

Health-friendly Hygiene With Silver Ions

Using Silver to Control Bacteria

The antimicrobial effects of silver have been well-known for centuries. Its effectiveness against algae, fungi or bacteria can be attributed to silver ions, which are released by silver when in contact with water. Silver ions are effective in combating bacteria even in weak concentrations, while remaining nontoxic to people. The reason for this is that silver ions are quickly bonded by sulfides in the organism. Sulfides are removed from the material cycle, for instance, as a dark, almost insoluble silver sulfide. Even in the environment, free silver ions bond to sulfides or chlorides. That's why free silver ions do not pose a health risk to people nor to the environment in the dose levels that are used normally.

Uses of Silver

Due to the proven antimicrobial properties of silver ions, silver has been used for decades in industrial and medical areas, ensuring a consistent hygiene in such areas. For instance, refrigerators are protected against bacteria and fungi thanks to surface coatings, and odor formation in clothing due to sweat is prevented by embedding silver particles in the fibers of the material. Silver is also implemented as a disinfectant and therapeutic agent for treating wounds. In such cases, it is not even possible to imagine bandages or dressings without a colloidal silver coating. Moreover, the use of silver ions is one of the most common drinking water disinfection methods available nowadays for controlling a microbial attack.

Silver in Humidification

Air humidifiers can contribute to the proliferation of microorganisms and therefore deserve particular attention from a hygienic standpoint. In such cases, silver can be used to reliably and effectively eliminate these germs. The "HygienePlus" approach implemented in the Condair DL adiabatic air humidifier is based on the tried and tested silver ionization principle and is registered under a patent. The process' effectiveness is verified in a declaration of conformity for hygiene as pursuant to VDI 6022 and a certificate of hygiene from the SGS Institut Fresenius (D). The use of silver ion in the Condair DL is guaranteed to be risk-free for the following reasons:

- Electronically regulated silver-ionization by means of electrolysis from metallic silver – a process that is registered in Germany with BAUA in accordance with the European Biocidal Product Directive 98/8/EC (BPD). (Reg. No. N-42889)
- The silver ions are applied exclusively to the humidification water.
- For wastewater there is a limit <0.1 mg silver/L (Swiss and German Water Protection Ordinance). That relates to discharge to public sewage systems. The mean values substantiated by Fresenius-Institut directly at the outlet of the Condair DL are already 50% less than the limit. Normally, this concentration is reduced even further by the wastewater volume of the entire unit. Silver has no impact on the purification capacity of sewage treatment plants, taking into account the conversion of silver in the wastewater into inactive silver sulfide. (see page 2)
- The silver concentration in the humidified air, tested by SGS Institut Fresenius according to VDI 3864, is <0.01 mg/m³ and thus falls significantly short of the industry standard recommendations.
- Nanosilver is not implemented.

Conclusion

The targeted use of silver ions as a hygiene measure in Condair DL air humidifiers has no negative impact on health or the environment.

Incidence of Silver in Dripping Water

UMTEC was commissioned by Walter Meier AG (Klima International), 8808 Pfäffikon/Switzerland, to examine the dripping water of the ceramic filter plates, which are used in air humidifiers, for silver. The water sample came from a test system operated by Walter Meier AG. The plates were previously subjected to a humid air stream continuously for more than 5,000 hours. The humid air contained silver, which was released by electrolysis. A sample of dripping water was then collected from under the ceramic plates.

The silver on the plates was then analyzed chemically (ICP-MS) and by means of a scanning electron microscope (SEM). The water sample was filtered on a SEM carrier for the electron microscopy and then examined at different resolutions.

Results

0.031 mg/L of silver were verified in the water sample.

The SEM also revealed silver crystals, which have been known as "silver dendrites" for many years (Fig. 1). These crystals are not regarded as nanosilver. The formation is associated with electrolysis and is most probably encouraged by the vaporization taking place at the filter plates.

Conclusion

The Swiss Water Protection Ordinance defines <0.1 mg/L of silver as the lowest limit for wastewater dischargers. This limit applies only to industrial sectors and not to domestic wastewater. Consequently, silver-containing dripping water can be discharged without any second thoughts and is insignificant for sewage treatment plants in light of the low water quantities. The estimated average load is negligible and has no impact on the purification capacity of municipal sewage treatment plants (nitrification). Moreover, the silver is effectively bonded in the sewage sludge¹. In addition to that, no heavy metals were identified in the dripping water.

¹ Zuleeg, S., M. Burkhardt, M. Boller, R. Kägi, B. Sinnet, J. Eugster and H. Siegrist (2010): Characterization and Balancing of Silver Particles in Sewage Treatment Plants. Report, Eawag, Dübendorf, 29 S.

(www.bafu.admin.ch/chemikalien/01389/01391/index.html?lang=de#sprungmarke0_34)

Figure 1: Incidence of silver crystals in dripping water from ceramic plates, verified using a scanning electron microscopy (SEM). The dark spots represent silver, while the light spots are organic or anorganic dust particles.

