Copper Development Association

Copper for Preventing Microbial Environmental Contamination

Press Information

28th October 2008

Contents

Background to antimicrobial copper

Well before micro-organisms were discovered, the Egyptians, Greeks, Romans and Aztecs used copper-based preparations to treat sore throats and skin rashes, as well as for day-to-day hygiene.

Then, in the 19th century, came the discovery of the cause-and-effect relationship between germs and the development of disease, allowing scientists to begin to understand the potential of copper's antimicrobial properties. Today, copper is used in applications ranging from antiseptics and anti-fungal products to medical devices and oral hygiene products by the pharmaceutical industry, as well as in other applications, such as water distribution, ventilation and air conditioning systems.

A solid body of scientific evidence shows that copper has a broad spectrum of antimicrobial efficacy and can inhibit the most important pathogens challenging public health, including Methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile* (two organisms causing hospital-acquired infections), Escherichia coli (E. coli, the 'burger bug'), as well as *Legionella pneumophila* (the bacteria which cause Legionnaires' disease). Copper has also been shown to inactivate Influenza A virus and so could even play a part in reducing the risk of a bird flu epidemic. Some of these laboratory findings are now being put to the test in clinical trials in both the UK and Germany with the first results from the UK showing great promise.

Laboratory research results that led to the Selly Oak trial

Laboratory research findings, in 2006, at the University of Southampton, by a team led by Professor Bill Keevil, on the survival of MRSA on surfaces, confirm that copper may play a key role in combating hospital-acquired infections. Their tests compared survival rates of MRSA deposits in a dry environment on stainless steel (the metal most commonly used in healthcare institutions), with a range of copper alloys.

The results show that, in these tests, the staphylococci are completely deactivated after only 90 minutes on the copper and 4½ hours on brass (an alloy of copper and zinc), whereas they are completely unaffected by stainless steel. This has led Professor Keevil to the important conclusion 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 could thus reduce the risk of cross-contamination between employees and patients in intensive care units'.

Further research has shown that, to achieve a significant antimicrobial effect, copper alloys should have a copper content of more than 65%, meaning that alloys such as bronze and brass would be effective. These alloys have enhanced properties, can be used in different manufacturing processes and also provide a palette of colours. Copper and copper alloy products are homogenous and solid so the antimicrobial effect will last throughout a product's long lifetime, irrespective of how much wear and tear and scratching they sustain. In addition, at the end of their lives, products made from copper and copper alloys are 100% recyclable.

References:
Noyce J O, Michels H and Keevil C W.
Potential use of copper surfaces to reduce survival of epidemic methicillin-resistant *Staphylococcus aureus* in the healthcare environment. Journal of Hospital Infection. 63: 289-97 (2006).

Weaver L et al. Survival of *Clostridium difficile* on copper and steel. Futuristic options for hospital hygiene. Journal of Hospital Infection. 68(2): 145-51 (2008).

Copper – the first material to be registered by US EPA as antimicrobial

The University of Southampton research provided the foundation for a year-long programme of testing, under United States Environmental Protection Agency (EPA) approved protocols, on 3,000 samples of five different copper alloys in independent laboratories in the US.

In March 2008, the EPA announced the registration of copper as an antimicrobial agent to reduce specific harmful bacteria linked to potentially deadly microbial infections resulting in 275 copper alloys acquiring the right to be marketed in the US as antimicrobial. The tests showed that 99.9% of the bacteria on copper alloy surfaces (with 65% or greater copper content) were eliminated within 2 hours of exposure. These materials exhibit a range of properties - mechanical and aesthetic - that make them ideal for use as antimicrobial surfaces, particularly in healthcare and other community facilities, that can become contaminated with bacteria, but also other environments, such as in the food-processing industry. Copper and its alloys are, in fact, the first solid materials to acquire this status. Typically, this type of registration has been granted to liquids (or aerosols) and gases under the categories of sanitisers and disinfectants.

