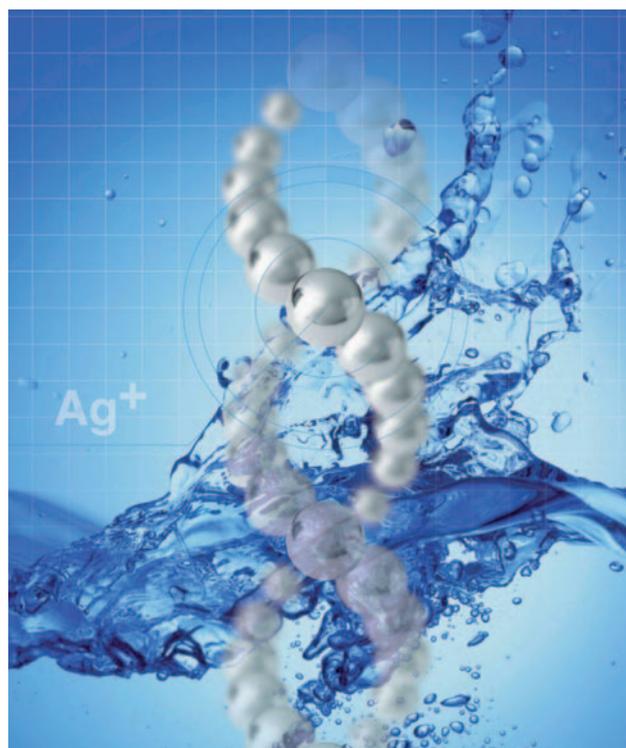


# The Future is Now. The Future is Silver.

By Michael DiRienzo, Executive Director, The Silver Institute



## A growing range of products is taking aim against bacteria with literal silver bullets that leave rival technologies in the dust.

*This article is adapted from a speech given at the 2006 LBMA Conference in Montreux, Switzerland.*

Bandages that help wounds heal faster. Washing machines that suppress bacteria while cleaning your clothes. Pens that prevent the transmission of bacteria from user to user. Wood that resists mould and mildew. Socks that control smelly feet.

From the battlefields of Afghanistan and Iraq to fighting infection in the home, when it comes to antibacterial fashion, silver is the new black.

All of the above miraculous-sounding products have one element in common: silver, which has been shown to have broad effect against bacteria, fungus and mildew. In a world concerned with the spreading of disease, silver is increasingly being tapped for its bactericidal properties and used in treatments for conditions ranging from severe burns to legionnaire's disease.

That silver controls bacteria is nothing new. Thousands of years ago, and with no understanding of 'germs' in the current sense, Romans and Phoenicians lined their drinking vessels with silver to better preserve liquids. American pioneers heading westward dropped silver and copper coins into their barrels of water to keep them safe for drinking.

What continued to remain a mystery until fairly recently was why silver was harmful to bacteria – but not to humans. The answer, in brief, is twofold: silver interrupts the ability of bacteria

cells to form certain chemical bonds that are essential to their survival, while cells in humans and other animals have thicker walls, and so are undisturbed.

### Taking Aim with Silver Bullets

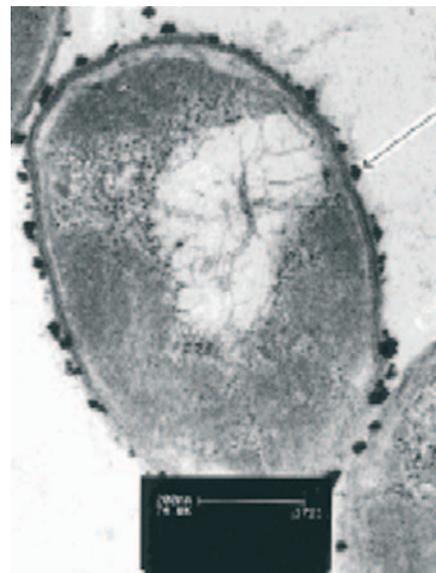
Making most of its germ-quashing properties, silver has more recently been clinically tested, proving effective against a growing list of bacterial threats, including legionnaire's disease, E. coli, streptococcus and MSRA – microbes that account for 95% of all the germs we encounter on a regular basis.

It should therefore come as no surprise that medical professionals and manufacturers of consumer products are increasingly incorporating silver into a wide array of applications, including wound and burn care, consumer appliances, textiles and clothing, wood preservation, water purification, commercial food and beverage preparation, furniture, building materials and more.



