

Bayer researchers develop a solvent-free raw material for imitation leather

Fashionable foams



Imitation leather is not just easy-care and hard-wearing – it also looks good. Imitation leather is used for shoes, jackets, belts, sofa covers and car seats. Sports goods manufacturers wrap it round championship soccer balls and fashion designers wrap it round their models. Several billion square meters of imitation leather are produced worldwide every year. Now for the first time Bayer researchers have come up with a raw material that can be made into this highly popular animal skin substitute without the need for any solvent.



Let it pour: as the photomontage on the left shows, imitation leather is a versatile material that can now be manufactured using a particularly environmentally friendly process (left). At the textile coating facility, Jonuz Mustafi supervises the manufacture of a length of imitation leather for test purposes (above right).

A kitchen mixer is one of Bruno Stüb- ben's most important pieces of equip- ment. In his brightly lit Bayer MaterialScience laboratory in Leverku- sen, the chemical laboratory technician uses it to whisk a milky liquid into frothy foam that looks like cream, but is in fact a new, solvent-free raw mate- rial for imitation leather. "Basically, the foam consists of solid polyurethane particles, water and of course air," explains Stüb- ben, as he applies the mixture onto a sheet of paper with a block of corrosion-resistant steel known as a Wasag applicator. After a few minutes in the drying chamber, the foam has developed into a kind of white skin about one millimeter thick. The only remaining trace of the bubbles is countless tiny pores which give the fabric that "scrunchy" feel that is typi- cal of leather.

Dr. Holger Casselmann, the market- ing manager at Bayer MaterialScience responsible for assessing the suitability of polyurethane foams for the imita- tion leather industry, is proud of the new, solvent-free material. "For a long time it was considered impossible to produce such a thin layer of polyure-thane foam that would also be hard- wearing," he comments. The tough new material with its porous structure, however, has already passed the main stress tests with flying colors. These involved bending the material vigor-

ously back and forth, subjecting it to temperatures of up to 70 degrees Cel- sius and 95 percent atmospheric humidity for several weeks and then testing it again for flexibility. Having come through this arduous "jungle test" without losing its shape, the foam-based "leather" has been pro- nounced suitable even for high-quality running shoes and seat covers.

This is a major break-through for the Bayer scientists in the search for a more environmentally friendly method of producing imitation leather. Poly- urethane, which is now used instead of polyvinylchloride in around 20 percent of all imitation leathers, is not applied on the desired fabric in the form of an aqueous foam, but is still dissolved in dimethylformamide (DMF), an evil- smelling solvent that has to be removed later on in a complicated and time- consuming process.

Research for the sake of the environment

The pores needed to give that typical scrunchy leather feel are produced afterwards by immersing the material in several water baths. The water mol- ecules then slip between the polyure-thane particles, thereby displacing the DMF. DMF is considered to be the only solvent with which this process can be carried out economically.



Dr. Holger Casselmann (right) and Thomas Michaelis check the scrunchiness and microstructure of the new imitation leather.

However, with environmental protection in mind, scientists worldwide have been looking for alternative, DMF-free production processes for over twenty years. Up to now, their efforts had been fruitless, as any methods that were potentially suitable turned out to be too time-consuming and costly. The new imitation leather raw material from the Bayer research laboratories, however, is not only free of solvents, but is also easy to handle: "With this new raw material, textile manufacturers can use their existing coating units without having to make any alterations," says Casselmann. The only extra equipment they have to buy is an industrial foam generator, so that they can produce the foam on the premises.

The foam basically consists of a fine, milky dispersion of nanometer-scale polyurethane particles suspended in water. Similar Bayer dispersions have been used for years to give jackets and other items of clothing more volume. "A nylon jacket without polyurethane or some other lightweight underlying structure to give it 'body' would hang off your shoulders like a wet rag," comments Casselmann. However, foam layers such as these would not be durable or hard-wearing enough for high-quality imitation leather, and

so the chemists have modified the recipe for producing the polyurethane. Normally, isocyanates and polyesters are linked to form long-chain polyurethane molecules that become entangled with one another in water to form tiny particles.

New polyurethane blend saves time and energy

Now the chemists have replaced the usual polyesters with polyethers and polycarbonates which make the material tougher, more elastic and less sensitive to environmental factors. The result is a particularly hard-wearing and long-lasting material.