It should be noted, nevertheless, that the use of copper alloy surfaces is additional to - rather than a substitute for - standard infection control practices.

Hospital-acquired infections

These illnesses, caused by pathogens such as MRSA and *Clostridium difficile*, in addition to the very serious risk to the lives of those involved, have a very significant impact on modern healthcare systems:

- Each year, hospital-acquired infections cost the National Health Service in the region of 1 billion pounds
- Infections on average extend hospital stay by 11 days per patient
- At least 5,000 patients die of complications from infections they contracted in hospitals
- Each year, 300,000 patients contract a nosocomial infection.

Reference:
The management and control of hospital-acquired infection in NHS Acute Trusts in England (HC 230 Session 1999-00). National Audit Office, February 2000.

Copper and copper alloy products and manufacturers

CDA is proud to work with its members and partners to facilitate the supply of products to the Selly Oak trial. Products have been phased into the test ward since the launch of the trial in March 2007. For an overview of products currently in the ward, see the website slideshow.

CDA is working with the following partners for the supply of products currently installed or in development:

Product suppliers/service providers

Frank Allart and Co Ltd	Architectural hardware
Allgood plc	Architectural hardware
Armack Chemicals Ltd	Metal finishing
Assa Abloy	Architectural hardware
Avilion Ltd	Taps
Doyle & Tratt Products Ltd	Copper switches
Dudley Industries	Washroom dispensing systems
Herck Metal Europe	Supplier of cold sprayable metal coatings
Huntleigh Technology plc Group	Hospital beds
IBP Conex Ltd	Plumbing fittings
Johnson Diversey UK Ltd	Commercial cleaning/hygiene solutions
Laidlaw Solutions Ltd	Architectural hardware
Metal Fusion Technology Ltd	Fabrication and welding
Nottingham Rehab Supplies	Suppliers of daily living aids
OMC Technologies	Cleanroom furniture
Ormandy Ltd	Coppersmiths/surface cladding
Parker Pens	Pens
SRB Engineering 2000 Ltd	Toolmakers and general engineers
SSK	Electrical switch plates and sockets
Union Architectural Hardware	Locking hardware
Willenhall Tube & Forging Co Ltd	Tube manipulation, machining/welding
Yorkshire Fittings Ltd	Tube fittings and valves

Copper and copper alloy suppliers

Blackheath Tube	Copper and copper alloy tube
B Mason and Sons Ltd	Cold rolled copper alloy strip
Bolton MKM Ltd	Brass extrusions
Cole & Swallow Ltd	Copper alloy tube
Columbia Metals Ltd	Specialist copper alloy stockholders
EIP Metals Ltd	Cold rolled copper alloy strip
Johnson Matthey Metal Joining	Brazing and metal joining
KME UK	Semi-finished copper/copper alloy products
Luvata	Metal fabrication
The Metal Centre	Copper alloy stockholders

About Copper Development Association

Established in 1933, Copper Development Association (CDA) is a membership-based organisation which supports and promotes the use of copper and its family of alloys by providing accurate, reliable, impartial, information to professionals – specifiers, designers, manufacturers, architects, engineers, installers – to end users and to the specifiers and designers of tomorrow, students, to ensure the ongoing correct and efficient use of copper.

The Antimicrobial project aims to exploit copper's natural antimicrobial properties in applications such as healthcare, food processing and HVAC to help protect public health.

CDA has formed the Antimicrobial Copper Interest Group for specifiers, designers, manufacturers, material suppliers and healthcare professionals wishing to develop copper alloy touch surfaces for hospitals to provide an additional weapon in the fight against hospital-acquired infections.

CDA is sponsoring the Copper Clinical Trial at Selly Oak Hospital, Birmingham, through an education grant, to demonstrate the efficacy of copper alloy touch surfaces in reducing contamination in a clinical environment. CDA liaises with other trial groups around the world to share information and expertise.

