**Antimicrobial Copper: Properties and Benefits for Healthcare Facilities and Other Buildings**

***Hundreds of copper alloys provide effective protection against infections spread by bacteria on ‘high-touch’ surfaces***

In the battle against the spread of several common forms of harmful bacteria, those responsible for the wellbeing of people in hospitals, schools and other buildings should welcome a new ally: copper. Copper first played a health-enhancing role in ancient times, when people used the metal to clean wounds and treat illnesses. In the 19th century, scientists began to grasp the potential of copper’s antimicrobial properties following the discovery of microbes and their role in spreading infection and disease.

Recently, these properties were officially recognized by the U.S. government, which certified that hundreds of copper alloys can quickly kill a number of microbes that regularly infect people in healthcare facilities and other public, commercial and residential buildings. As a result, a variety of products made of these alloys will soon be available to reduce the spread of harmful bacteria by touch in many different applications.

This paper takes a detailed look at the need for antimicrobial copper alloys, how they work and the specific benefits they offer when used to make frequently touched objects such as push-plate wall switches from Larco, which allow handicapped people to open automatic doors. While copper alloys do not eliminate the need for cleaning and disinfecting, the paper shows how they can provide effective secondary protection from infection-causing bacteria, reducing human suffering and related financial costs in hospitals and elsewhere.

**Infection-causing bacteria**

Despite scientific advances that have resulted in a better understanding of the microbes that cause hospital-acquired infections, statistics from the U.S. Centers for Disease Control and Prevention (CDC) show a sharp increase in the number of these infections during the past two decades. Each year, hospital-acquired infections cause hundreds of deaths and add billions of dollars to U.S. healthcare costs.

One of the main causes of hospital-acquired infections is Methicillin-Resistant *Staphylococcus aureus* (MRSA), an antibiotic-resistant bacteria strain. Difficult to treat and potentially deadly, MRSA infections are a growing medical problem, with cases increasing by more than 90% in the last decade, according to researchers at Princeton University. Each year, MRSA infections cost the healthcare industry billions of dollars and claim more lives than HIV/AIDS, Parkinson’s disease, emphysema or homicides.

In addition to hospitals, facilities such as nursing homes, rehabilitation centers and dental offices are breeding grounds for MRSA and other dangerous bacteria. But the danger isn’t limited to healthcare facilities. For example, MRSA has become a major concern in U.S. schools, resulting in school closures, serious illnesses and even deaths. In fact, MRSA and other dangerous bacteria can be a threat in many types of public, commercial and residential buildings.

**Problems posed by contaminated surfaces**

When buildings house these pathogens, they are often found on so-called “high-touch” surfaces—i.e., surfaces frequently touched by building occupants. High-touch surfaces include door handles and knobs, light switches, counters, tabletops and bed rails. A number of studies have looked at how contact with contaminated surfaces such as these can result in transmission of infection-causing bacteria.

To reduce this danger, the CDC recommends the appropriate use of cleaners and disinfectants in its “Guidelines for Environmental Infection Control in Health-Care Facilities” (2003). The guidelines call for more frequent cleaning and disinfecting of high-touch surfaces than of other surfaces that are touched less often and therefore pose less of a danger.

The CDC guidelines and other sources of information have increased awareness among hospital personnel of the role contaminated surfaces play in the transmission of infection-causing bacteria, as well as what needs to be done about it. Judging by the large number of hospital-acquired infections, however, it appears that hygienic practices are still deficient in many hospitals. This conclusion is confirmed by recent studies showing that hospitals often do not adequately clean high-touch surfaces. For example, in a 2008 study entitled “Identifying opportunities to enhance environmental cleaning in 23 acute care hospitals,” Phillip Carling, director of infectious diseases and epidemiology at Caritas Carney Hospital in Boston, and two colleagues “identified significant opportunities in all participating hospitals to improve the cleaning of frequently touched objects in the patient’s immediate environment.”

Even excellent hygienic practices, however, may not be enough to protect people from microbes that are becoming resistant and even immune to disinfectants. For example, researchers in Ireland noted that *Pseudomondas aeruginosa*, a bacteria strain that causes a variety of infections in people with weakened immune systems, somehow managed to survive the addition of increasing amounts of disinfectant to certain bacteria cultures.

Adding to difficulties of dealing with infection-causing bacteria are financial considerations. In 2008, for example, the U.S. government announced that Medicare will not cover costs related to preventable hospital-acquired infections.

