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The spray-on miracle that could revolutionise manufacturing

Liquid glass sounds like the stuff of sci-fi, but its patent holders claim it will protect us from disease, help grow crops and keep wine delicious. But can it really live up to the hype?
By **Steve Connor**

It sounds too good to be true: a non-toxic spray invisible to the human eye that protects almost any surface against dirt and bacteria, whether it is hospital equipment and medical bandages or ancient stone monuments and expensive fabrics.

But true it is. The spray is a form of "liquid glass" and is harmless to living things and the wider environment. It is being touted as one of the most important, environmentally-friendly products to emerge from the field of nanotechnology, which deals in objects at the molecular end of the size scale.

Tests have revealed an astonishing variety of potential uses for the liquid glass, from protecting vineyards against fungal attacks to coating medical implants with non-stick, antibacterial surfaces. Scientists have even used it to spray fabric with an invisible, dirt-resistant film – emulating the fictional invention of unstainable clothing in the 1951 Ealing comedy *The Man in the White Suit*.

The secret of liquid glass is that it forms an ultra-thin film between 15 and 30 molecules thick – about 500 times thinner than human hair. On this nanoscale – a few millionths of a millimetre thick – liquid glass turns into a highly flexible invisible barrier that repels water, dirt and bacteria, yet is resistant to heat, acids and UV radiation but remains "breathable".

A family-owned German company called Nanopool holds patent rights on the technology behind the liquid glass, which emerged from research at the Institute for New Materials in Saarbrücken. Nanopool is already talking to British firms and the NHS about using the product for a diverse range of applications, from coating designer handbags to spraying the nose cones of high-speed trains.

An NHS hospital in Southport, Lancashire, has just completed a year-long trial where a variety of surfaces were coated with liquid glass to test its ability to resist dirt and microbial growth. The results of the trial are expected to be published next month.

Similar tests by food-processing firms in Germany have shown that sterile surfaces treated with liquid glass are just as clean and free of microbial contamination after being washed in hot water as untreated surfaces washed in the usual way with strong bleach, and the antimicrobial effect continued over many months.

The liquid glass is composed of almost pure silicon dioxide, the chemical constituent of quartz or silica, the most abundant mineral in the Earth's crust. It is quite inert and has no known harmful impact on the environment, unlike many of the domestic and industrial cleaning products its use could help to reduce.

The "easy-clean" properties of the liquid glass could lead to drastic cuts in the amount of potentially toxic cleaning agents used in factories, offices, schools, hospitals and the home, as well as cutting the costs of labour and the amount of time spent scrubbing surfaces.

It works by forming a highly water-repellent or "hydrophobic" layer that resists dirt and bacteria, so that treated surfaces can be quickly be washed clean with plain water, according to Neil McClelland, Nanopool's UK project manager.

"Many UK supermarkets are unwilling to stock the technology as many of the other cleaning products which they sell will become redundant. This is also the case with some major cleaning companies who are scared of having to clean less frequently and to change from using cleaning chemicals to using water in most instances," Mr McClelland told *The Independent*.

A number of leading organisations are conducting cleaning tests with the product, including a train company in Britain which is using it to protect the front of the train as well as inside its carriages; an international chain of luxury hotels; an upmarket fabric and clothing firm; and a German branch of a hamburger chain.

The secret of the glass's unique properties lies in the way it is manufactured so that it can be sold in a solution of water or alcohol, depending of the type of surface to be covered. When sprayed on a surface, the glass solution forms a flexible, ultra-thin film that generates strong electrostatic forces that bind it to the material in question, yet repel water from the opposing, exposed surface.

"In essence, we extract molecules of silicon dioxide from quartz sand and add molecules of water or ethanol depending on which surface is being coated. The really clever part is that there are no added nano-particles, resins or additives – the coatings form and bond due to quantum forces," Mr McClelland said.