CDA is part of a global network of 28 Copper Centres with a regional office in Brussels, European Copper Institute, and headquarters in New York, International Copper Association, Ltd.

For more information on Copper Development Association and its various projects, see:
CDA Organisation and Activities.

For more information on antimicrobial copper see:
www.copperinfo.co.uk/antimicrobial.

For further information contact:

Bryony Samuel
Marketing Co-ordinator
Copper Development Association
5 Grovelands Business Centre
Boundary Way
Hemel Hemsptead
HP2 7TE

Email: bryony.samuel@copperdev.co.uk
Telephone: 01442 275705

Typical copper applications

Copper is everywhere in our daily life… although it is not always visible. Here are a few examples of 'hidden' copper:

Underground: tube network, high voltage cables, lighting, gas pipes, water distribution network, etc.

Behind walls: telephone lines, data cabling, electricity network, domestic water pipes, valves and fire sprinkler systems.

Inside household appliances: as wires, transformers, motors, ventilators, switches, refrigeration tubes, air conditioners, printed circuit boards, etc.

Beyond its hidden presence, copper is used in many household objects such as taps, radiators, door handles, furniture, saucepans, etc.

Copper in electrical systems and the energy sector
Copper can improve the efficiency of energy production and distribution systems. Electricity conducted by copper encounters much less resistance compared with any other commonly used metal. This is the reason why copper is found in wires and cables, as well as in generators, motors, transformers, and renewable energy production systems. All household electrical appliances, electronic and telecommunications devices also contain significant quantities of copper.

Copper and its alloys in construction
In France, the use of copper-bearing metals in architecture has increased by 600% in 15 years. Builders, architects and decorators are fond of these metals because of their malleability, their resistance to corrosion, their durability and their aesthetic qualities. They use them in two forms:

- Architectural bronze (brass) shapes used to build façades, curtain walls, canopies, doors and window frames
- Copper sheets for roofs and cladding. Copper is used for roughly 10% of metallic roofing, as well as for façades and as a decorative element.

Finally, as a naturally antibacterial material, copper is often used to ensure the health and safety of water distribution systems and in heating and air-conditioning systems.

Copper in telecommunications and high-tech products
Copper is a key component of new information and communications technologies. Present in computer chips, printed circuits and mobile telephones, copper offers excellent conductivity and heat removal. New technologies have also dramatically improved data transmission speeds, e.g. ADSL, through lines made of copper wire.
Copper is also one of the components of superconductor cables used in nuclear research and contributes to the operation of MRI scanners in hospitals.

Further media resources

High res images:

The following can be downloaded from an ftp server (address below) using:
username: copper, password: cbcopper
ftp://copper@mail.eurocopper.org/EUROCOPPER/CDA/clinical trial/ICAAC Oct 2008

Installed copper products – taps, toilet seat, door handle
Cleaning of taps
Professor Elliott

Video footage

1. ***Trial Results and their Significance – Interview with Professor Tom Elliott (Consultant Microbiologist and Deputy Medical Director, University Hospital Birmingham NHS Foundation Trust)***

Available as high-res broadcast quality from bryony.samuel@copperdev.co.uk
Lo-res version – *4.5 mins, 8.8MB*

Q - Why did you carry out this clinical trial?
We had shown in the laboratory, with colleagues at Aston and Southampton Universities, that copper has antimicrobial properties. We wanted to show that, by putting copper in a clinical environment, it reduces the number of microbiological organisms associated with these devices.

Q - How has the trial been conducted?
We have been planning the trial for a year. We carried out a pilot study where we had a few items made by local manufacturers and had them installed in a ward. The first question we asked was: 'if you put a pair of taps in a sink does that reduce the number of organisms present in this environment?'

