrinkle free — it actually debuted in 1964.

Fabrics like cotton are pretty good at resisting wrinkles. The fibers are cellulose-based, and they tend to bond together at the molecular level with what are called "cross-linked hydrogen bonds." If you stress the fabric by folding it (or sitting on it), these hydrogen bonds force the fabric back where it belongs. No wrinkles.

That it, unless it gets wet. Water, including humidity and sweat, interferes with those hydrogen bonds. It prevents the fabric from returning to its wrinkle-free state, which is why clothes coming out of the washer are wrinkled, and why steam irons work better than dry ones.

Wrinkles in time

If you want to make something wrinkle-free — so that when it comes out of the laundry it looks neat and perfect — you need to bond those fabric fibers with something that's waterproof. No water, no wrinkles.

Ruth Rogan Benerito.

The mother of that invention was one Ruth Rogan Benerito, research leader of the Physical Chemistry Research Group of the Cotton Chemical Reactions Laboratory. (Whew!) She discovered that certain chemicals — notably formaldehyde and substances related to it — could make cellulose fibers resistant to wrinkles.

The permanent-press industry was born. Sort of. (Benerito is still alive, by the way; she teaches chemistry at the University of New Orleans.)

But there were problems. Early wrinkle-free clothes didn't last as long; the chemicals weakened the fibers. And formaldehyde is toxic. Still, it was a start. The good thing is that once these treatments are applied to fabrics, they're pretty much permanent.

Benerito's work started the textile industry down Chemistry Row, trying various concoctions to make fabric wrinkle-free, long-lasting, and (preferably) non-toxic.

1987 was a turning point. That's when a chemical called — get ready —dihydroxy dimethylol ethylene urea (DMDHEU) showed a lot of promise. It's inexpensive and non-yellowing, but it's

related to formaldehyde so there's that whole toxicity thing. Adding some chemical buffers and catalysts, however, made it safe.

In other words, your Dockers are wrinkle-free thanks, probably, to pre-buffered glycolated dihydroxy dimethylol ethylene urea with a magnesium-based catalyst.

Tell your friends.

DMDHEU made it out of the beaker in 1992, when Haggar debuted the first wrinkle-free pants for men. Other clothing soon followed, including stuff for women and kids.

Today, DMDHEU is joined by other wrinkle-free technologies that are applied at various stages in the manufacturing. Nothing's perfect … yet. Many weaken the fabric (which is why some manufacturers blend in polyester for strength). Some are better at resisting wrinkles, but won't allow creases to hold. Others only work on certain fabrics. Others give fabric a soft look, which isn't good for men's dress clothes. Others are expensive. Others don't last as long.

You get the idea.

But one big problem with many of the wrinkle-free treatments is staining. Wrinkle-free fabrics just love oil — so much so they won't let go.

Back to the beakers went the manufacturers: Wrinkle-free needed to be stain-free as well.

The human stains

In 1953 a 3M scientist named Patsy Sherman was working with a latex compound for treating rubber tubing. She spilled some on her canvas sneakers, and noticed over the next few months that the formerly-wet spot stayed clean. She had discovered a substance that repelled oil and water — and the stains they carried.

Patsy Sherman.

Today we call it "Scotchgard."

Scotchgard, whether put on clothing during manufacture or sprayed on at home, is probably the best-known way of making fabric resistant to stains. There are other, similar ways, all of which involve coating the fabric with some sort of chemical and then baking or drying it on. Teflon (the same stuff on your non-stick pans) is the big gun here, but other companies are in the game.

Perhaps the coolest of the lot is Greensboro, N.C.-based Nano-Tex.

If you buy a pair of Lee Performance Khakis, for example, you're buying pants treated with a chemical from Nano-Tex that's virtually stainproof. The fabric is soaked in a solution that contains gadzillions of tiny particles, then heated to bond them to the fibers. (They call it nano-technology, but I can't say whether the molecules are small enough to really qualify for the moniker. As if it makes a difference.)

The particles wrap themselves around the individual fibers of the khakis, with microscopic "whiskers" sticking out. These cause a barrier of air to form around the material, which prevents

liquid from getting through. Because the whiskers are so small, they don't affect the feel of the fabric.

The result is clothing that looks and feels like cotton (or a cotton-polyester blend), but is virtually stain-, sweat-, and wrinkle-proof. Nano-Tex's customers include Dockers (look for "Never-Iron" technology), Eddie Bauer, Gap, Old Navy, and Perry Ellis.

What's next, beyond "no-care" clothing? Companies like Novozymes Biologicals already make a treatment for carpets that makes them literally self-cleaning; why not shirts, pants and onesies too? Maybe in a few years "doing laundry" will mean, at worst, getting a bottle of Windex and a towel.

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