

# New surface treatment techniques to minimize copper alloy leaching in drinking water

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## Summary

Recently, water quality requirements have become strict worldwide due to the enhancement of regulations on drinking water imposed by WHO. In order to secure the safety of tap water, requirements regarding water pollutants specified by standards are becoming stricter, and more and more substances in water are being regulated. Requirements for stricter water quality criteria and an increased number of controlled substances are global issues that will continue to be relevant in the future. Water supply equipment is mainly made of copper alloys such as bronze and brass, some of which are Ni-Cr plated. Although the materials used in the equipment will remain unchanged, surface treatment is needed to satisfy the latest leaching values for copper, zinc, lead, cadmium and nickel required by the market. In this report, we introduce new methods developed to minimize the leaching values for copper alloys used in water supply equipment.

## Keywords

coating on the surface, copper alloy, surface treatment, water supply equipment

## 1. Introduction

Water is essential for human beings to survive. Nevertheless, many people around the world still die from unsafe drinking water. Therefore, in order to protect our health from risk of infectious diseases and mineral poisoning, ingestion of clean tap water is absolutely necessary. In 1985, WHO (World Health Organization) promulgated Guidelines for Drinking-Water Quality and now many countries regulate their water quality standards in compliance with the WHO guidelines. Despite this, highly infectious diseases that spread world wide in a short time, such as SARS (in 2003) and the new influenza virus (in 2009), show no sign of eradication. Promotion and widespread use of safe and clean tap water should be accelerated worldwide as a first step to protect human health.

Recently, the requirements for water quality in each country are becoming stricter worldwide due to the enhancement of regulations on drinking water imposed by WHO. Therefore, copper alloy cannot be applied as the same way as in the past. In Japan, new materials such as lead-free copper alloy, cadmium-free copper alloy and stainless steel are beginning to be used as an alternative, but they are expensive and minor metals have to be used. So, by adopting new surface treatment techniques and taking full advantage of minor metal-free copper alloy, we have succeeded in manufacturing water supply equipment conforming to the WHO guidelines for drinking water [1].

## 2. WHO Guidelines and Regulation Standards in Japan and USA

Various elements that affect human health are covered in the Guidelines for Drinking-Water Quality by WHO. Some representative elements, mainly related to copper alloy, and their regulation standard values in WHO guidelines, Japan, and USA are shown in Table 1 [2] [3].

**Table 1** Copper Alloy-Related Chemical Element Standards in Drinking Water in WHO, Japan and USA (mg/L)

|                              | Cu  | Zn  | Pb    | Cd    | Ni   | Fe  | Al  |
|------------------------------|-----|-----|-------|-------|------|-----|-----|
| WHO (Guideline values)       | 2.0 | —   | 0.01  | 0.003 | 0.07 | —   | —   |
| Japan (Regulation standards) | 1.0 | 1.0 | 0.01  | 0.003 | —    | 0.3 | 0.2 |
| USA (Regulation standards)   | 1.3 | 3.0 | 0.005 | 0.005 | 0.1  | —   | 2.0 |

## 3. Evaluation of KITZ Surface Treatment Techniques

The leaching source of copper alloy materials is the contact surface of the water supply equipments. We apply two types of surface treatment techniques; mixed acid washing treatment and surface coating

treatment. For mixed acid washing treatment, a mixed solution of nitric acid and hydrochloric acid is applied to effectively prevent lead, aluminum, iron and nickel compounds from leaching. As for the surface coating treatment, a film made from heterocyclic compound and organic acid prevents contact with water and leaching of copper, zinc, cadmium and nickel on the nickel-plated surface. The process flow in which these two types of treatment are combined is shown in Fig.1 and Fig. 2

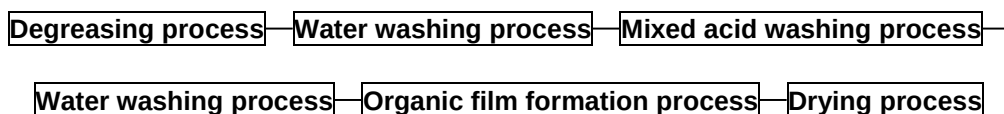


Fig 1 Surface treatment process



Fig.2 Our surface treatment process in Thailand

#### 4. Conclusion

These surface treatments are simple and easy as well as low in cost. The processes can even be performed by hand. Pharmaceutical raw materials used for the surface treatments, such as hydrochloric acid and nitric acid used in a mixed acid washing process and vegetable oil used in a film forming process, are easily obtained in many countries.

Tap water should not be a luxury item, as it is absolutely essential for everyday human life. Everyone in the world is entitled to safe and clean tap water. Our surface treatment techniques to minimize copper alloy leaching are strongly suggested in order to realize a world in which all people can use tap water free from anxiety.

#### 5. Reference

- [1] WHO Guidelines for Drinking-water Quality First addendum to third edition
- [2] Ministry of Health, Labour and Welfare  
[http://www.mhlw.go.jp/english/policy/health/water\\_supply/4.html](http://www.mhlw.go.jp/english/policy/health/water_supply/4.html) (accessed 9 June 2011)
- [3] NSF/ANSI 61 Drinking water system components health effects