We demonstrated that there was a reduction. This meant it was worthwhile continuing with a proper, controlled study to see whether or not copper continues to have this property over a period of time. So we planned a crossover study. This is where you have items made from copper and you compare them with items made from standard products. For example, it could be chrome-plated taps or a push-plate made from plastic or aluminium or a grab rail made from chrome.

We compared copper with non-copper items on a busy medical ward. After a period of time, five weeks, we changed items over. We sampled these items, twice a day. First in the morning, at 7am, before any cleaning had taken place on the ward after the overnight period. Then we sampled again at 6pm to see if there was any change in the organisms on the surfaces.

The samples included taking swabs, in the same way that we swab patients or wounds. We swabbed the surfaces and then we put them in up to seven different culture media to identify any bacteria or fungi which may have been present on the

surfaces. We then counted the number of organisms on the surfaces. We did this over a 10 week period.

The reason we changed things over was to overcome bias. For example, it might be that one sink is used more frequently than another sink or one toilet is used more frequently than another. So, by doing this unique cross-over study, we are able to take this bias out and ensure that if there was an effect we could demonstrate it.

We carried out statistical analysis on the results which included the number of organisms per unit area of the devices. We then asked ourselves: 'Was there any difference and was it significant?' We are telling the Interscience Conference on Antimicrobial Agents and Chemotherapy, the premier conference on infectious diseases and microbiology, [in Washington DC, USA] attended by 10,000 people, that the copper results in a significant reduction in the number of organisms on those surfaces compared to the standard products. This was despite absolutely scrupulous cleaning on the ward. The reason you get organisms on surfaces all the time is because we are touching them. We have environmental contamination. Everybody realises that. But the copper appears to be an intelligent metal so it augments already good cleaning processes. It is the first time I have ever seen the results shown. That environmental contamination is greatly reduced.

Q - What, specifically, have you found?
We have found that 90 to 95 percent of numbers of organisms on our standard items have been reduced in terms of total numbers on the copper. So we are seeing a significant reduction in the total numbers of organisms on the copper items, which is very exciting.

Q - What is the significance of that?
We know that organisms can spread round. Everyone is covered in organisms. Which means that organisms are everywhere, which means they are on surfaces, what we call fomites [any surface that can harbour infectious organisms]. But we also know organisms can spread by hands: hands on to surfaces, then spreading that way. So what it means is if we can keep our environment even cleaner, remembering that in our trial we had enhanced cleaning every two to three hours.

But you still do get contamination occurring because we are covered in organisms and we touch things. What it means is that our environment is even cleaner. What does this means for the patient? What it means is that the risk of picking up an infection is reduced. That is what it must mean. Because we know that is one of the vehicles where organism can spread from one surface to another by touching. So the results are very exciting.

They are more exciting than I thought we would achieve. From the laboratory results, they looked very promising. But, when you put it into the clinical environment, you always wonder whether or not it is going to work.

The findings of a 90 to 95 per cent killing of those organisms, even after a busy day on a medical ward with items being touched by numerous people, is remarkable. So it may well offer us another mechanism for trying to defeat the spread of infection.

Q - Now you have completed this trial, what are the next steps?
We need to do a longer study, and we are planning this for next year, a year's study, when we will look at other items so we will extend it to things like electric switches and drain tubes associated with sinks and grab rails to see whether other areas also have an equal success in reducing the numbers of organisms.

But I would expect that the results will cause a lot of interest in terms of the Department of Health. We know there is some interest already. And they would need to decide how this fits in with a strategy to prevent infection. The Department of Health has been doing a tremendous job in terms of already defeating infections in some areas. We have already seen a significant reduction in MRSA and C diff in the UK. [The question is] is this going to help them further in defeating these organisms?

Q - Given your experience, how significant are these findings?
I have been a consultant microbiologist for several decades and have got some experience in terms of fighting infections. Prevention of infections has been my goal in my career. And this is the first time I have seen anything as much as copper in terms of the effect it will have on the environment. We have talked about different agents in the past, cleaning agents like chlorine and hydrogen peroxide which have an immediate effect but not a long lasting effect like the copper.

