

Abstract

Background information

Copper, as a versatile and noble metal, occupies a nearly irreplaceable place in modern society. It is hard to lead a life without copper. Unfortunately, no matter how inert copper is, it can still be corroded. Acid leaks from worn-out copper pipes are reported from time to time. Recently, an old lady allegedly poured 23 bottles of fuming hydrochloric acid into the drain, cracking the copper pipe, leading to acid shower which burned several passer-bys. Together with the unpleasant sight of green stains emerging from copper water outlets in urinals, our interest was aroused to investigate:

- action of three types of commonly available commercial drain pipe cleaners (ammonia, caustic soda and fuming hydrochloric acid) on copper pipes and its alloys
- corrosion resistance of copper and its alloys against ammonia in conditions of a urinal.

Strategy of investigation

The main idea of the whole investigation is corrosion resistance of copper and its alloys against different commercial drain pipes cleaners.

Before the preparation and analysis on copper-cleaner reaction mixture begin, the strength of the above cleaners must be gauged so that an estimation of extent of corrosion can be done. This is achieved by qualitative analysis on concentration of effective ingredients of each cleaner by acid-base titration.

Copper and alloy pipes are immersed in the three kinds of cleaners separately for a week. As corrosion of copper in these cases is complex and quite a number of products are formed, different strategies are manipulated to convert all other copper species to tetraaquacopper (II), which then oxidises excess potassium iodide to brown iodine. Followed by is the titration of iodine formed against sodium thiosulphate, which reduces brown iodine to colourless iodide, to determine the concentration of tetraaquacopper (II).

Findings of the investigation

Comparing different alloys immersed in the same kind of cleaner:

- brass has the lowest corrosion resistance while nickel-plated copper has the highest corrosion resistance in fuming hydrochloric acid;
- pure copper has the highest corrosion resistance while nickel-plated copper has the lowest corrosion resistance in alkaline drain cleaner such as caustic soda;
- nickel-plated copper has the highest corrosion resistance while brass has the lowest corrosion resistance in ammonia solution and ammonia formed from bacterial hydrolysis of urea in urine.

Comparing different kinds of cleaner immersed in the same alloy or metal:

- Caustic soda causes the least corrosion, followed by ammonia and lastly fuming hydrochloric acid.