**Copper’s special properties**

Faced with a daunting combination of health-related concerns and budgetary pressures, hospital administrators are looking for practical options for reducing the threat posed by dangerous microbes. Such an option is now available thanks to the unusual properties of copper. Research has shown that copper alloys are intrinsically antimicrobial, allowing them to provide protection from harmful bacteria that does not wear off and cannot be removed from a surface. What’s more, no research shows pathogens developing resistance or immunity to the antimicrobial effects of copper alloys.

The copper in certain enzymes actually helps microbes produce important chemical reactions. Copper’s antimicrobial characteristics stem from excess amounts of the metal. Researchers believe elevated copper levels inside a cell cause oxidative stress and damage to the cell. In addition, it is thought that excess copper can cause a decline in the membrane integrity of microbes, leading to leakage of essential nutrients that results in cell death. Scientists also think excess copper can bind to proteins that have no need of the material, causing a loss of protein function and/or breakdown of the organisms into nonfunctional parts.

In early 2008, after years of independent laboratory tests and additional testing under its own protocols, the U.S. Environmental Protection Agency registered 275 copper alloys as antimicrobial materials. This action represents a legal decision by the U.S. government acknowledging that uncoated versions of the named copper alloys kill 99.9% of several types of disease-causing bacteria within two hours when surfaces are cleaned regularly to remove dirt that may impede contact with the copper. The bacteria strains mentioned in the EPA registration are the following:

* **Methicillin-Resistant *Staphylococcus aureus***. Figure 1 shows the survival of MRSA on copper and stainless steel.
* ***Staphylococcus aureus***. Infections from this bacterium, including life-threatening illnesses such as pneumonia and meningitis, are common in healthcare facilities.
* ***E. coli* O157:H7**. A pathogen responsible for many food recalls, this microbe can cause severe stomach cramps, vomiting and kidney failure. The effects of EPA-registered copper alloys on *E. coli* O157:H7 are shown in Figure 2.
* ***Enterobacter aerogenes***. Commonly found in hospitals, this bacterium causes infections that often prove fatal. The effects of EPA-registered copper alloys on *Enterobacter aerogenes* are shown in Figure 3.
* ***Pseudomonas aeruginosa***. This microbe often infects vulnerable people in hospital settings, with potentially deadly results.

Can the performance of antimicrobial copper alloys be impacted by the disinfectants and sanitizers commonly used in healthcare facilities? The effect of these types of products has been studied by the U.S. Copper Development Association and others. When the products are used according to manufacturer’s instructions, it was found that none of them adversely affects the performance of EPA-registered alloys.

**Antimicrobial copper in use**

Antimicrobial copper can be used to produce so-called “hygienic surfaces” that kill and inhibit the growth of certain dangerous organisms. These surfaces can serve as an extra line of defense against harmful bacteria in healthcare facilities, schools and commercial and residential buildings.

A list of potential uses for antimicrobial copper alloys is presented in the nearby table. The alloys come in sheets that can be fabricated into doorknobs, countertops, handrails, wall switch plates and other high-touch objects. In healthcare buildings, doorknobs, door handles and push plates are among the easiest components to convert to copper alloys in both retrofit situations and new construction. Another option is covering existing high-touch objects with snap-on copper alloy sheathings or slipcovers to provide protection from dangerous microbes.

Facility managers, product specifiers, contract cleaning personnel and others interested in antimicrobial copper must bear in mind that it is meant to be a *supplement* to conventional infection-control practices, not a *substitute* for them. This means that even after products made of EPA-registered copper alloys are installed, facilities must continue to follow standard procedures and guidelines for the regular cleaning and disinfecting of high-touch surfaces.

**Conclusion**

When used in place of stainless steel and other materials commonly used to make high-touch surfaces, antimicrobial copper alloys can serve as an effective extra line of defense against dangerous bacteria. The alloys provide continuous protection between routine cleaning and disinfecting of surfaces in healthcare settings and elsewhere. Once the special properties of registered copper alloys become generally known, as well as the resulting benefits and the many possible uses for these alloys, antimicrobial copper surfaces are likely to become common features in a wide range of buildings in the U.S. and around the world.

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Art Ideas

1) Figure 1 shows the survival of MRSA on copper and stainless steel. “Antimicrobial Efficacy,” p.2

2) Figure 2 shows that registered copper alloy surfaces kill 99.9% of *E. coli* O157:H7 within two hours, while stainless steel surfaces have virtually no effect on *E. coli* O157:H7 after six hours. “Antimicrobial Efficacy,” p.2

3) As shown in Figure 3, more than 99.9% of *Enterobacter aerogenes* is killed within two hours on copper and brass surfaces, while a stainless steel surface has very little impact on the microbe. “Antimicrobial Efficacy,” p.3

4) A list of potential uses for antimicrobial copper alloys is presented in the table. Big paper, p.107