We have shown in our study that copper has an effect for months. From our pilot study to the study we have presented in North America, copper has continued to work. Copper is an intelligent metal.

So, from my viewpoint, from my experience and my career in terms of preventing infection, this is a very exciting finding, an unexpected finding, that perhaps copper will give us this advantage in keeping surfaces clean and perhaps challenging infections further.

Q - How would copper fit in with other infection prevention measures?
It's what I would call an intelligent metal. The copper is quietly working away in the background, killing organisms all the time. It needs to be part of what we call bundle of care in terms of an approach to preventing infection. In our trust led by our senior nurse we have what I would say is some of the highest quality infection prevention measures in terms of washing of hands, cleaning surfaces and managing the environment.

This gives us another arm, another weapon to fight infection which is around us and challenging us all the time. So I would see this in addition to the bundle of care we have at the moment.

Q - How does copper actually kill the organisms?
It's not clear at the moment how copper affects organisms. There are various theories on this. The most likely cause for the antimicrobial activity of copper in terms of killing organisms is the release of electron ions. What we think is happening is that the copper is being changed from cuprous to cupric. So there are two different forms and in doing so we have an electron release. And it is proposed

that the activity that comes from the release of that electron is actually killing the organisms.

I would also propose that copper is affecting the membranes of the bacteria. They are all covered with a thick cell wall and within that cell wall is a membrane. I think that membrane activity is being affected by the copper. The membrane is important to the organisms because it is controlling food coming in and waste going out. If the copper is affecting the enzymes what it is doing is preventing the organisms from feeding, having nutrition and therefore killing them. So I think that is overwhelming the membrane as well.

Q - Is it safe for us to have copper in the ward?
We know that people wear copper bracelets for trying to prevent arthritis or the effects of arthritis developing and they don't get a reaction. We know that people put copper on their skins and there is no reaction. We know that having copper in the clinical area has not resulted in any reaction. The other main thing is that we have copper coins in our pockets and we handle copper every day. The fact is there are copper and brass items in our environment daily and we don't get reactions to it. It seems to be killing mainly the bacteria and fungal cells, which is very exciting.

2. ***Copper Products – Practical Aspects - Interview with Mark Tur, Technical Consultant, Copper Development Association***

Available as high-res broadcast quality from bryony.samuel@copperdev.co.uk
Lo-res version *– 4.5 mins, 10.8MB*

Q - Why the interest in antimicrobial copper now?
Once we started looking into it we found that we had forgotten what we knew 6,000 years ago – copper kills bugs – and the application of it through the science has just given us that extra foundation that we need these days to make a proper assessment of copper.

Q - What is CDA's reaction to the news of the results?
The Phase 2 work which has only recently been presented in America shows that we are now achieving over a much longer time period, and better statistics therefore, results that show differences of 95% plus – that's phenomenal. As one of our healthcare partners mentioned in a recent meeting, those are very startling results so we are very very encouraged and Phase 3 will be a much longer term reinforcement stage of that work.

Q - Which items have been replaced with copper and how easy has it been to make them?
Copper has got a great attribute, that is apart from the fact that it kills bugs. It has great fabricity and that means you can make it into all sorts of things. You can turn it into a tap, you can bend it, you can do all sorts of wonderful shaping things with it – it's very easy to work with - it's a manufacturers dream in many ways, so many of the items you see here, for example, are already being made in copper in different applications. Many of them, like the taps here, would have been made in copper traditionally for 200 years and then chromium plated, so we are covering

up the active surface and we want to go back to that. And it really is the surfaces that we are talking about, the touch surfaces in particular, the door handles, push plates on doors, toilet flushes on loos, toilet seats, we can imagine things like that being changed. We are working very closely with our partners to replace many of the standard touch surface items.