When bacteria or other microbes land on the glass surface they are not killed, but they cannot divide and replicate easily, he said. This imparts a natural, antibacterial property to the layer of liquid glass similar to the silver-ion surfaces used to protect some kitchen equipment, but with a longer-lasting effect, Mr McClelland claimed.

"Very soon almost every product you purchase will be protected with a highly durable, easy-to-clean coating ... the concept of spray-on glass is mind boggling," Mr McClelland said.

Sprayed onto outdoor stone or brick, the liquid glass creates a water-resistant surface that is easier to clean. It allows the stone to breathe, preventing a build-up of mildew under the nano-coating. Graffiti is more easily removed from treated statues, without the unsightly "shadowing" from conventional anti-graffiti treatment, Mr McClelland said.

Britain's war graves organisation, Alrewas, is in discussions with Nanopool about treating its stone monuments and Turkish scientists are conducting tests of liquid glass on important national monuments in Turkey, such as the Ataturk Mausoleum in Ankara and the 15th Century Ilyas Bey Mosque in Miletus.

Professor Bekir Eskici of Ankara University, director of the mosque project, said that the liquid glass solution was applied to the building's dome as well as its decorative marble surfaces in August 2008. The surfaces are still water-repellent and there are no colour changes to the materials, Professor Eskici said.

Sascha Schwindt, managing director of Nanopool, said that agricultural companies were also interested in liquid glass as a treatment against fungal attack on plants and seeds. Vineyards are testing it against a common grape fungus and wine makers are interested in using the product to prevent "corking".

Mr Schwindt said that tests have also shown that seeds sprayed with the liquid glass are not just protected against fungal attacks, but germinate and grow faster than untreated seeds. "We think it's because the energy of the seeds is used for development and growth rather than defence against bacteria and fungi in the soil," he said.

The agricultural aspects of the liquid glass came out of tests showing that treated wood is resistant to termite attack. Wood sprayed with the liquid glass survived undamaged after being buried in a termite mound for nine months, Mr Schwindt said.

"Our hypothesis is that the termites do not see the treated wood as wood but as a solid barrier," he said.

Professor Colin Humphreys of Cambridge University, a respected expert in the field of materials science, said that Nanopool's liquid glass appears to have a striking range of applications. "I have to say the product looks impressive," he said.

Nano invention Macro possibilities

Fantasy becomes reality: Alec Guinness starred in the 1951 satire *The Man in the White Suit* BFI

Its uses in the fashion industry

The liquid glass produces a highly flexible, invisible barrier to liquids and dirt. It cannot be seen by the naked eye and yet it allows fabrics to "breathe", according to its manufacturers. Expensive fabrics could be treated to make them stain resistant and at least one maker of upmarket handbags and coats is understood to be conducting negotiations about treating its products before they leave the factory. The day may soon come when the clothes are routinely treated with liquid glass to give them protection against dirt – the angle in the 1951 classic comedy movie *The Man in the White Suit*.

Agriculture

Wood treated with liquid glass was found to be resistant to termite attacks in tropical climates. This led to tests on vines showing that treated plants are more resistant to a fungus that attacks the grapes. Seeds coated with liquid glass are less likely to be be attacked by fungal spores and germinate and grow faster than untreated seeds, probably because they do not waste energy fending off the microbes. Wine corks treated with liquid glass may also be protected against "corking", when contaminants in the cork taint the flavour of the wine.

Coated grapes resist fungal attack

Stone monuments

Stone surfaces coated with liquid glass are protected against the weather and easier to clean, especially if grafittied. For 18 months, scientists in Turkey have been running trials on the Ataturk Mausoleum in Ankara and a 15th-Century mosque. They report continued water protection and no discolouration. Talks are taking place about the possible use of liquid glass in Britain to protect memorials and war graves.

Domestic bathrooms

Millions of homes use cleaning agents and bleach. Tests by food processing companies in Germany have shown that sterile surfaces treated with the liquid glass can be cleaned with plain hot water and have levels of sterility seen on surfaces washed in bleach.