While it is known that biocide uses for silver are increasing – based on the large number of new products being introduced – exact data are difficult to come by because, except for water treatment, the applications are new. Looking to the future, the silver biocide segment is poised for further growth for multiple reasons: general economic growth; wider acceptance of silver as a biocide, which has been backed by scientific research and testing; and the outright banning of some chemical biocides, which is driving a search for alternatives.

As the table shows, Europe and North America use more silver in biocide applications than Japan, but Japan uses more per capita. Japan has had a cultural tradition of fighting bacteria, in part because of its dense



Silver ions 'attack' the walls of a bacteria cell.

Silver-Based Biocides		
Estimated Sales for 2004 by Geographic Region (in troy ounces)		
	Water Treatment	Other Applications
Japan	740,000	440,000
Europe	1,200,000	360,000
North America	1,150,000	570,000
Rest of World	210,000	230,000
TOTALS	3,360,000	1,600,000

population, and it has always been at the forefront of new consumer applications for silver, such as refrigerators, metal doorknobs, handles and cell phones.

### Bandages and Battlefields

Because many patients have compromised immune systems, hospitals in the US have become major users of silver biocides for their water systems, instruments, catheters,



Major manufacturers offer bandages incorporating silver in the wound pad, where it reduces the growth of hundreds of types of bacteria responsible for wound infection.



furniture and almost any service in the operating rooms. And health departments in New York and Maryland have approved silver-copper ionisation as a primary treatment for long-term control of legionella.

Silver-embedded bandages find their greatest use in hospitals: the use of silver in wound dressings was first tried on burn victims, who were highly susceptible to infection without the protection of skin. Doctors found that not only did silver inhibit the growth of bacteria, but also helped the wounds heal more quickly. Some research has suggested that the reason is because the body is using resources for repairing cells and not to fight off infection. More recently, silver bandages have spread from the hospital to the local pharmacy, as the public has gained better

access to silver's ability to kill bacteria.

This infection-fighting ability has not gone unnoticed by the pharmaceutical sector. Innovative Medical Services (IMS) recently announced results showing that its silver-based product, Axenol, is 99% effective against acne-causing bacteria, adding that the product was the company's most successful retail introduction in its 11-year history. Axenol is currently undergoing FDA approval in the US. And for cyclists, who are often plagued by skin wounds and other injuries, Silverlon, a dressing containing silver ions, has proved so excellent for wrapping skin wounds that the US cycling team keeps the product on hand for application to abrasions and road burns common in bicycle racing.

Perhaps no group is more prone to injury than the military. In the United States, the Defense Department uses QuikClot, a clotting powder that was successful in reducing the number of soldiers who bleed to death on the battlefield – so successful, in fact, that it's been given to every Marine in Iraq and Afghanistan.

However, in addition to clotting, the powder heats up upon contact with blood, and so its usage off the battlefield was limited, until university researchers added silver ions – which not only helped disperse the heat produced, but had the added benefit of anti-bacterial action. The change allowed the technology to be modified for civilian life, for use by paramedics and other first responders.

### Food Technology: The Dish on that Silver Spoon

That untarnished truism – 'Born with a silver spoon in one's mouth' – was originally a reference to health: babies fed with silver spoons tended to be healthier than those fed with spoons of other metals.

For today's consumers of the food industry's products, silver's main advantages over other "complicated processes" (like chemicals or constant cleaning) are its low toxicity, ease of use – because the silver is imbedded in the equipment – and its ability to handle a wider range of bacteria than many individual bacteria-fighting chemicals.

For decades, restaurant ice making, food shipping and more involved industrial processes were plagued by bacteria forming in hoses and fittings.

Today, manufacturers of



In Samsung's Silver Wash machines, laundry is exposed to a silver colloidal solution that penetrates the fabric and coats it with positive silver ions, killing bacteria.

commercial ice machines are using silver-embedded hoses, clamps, pipefittings, and other hardware in places that harbour bacteria. Meat processors are starting to use silver-embedded tables, grinders, tools, refrigerators and hooks. For the dairy industry, the Netherlands-based Eriks group is introducing sealing rings containing a silver-based biocide to provide protection against the bacteria that can build up on processing equipment.

The food industry's silver lining extends from occupational clothing to floor-to-ceiling prevention of pathogen build-up in food processing and storage facilities. The latest specialty packaging uses silver to keep fruit, vegetables and cut flowers fresh whilst in transit, and citrus researchers are seeking funding to see if silver could be useful in combating the citrus canker, a bacterium-caused affliction that threatens many of the citrus crops produced in Florida.

As part of the NEEMO programme, groups of NASA employees and contractors spend up to three weeks at a time in Aquarius, an underwater laboratory off the coast of Florida where conditions in the International Space Station are simulated. Silver-based clothing has been used to cut down on bacteria and odour.