And that's not all. By increasing the solids content of the polyurethane dispersions by 20 percent to 60 percent, the Bayer researchers have ensured that they are not just environmentally friendly, but have economic advantages, too: thanks to the high solids content of the dispersion, one single application of the resultant foam on the fabric substrate is all that is required, and because the foam layer contains less water, it also dries more quickly. This saves valuable time and energy. "With a solids content of 60 percent we're getting very close to the

Wafer-thin foam: Bruno Stübgen (left) whips up a batch of polyurethane dispersion for a trial production of imitation leather. Jonuz Mustafi (right) uses the coating system to apply a millimeter-thick layer of polyurethane foam and checks its adhesion to the (white) textile substrate.



limits of feasibility," says Casselmann to underline the significance of that they have achieved. The polyurethane particles cannot be brought any closer together in water or else they would form lumps and sink to the bottom.

The Bayer chemists' achievement is the result of several years of intensive research. What finally did the trick was using a mixture of very small and considerably larger polyurethane particles (see graphic). In the aqueous dispersions, the small particles fit perfectly into the gaps that form between several large polyurethane particles.

In a pilot plant at Bayer's Leverkusen

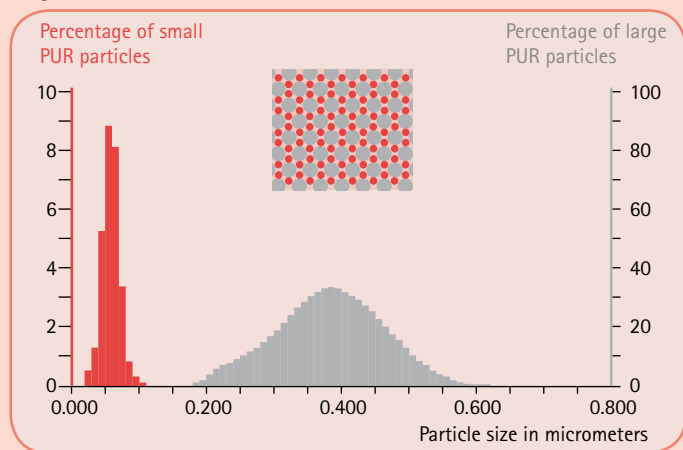
site and at several customers' plants, scientists are working flat out to test the potent polyurethane dispersions for their suitability. One of their main tasks is to find out the ideal temperature for drying the foam layers so that they do not lose the desired structure. Textile manufacturers and scientists are also working together to investigate which additives such as colorants or flow control agents are suitable for the new product. Their aim is to prove within as short a time as possible that the new raw material is not just a lot of froth, so to speak, but is suitable for industrial-scale production.



www.cci.ethz.ch/experiments/Polyurethan/en/stat.html

A film showing how polyurethane is manufactured can be seen on the website of the ETH Zurich (Swiss Federal Institute of Technology in Zurich). However, whereas in the case of imitation leather the foam is produced by stirring, here it is produced by the carbon dioxide that forms when isocyanates react with water.

A perfect mix



Thanks to a new process, Bayer chemists are now able to produce a mixture of small (red) and large (gray) polyurethane particles. In water, the small particles accumulate between the larger ones (square, above). The result is a particularly dense and hard-wearing raw material for imitation leather that can be manufactured cost-effectively in an environmentally friendly process.



An interview with designer Thomas Meyer zu Capellen

Perfect for any outfit

What role does imitation leather play in the world of fashion?

research talked to Thomas Meyer zu Capellen, a textile designer and lecturer in textile technology at the Hamburg Academy of Fashion and Design.

What makes a fashion designer choose imitation leather for accessories or clothing?

It is a perfect material for designers, because you can do just about anything with it. It is far easier to work with than genuine leather, and nowadays it looks and feels so much like the real thing that it is hard to tell them apart. It is also extremely versatile. Imitation leather is now available in all conceivable colors and a wide range of thicknesses, making it suitable for everything from luxurious coats to flimsy lingerie. It is because of this tremendous potential that we in the fashion business prefer to talk of imitation leather rather than synthetic leather. It doesn't sound so much like a cheap fake, more like an ideal companion.

Does the customer also benefit from the properties of imitation leather?

Of course. Imitation leather is extremely easy-care, it is not sensitive to grease and dirt and can even be washed in the washing machine.

Despite all these advantages, imitation leather has so far not found its way into haute couture. Why is this?

Both the fashion public and the designers are too conservative in their thinking. But I am sure that sooner or later imitation leather with its outstanding properties will make it into the world of haute couture, too.