

# Precious metal

*Director of the Copper Development Association Angela Vessey describes how an old school fixture is providing a new handle on infection control...*

Several decades ago, brass door handles and handrails would have been commonplace in hospitals throughout the country, as they were in many public buildings. Functional, durable yet attractive, these copper alloy fittings were a recognised symbol of the establishment. Then, following changing trends in interior design, these were replaced with more clinical looking aluminium and stainless steel, or cheerfully coloured powder-coated products. However, there are now moves to re-introduce brass door handles and incorporate antimicrobial copper into other frequently touched surfaces in hospitals to help reduce the risk of infection.

## History

Well before micro-organisms were discovered, the Egyptians, Greeks, Romans and Aztecs used copper-based preparations to treat sore throats and skin rashes. In the 19th Century, Pasteur developed his germ theory of disease and the scientific investigation of copper's antimicrobial properties began. In the last few decades, a multitude of studies have been published in peer reviewed scientific journals looking at the antimicrobial efficacy of copper against bacteria, viruses and fungi that threaten public health. Copper's natural antimicrobial properties are already exploited in antiseptics, anti-fungal products and medical devices. Results from clinical trials now indicate a role for copper in reducing contamination in clinical environments, and therefore lowering the risk of healthcare associated infections, which result in costs to the NHS in excess of £1bn and 5,000 deaths per annum.

## The science

Professor Bill Keevil's team at the University of Southampton have measured the survival of different micro-organisms on copper and copper alloy surfaces. The tests were carried out at room temperature and relative humidity, but with an exceptionally high challenge of micro-organisms (10 million per cm<sup>2</sup>). Stainless steel, the material commonly used in hospitals, was used as the control. Results showed that pathogens on today's 'most wanted' list, including Methicillin-Resistant *Staphylococcus aureus* (MRSA), *Listeria Monocytogenes* and *E. coli*, were eliminated from copper within two hours, yet survived on stainless steel for days and even months. This led Professor Keevil to conclude that 'the use of copper alloys in applications such as door handles, trolleys, or any other work surface, could considerably reduce the presence of

MRSA in hospitals and thus reduce the risk of cross-contamination between employees and patients'.

Keevil and others have demonstrated the efficacy of copper and copper alloys to inactivate many different types of harmful bacteria, fungi and viruses. Alloys with copper content greater than 60% gave the best results and when a bacterial challenge of MRSA more typical of a ward environment (1,000 bacteria per cm<sup>2</sup> coupon) was applied to pure copper, total elimination occurred in just 15 minutes.

## Copper – approved antimicrobial

The Keevil test formed the basis of independent laboratory tests carried out in the United States, which also included a wear and re-infection test. The results led to 300 copper alloys becoming the first solid materials to be registered by the US Environmental Protection Agency as antimicrobial with associated public health claims.

Interestingly, in the Keevil test, sterling silver and nano-silver containing materials behaved as the stainless steel control, ie. showed no antimicrobial effect. It is apparent that copper has set the gold standard for antimicrobial material testing, and is already considered by some as the positive control for such testing.

## Clinical trials

Copper has been put to the test in hospitals around the world – in the UK, US, Japan, Germany and South Africa. Selly Oak Hospital, Birmingham, is the leading trial and the first to report results. In a busy 20 bed general medical ward, copper touch surfaces such as taps, door furniture, grab rails, over-bed tables and toilet seats were introduced over a period of months. Three of these products – taps, door push plates and toilet seats – were sampled over a 10 week period and the level of microbiological contamination measured. The results showed that the copper surfaces had 90-100% less contamination than standard components in the same ward.

Trial leader, Professor Tom Elliott, said, on the significance of these results: "What this must mean is that the risk of picking up an infection is reduced because we know that one of the vehicles where organisms can spread from one surface to another is by touching them. So the results are very exciting."

## How does it work?

Copper is an essential nutrient for bacteria as well as humans, but in high doses, copper ions can cause a series



*In a clinical trial, frequently touched surfaces made from copper alloys harboured 90-100% fewer bacteria than controls*

of negative events in bacterial cells. The exact kill mechanism is still unknown; however, several theories exist and are being studied. Put simply, excess copper ions disrupt the biochemistry of bacteria, overwhelming them.

### Can copper surfaces reduce hospital infection?

While there is no substitute for good hygiene practice, effective antimicrobial surfaces can provide an additional weapon against micro-organisms. Copper alloy surfaces still need to be cleaned, in the same way as standard products, but will work away in the background 24/7. It is reasonable to assume that a 90-100% reduction in contamination in a ward environment will reduce the risk of infection.

### Copper alloys

Copper forms alloys readily with many elements to produce a range of materials, each with a unique combination of mechanical properties. The alloy families are brass (copper and zinc), bronze (copper and tin), copper-nickel (copper and nickel) and nickel silver (copper, nickel and zinc). In addition to a unique set of properties, the alloys provide a range of colours, from the reds of the higher copper alloys, through the golds of the brasses, to the silver of the nickel silvers.

Copper and its alloys are easy to form into long-lasting equipment and fittings suitable for service in the healthcare environment. Whole life product costs are comparable with other materials and, at the end of their service life, products are fully recyclable and therefore contribute to sustainable design.

Anyone who has walked around a hospital will be familiar with the knocks and scratches that equipment and fittings bear – the scars of use and abuse. On a microscopic scale, these represent chasms in which infectious pathogenic organisms can lurk and survive. Copper alloys are homogenous, so a product such as a brass door handle is antimicrobial through and through. Serious consideration must therefore be given to fitness for purpose, durability and lifetime of products before considering using any form of copper coating.

### Applications

Door handles are just one example of hospital touch surfaces that could benefit from the hygienic properties of copper. Healthcare professionals can identify the high risk surfaces in a particular ward environment based on their understanding of day to day operations and the behaviour of patients/staff/visitors. Environmental studies show that the greatest contamination tends to be found around patients. The contaminated areas would vary depending on patient mobility, so the copper alloy surfaces required in an ICU might be different to those on a general medical ward. At Selly Oak, some of the high risk surfaces identified by the clinical trial team were: toilet flush handles, toilet seats, cubicle door locks, grab rails, taps, dispensers of all kinds, light switches and pulls, over-bed tables and commode chairs.

It is not just healthcare facilities or indeed only touch surfaces that can benefit from this natural property of copper. Copper kills the pathogens problematic in food processing (eg. *E. coli*) and in air conditioning systems (*Aspergillus niger*). Indeed, any application where hygiene is a critical consideration could benefit from the incorporation of copper.

For any new build project, the cost of procuring and installing copper alloy fittings and equipment will be comparable to standard items. The key consideration here will be aesthetics – whether to opt for a markedly different red/gold look (a highly visible hygienic measure) or to choose the silver coloured alloys that resemble materials currently in use.

To introduce the hygienic advantage of copper alloy components in existing facilities, a multi-disciplinary approach is recommended to define the high risk items for problematic areas, and then assess the potential cost benefit of reducing the risk of cross-contamination.

NHS trusts are starting to consider the implementation of copper alloy surfaces, and the supply chain is gearing up to meet the anticipated demand. So look out for the reappearance of familiar brass door handles at a hospital near you and be reassured (but never complacent – keep using the alcohol hand gel) by their contribution to improved hygiene.



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