Ahead of flu season, Hong Kong's MTR Corporation spray surfaces passengers often touch – such as grab poles inside the trains, escalator handrails and buttons on ticket machines – with a nano silver-titanium dioxide coating.

### Wood and Paper, Termites and Toxins

Wood preservation shows great potential use for silver biocides, given impetus by the fact that chromated copper arsenate (CCA) was phased out by the US government in 2003. Protective coating maker EnviroCare has teamed up with PRIMETech, which produces machine-coated products, to manufacture DOA, silver-ion-embedded lumber that resists mildew and mould.

Research conducted at the Department of Agriculture's Forest Product laboratory in Madison, Wisconsin, shows that silver-embedded treatments are effective in improving the resistance of wood to termites. And research sponsored by the Silver Research Consortium, and at Florida International University and Mississippi State University, indicates that wood

treated with silver-based liquid preservatives can withstand both the South Florida soil environment and exposure to aggressive



brown-rot fungus.

British papermaker James Cropper has introduced a line of silver-based paper products called DocuGuard. Early applications will include protecting hospital case notes and medical files against the proliferation of bacteria, and there's the promise of widespread future applications, such as business stationary, envelopes, brochures, book-binding materials, and food packaging.

### Smell-Free: From Socks to Space

The secret to smelly feet is bacteria: eliminate them, and the odour disappears. This has been achieved by knitting silver-coated nylon into the socks, addressing the problem from the ground up. One popular silver-based fabric is X-Static, now used in many garments and footwear, and especially useful in hiking and camping clothing.

When it comes to washing clothes, silver again has a role to play. Samsung Electronics has developed a washing machine that uses the antibiotic properties of silver to disinfect clothing. When the AG Plus washing machine is set on 'silver sterilisation', the system generates silver nano-particles that kill off most of the bacteria and mould in the laundry load – even with cold water.

Silver finds use in other appliances as well. Samsung and BSH include silver antimicrobials in refrigerators, and BSH goes a step farther, using silver coatings in all its new refrigerator and air purifier product lines. Asia is the major market for such appliances, followed by Europe, the Middle East and North America. And though the current level of silver used as a biocide in appliances is small – about 50,000 troy ounces – it's set to grow rapidly if current trends continue.

Outside the home, silver is finding use in recreational areas, such as playgrounds, where its low toxicity makes it ideal for use in composite plastic equipment. On a larger scale, silver ions in swimming pools reduce the need for harsh chemicals. One example of such an in-pool solution is Floatron, a small solar-powered ioniser that disperses silver and copper ions to purify and soften the water.

Farther outside the home – 1,000 feet under the sea off the coast of Florida – the US space agency NASA is operating an ongoing programme called NEEMO, which simulates life in the confines of the International Space Station. On a

Sport socks incorporating fibres coated with silver are a sports enthusiast's dream: they are anti-odour, anti-static and thermodynamic.

recent mission, all members of the grateful crew wore silver-based clothing to cut down on bacteria and odour.

### The Ultimate Safe House

Many of the above-described products and technologies, along with others, have been incorporated into what is perhaps the ultimate safe house – an 11,000-square-foot property called Camino de Robles (Spanish for 'Path of Oaks') built just outside of Los Angeles, California, by specialists in silver-embedded technology, AK Steel and AgION.

From frame to roof, the house was constructed of steel for fire and earthquake resistance. Inside, all areas that are considered 'high touch' – those that could harbour disease, such as hand rails, faucets, switch plates, kitchen surfaces and door knobs – have been embedded with silver.

Heating, ventilation and air conditioning ducts were made of AgION-coated steel, and AgION was also used in some non-steel products, such as refrigerator trays and counter tops, where the slow release of silver ions will inhibit the growth of bacteria on the



A computer-generated drawing of Camino de Robles, an 11,000-square-foot house in California. The house makes extensive use of silver ion technology.

surfaces. The AgION finish remains effective for the useful life of the product and does not cause any discolouration.

From the seafloor to the Space Station, the growing benefit – and promise – for industrial and consumer uses of silver are undeniable. ■

*Since 1999, Michael DiRienzo has been executive director of the Silver Institute, responsible for the Institute's daily activities, budget, implementation of the annual plan, media affairs and government-related activities. From 1999 to 2002, he was also vice president of the Gold Institute, managing the association's government and public relations activities.*

*The Silver Institute's members are leading silver mining houses, bullion banks, refineries, end users, and wholesalers of silver investment products. Its mandate is to stimulate silver demand and provide accurate information to members, the media, the public and government officials.*