Q - When you talk about copper items do you mean made from pure copper?
I would say that, whilst we use the term copper, and we refer to this as our copper ward, we are actually referring to that as a matter of shorthand. We are using a lot of alloys here, like brasses, bronzes, different materials. Brass is a mixture of copper and zinc. Bronze, that you might see statues made out of, is actually copper and tin, and then there are other more complicated alloys in the whole family of the copper sequence. From a metallurgist's point of view it is a material that is wonderful to work with, because it alloys very well with different types of material, different elements, makes them stronger, gives them very special properties.

Q – The copper items look quite different to the conventional items – will this be a problem?
Some people do say that the copper alloy products look different and they do look different. These have been up here for over a year and they have some tarnish on them, some oxidation. We are not bothered about that because, if anything, our science has proved that the oxidation actually accelerates the efficacy against these pathogens. It actually improves the way that copper can tackle these bugs. We are not worried about that. I think there's a cultural issue here, people will have to get used to being faced with something a little bit different.

Q – How does the cost of copper items compare to the conventional items they have replaced?
It is cost-effective. The installed cost of these components is comparable to what you would call standard items on the ward – the plastics, the stainless steels, the aluminiums.

Q – How important is this trial to the copper industry?
This is a fundamental step for the copper industry. This is the first set of trials that are reporting just now. We've got trials going on in South Africa, Japan, the USA, Germany but this is the first and this will be the one that makes people sit up and take notice. Over the next years as the healthcare personnel talk to the manufacturing personnel they will develop new applications so it is a real major step for a new application area for copper.

Q – Who has provided the copper components?
We decided we needed to with small local firms because they provided the flexibility and the enthusiasm to work with us. They are currently making all these items now but they might be making them either in a different material or doing some additional work to them and we just have to control the manufacturing a little bit more closely for this environment. We expect that, as the demand for these products rolls out, they will be the first to benefit.

3. ***Manufacturing brass products – Avilion Ltd (manufacturer of taps and showers)***

Available as high-res broadcast quality from bryony.samuel@copperdev.co.uk
Lo-res version *– 5 mins, 10.6MB*

ICAAC Poster

Copper for Preventing Microbial Environmental Contamination, A L Casey,[1] P A Lambert,[2] L Miruszenko,[1] T S J Elliott.[1]

[1] University Hospital Birmingham NHS Foundation Trust, Birmingham, UK
[2] Aston University, Birmingham, UK

About ICAAC

48th Annual ICAAC/IDSA 46th Annual Meeting, Washington, DC, October 25-28, 2008.

Held annually in the fall, the Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC) is the world's premier meeting on infectious diseases and antimicrobial agents, organised by the American Society for Microbiology. More than 10,000 scientists from around the world participate in ICAAC to exchange information and foster global solutions to the challenges of HIV/AIDS, anthrax, smallpox, SARS, and other topics including bioterrorism preparedness, recognition, detections, and medical treatments. ICAAC meets educational needs by providing timely information to improve healthcare and the management of infectious diseases.

Contacts for arranging interviews

Professor Tom Elliott (Clinical Trial Leader) Consultant Microbiologist and Deputy Medical Director University Hospital Birmingham NHS Foundation Trust Contact via: Andy Comber Head of Communications University Hospital Birmingham NHS Foundation Trust Email: Andy.Comber@uhb.nhs.uk Direct line: 0121 6271627 Ext 51612 Fax: 0121 2041512	**Professor Bill Keevil** (Clinical Trial Partner) Director of the Environmental Healthcare Unit, School of Biological Sciences University of Southampton Contact via: Sue Wilson Media Relations Officer University of Southampton Email: S.J.E.Wilson@soton.ac.uk Direct line: 02380 595457
Professor Peter Lambert (Clinical Trial Partner) Professor of Microbiology School of Life and Health Sciences Aston University Contact via: Sally Finn Press Officer Aston University Email: s.l.finn1@aston.ac.uk Direct line: 0121 2044552	