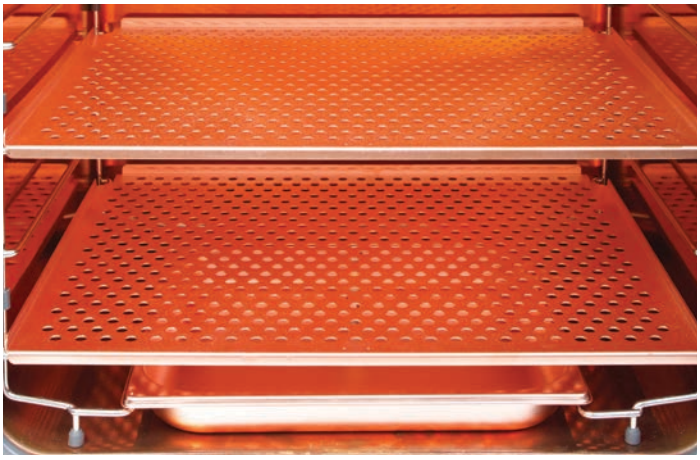
Copper Options for CellXpert® CO_2 Incubators – Considerations for Contamination Prevention

Introduction

Stainless steel, which is commonly used for the interior of standard CO_2 incubators, is widely known for its availability, durability, corrosion resistance and compatibility with standard disinfectants. The utilization of copper, on the other hand, has been popular for decades, due to its antimicrobial properties. Therefore, optional copper interior parts are also available for the CellXpert CO_2 incubators, as a part of the strategic contamination prevention concept that includes a fanless design, a seamless chamber, fewer internal parts, a removable water tray, and heating of all chamber walls and the window to avoid condensation.

Here, we explain why opting for an optional copper water tray and shelves instead of a full copper chamber is a good choice. We also look into the relevance of copper alloys provided by other manufacturers for CO_2 incubator interior as an alternative to copper.

Copper water tray and shelves vs. full copper chambers
As microorganisms require moisture to propagate, the water tray inside a CO_2 incubator constitutes the greatest risk factor for contamination. The shelves represent an additional possible contamination source in case liquid or spilled media resides at the outer vessel wall, potentially enabling microbial growth. Copper's antimicrobial properties are effective only with direct contact, causing bacterial death either by membrane degradation or genotoxicity [1]. Implementing a copper water tray and shelves should therefore be sufficient to increase contamination protection. Given the high investment costs and use of natural resources, a copper chamber is only recommended for the following cases.



1) Risk of condensation
Modern CO_2 incubators like the CellXpert come with tight door seals, heating of all chamber walls and the door to ensure a temperature above the dew point, and good insulation. The risk for relevant condensation formation in these incubators at standard ambient temperature and humidity is neglectable. If for technical reasons condensation at the chamber walls may be a risk in other incubators, a copper chamber can provide additional protection.

2) Fan-assisted CO_2 incubators
Fan-assisted CO_2 incubators require higher maintenance efforts due to complex additional internal parts (e.g., fan, fan duct, duct parts, cover sheets). These additional parts often create niches and cracks, which offer perfect conditions for contaminants to thrive if hidden behind covers. Finally, a fan-assisted CO_2 incubator can support the spread of airborne contaminants and are usually not recommended, even if a HEPA-filter is in use [2]. To compensate for this higher contamination risk and impeded cleanability, a copper chamber option can provide additional protection.

The CellXpert is a fanless CO_2 incubator with advanced contamination protection and excellent cleanability (Video) making a copper chamber expendable.

Copper vs. copper alloy

Due to the warm, moist, and slightly acidic atmosphere the copper interior tends to corrode and build a green patina over time. Although this discoloration looks unappealing, the patina on the copper surface enhances its antimicrobial effectiveness compared to polished copper (see details in this white paper). From a financial aspect, the invest into a copper CO_2 incubator tends to be higher than a stainless-steel version. For these reasons some CO_2 incubator manufacturers have introduced copper alloys as an alternative stating that it combines the good properties of copper and stainless steel. For an alloy to be antimicrobial, it typically needs to contain at least 60 % copper. However, our external analysis reveals that some CO_2 incubator alloys contain less than 5 % copper, which can significantly reduce their antimicrobial effectiveness as shown for Methicillin-Resistant Staphylococcus aureus, when a 55 % copper alloy was compared to 99 % [3] (see details in this white paper).

Therefore, we recommend asking the manufacturer for the copper content of the material, when considering buying a copper alloy CO_2 incubator, and ensure the material is listed by the EPA (US Environmental Protection Agency, 4) as a medically effective copper alloy.

The water tray and shelves of the CellXpert are galvanized with 100 % copper for permanent antimicrobial effectiveness (see details in this white paper).

There is some concern that copper ions from a full copper interior could be released into the chamber atmosphere and negatively affect cell cultures. However, this effect is not well-documented and would likely also apply to other metals like chromium or nickel found in stainless steel.

References

[1] Vincent, M. et al. (2018). Contact killing and antimicrobial properties of copper. Journal of Applied Microbiology. 124(5):1032-1046. https://doi.org/10.1111/jam.13681

[2] Geraghty, R.J. et al. (2014). Guidelines for the use of cell lines in biomedical research. British Journal of Cancer. 111(6):1021-46. https://doi.org/10.1038/bjc.2014.166

[3] Michels, H.T. et al (2005). Copper alloys for human infection disease control. Poster at the Materials Science and Teaching Conference, Copper for the 21st Century Symposium, September 25-28, Pittsburgh, PA, US.

[4] U.S. Environmental Protection Agency. EPA registers copper-containing alloy products, Pesticides: Topical & Chemical Fact. Sheets; 2008. https://www.copperalloystewardship.com/.

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