How chemistry can make your ironing easier

March 16 2017, by Mark Lorch

Credit: AI-generated image (disclaimer)

I hate ironing, I'll do more or less anything to avoid it. So faced with a giant pile of laundry I got easily distracted. I started to wonder why those shirts emerged from the machine looking like a tangled bag of rags. How come the cotton clothes get crumpled so easily? And what's with easy-iron garments, why don't they need so much pressing?

Since I'm a scientist I know its important to understand the theory

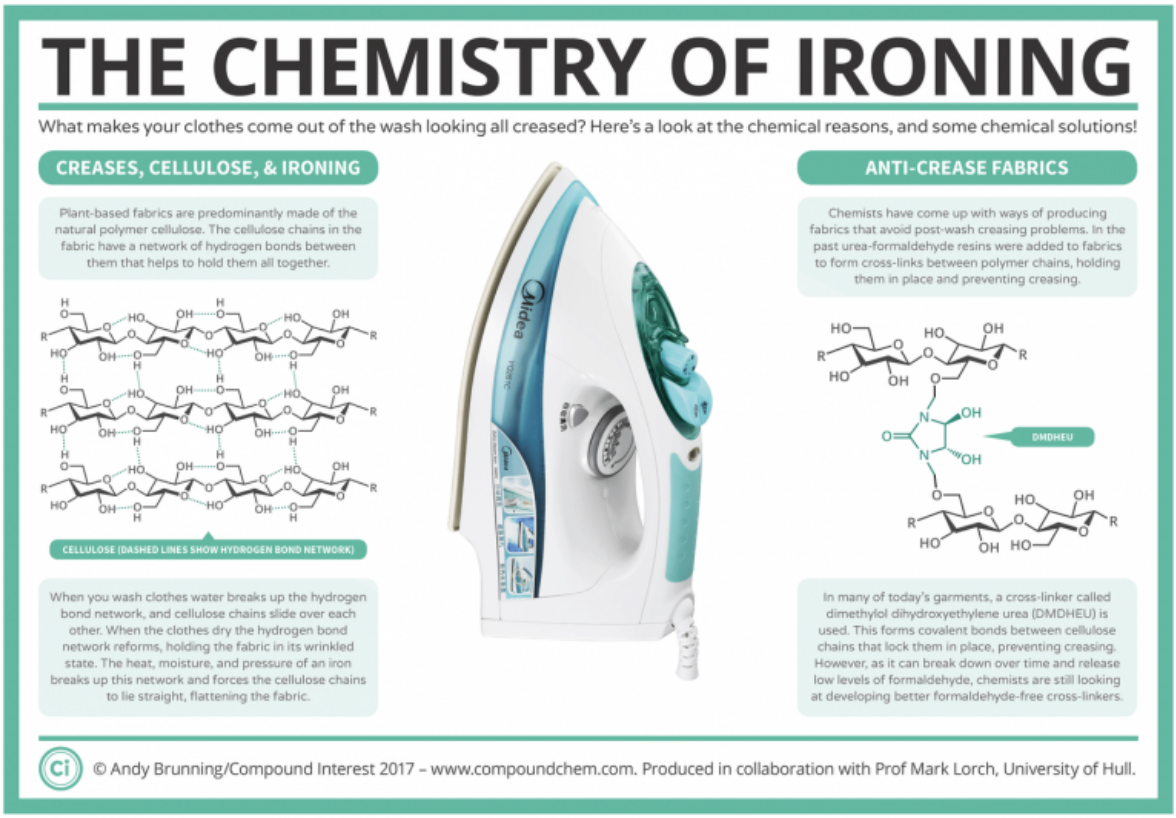
behind a methodology. And so it became imperative, before unleashing the iron and its board, that I found the answers to these pressing questions.

It turns out that the wrinkles in my shirts are all down to the chemisty of plant-based fabrics. Cotton, linen, hemp and so on are predominantly made of cellulose. Cellulose is what's known as a polymer because it consists of thousands of glucose molecules joined together to form linear chains. Each glucose subunit is "sticky" because it can bind to neighbouring cellulose molecules via something called hydrogen bonds. Individually, these bonds are very weak, but together they form a strong network that gives the fabric its strength.

These hydrogen bonds are particularly dynamic in that they are forever breaking and then rapidly reforming. As a result, clothes start taking on the shape that they are left in. This isn't a problem if I get around to putting freshly ironed shirts on a hanger. But it is an issue when I chuck them in a heap on the "floordrobe". As they sit there in a pile, the bonds break and reform, the clothes take up the new shape of the fabric, and the creases set in place.

Just add water

Things get even worse when water enters the equation (like in the washing machine). Water molecules insert themselves between the cellulose molecules, break up the hydrogen bonds and act like a lubricant, allowing the cellulose molecules to slide over each other. Then, when the fabric dries, the cotton keeps its now wrinkled shape. And that is the state of the pile of shirts that now stands before me.



The Chemistry of Ironing. Credit: Andy Brunning / Compound Interest

This is where the hot, steaming iron comes in. The combination of heat and moisture quickly breaks the hydrogen bonds. As I apply these with a bit of pressure, all the cellulose molecules are forced to lie parallel with each other, so flattening the cloth.

But what if I want to avoid doing the ironing? The wrinkled look is always an option and, as an academic, I can just about pull it off. But occasionally I do need a pressed shirt. I could go with the age-old practice of starching my clothes to keep them crease free. This works because starch is also a polymer made from glucose, so it too can form

all those sticky hydrogen bonds.

But, unlike cellulose, starch is a branched polymer. This means that if I apply it to cellulose, it sticks and acts like a scaffolding holding all the cellulose molecules in place. The drawback is that it gives me a rather stiff look and more to the point the starch is soluble so it just comes out in the wash. The net result is that it doesn't do much to reduce my list of chores – I still need to iron and I'd just have to apply starch too boot.

What I need is a more permanent version of starch. And that's exactly what I get in easy-iron clothing. Originally, formaldehyde was used to permanently link cellulose molecules together, stopping them sliding about and limiting the amount of wrinkles that formed. More recently, formaldehyde (which isn't very nice stuff) has been replaced with friendlier (but even less easy to pronounce) cross-linkers such as dimethyloldihydroxyethyleneurea. The wrinkle-resistant shirts are good in a pinch but they have a slightly plastic feel that I don't particularly like and they still release tiny amounts of formaldehyde which can irritate the skin.

The pile of laundry is still waiting for me. But at least I have the theory of ironing all straightened out, and so I suppose I'd best just get on with the practical session. Or maybe I'll go for that crumpled look and just call myself a theoretical ironist.

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