

Copper level investigation in drinking fountain bubbler water in Macquarie campus

Introduction

Copper and copper compound are found in the environment in a variety of forms. Copper was exposed through the food eating, the water drinking and the air breathing. Basically, there is direct contact of skin copper in the water, soil and other copper containing materials. Copper compounds are formed when copper joins with other chemicals. The source of Copper compounds is also found in water, air and soil. Large amount of copper can be found in drinking water because of plumbing material that the copper pass through it. The main factors that reinforce high copper concentration in water are corrosion of copper pipes. Variation of PH, hardness, dissolved oxygen, the presence of oxidizing and complexion agent, and stagnation time in the pipes. The tendency of water to be corrosive is controlled principally by monitoring or adjusting the pH, buffer intensity, alkalinity, and concentrations of calcium, magnesium, phosphates, and silicates in the water. Actions by a water system to address these factors can lead to reduced corrosion by reducing the potential for the metal surface to be under the influence of an electrochemical potential. According to the Quarterly Drinking Water Quality Report on 01/01/2011 to 31/03/2011 for water in Sydney New, south Wales, Australia, from Sydney Water, mineral elements can enter the water from the catchment system. Therefore, when the corrosive water is retained in the system and sits motionless for about six hours, copper levels rise to 1 mg/L which become dangerous. Additionally, drinking water is contaminated with copper if the source water is contaminated. However, the water in Sydney was controlled for pH, hardness, temperature and even the flow of water in the main meters. Metal pipe corrosion is a continuous and variable process of ion release from the pipe into the water. Under certain environmental conditions, metal pipes can become corroded based on the properties of the pipe, the water properties, and stray electric currents. When metal pipe corrosion occurs, it is a result of the electrochemical electron exchange resulting from the differential galvanic properties between metals, the ionic influences of solutions, aquatic buffering, or the solution pH. For corrosion of metal water pipes to occur, an electrochemical cell must be present. An electrochemical cell can be thought of as a battery, with an electric current between a positive potential (anode) and a negative potential (cathode). The corrosive electrical potential is typically created by differences in the types of chemicals in the surface of the metal pipe. All metals have slightly different properties, and galvanic differences are the tendency of one metal to release electrons to another metal. The galvanic series of metals is the hierarchy of which metals will release their electrons to other metals. Metals lower in the galvanic series more negatively charged will sacrifice their electrons to metals higher in the series. An example that many people are familiar with is zinc galvanizing of steel, where the zinc surface coating protects the steel from rusting. The galvanic interaction of different metals has a significant role in pipe corrosion, because many commercial metals are alloys of various metals. Therefore, the interior or exterior surfaces of the pipe can provide locations for an electrochemical cell which can start the process of pipe corrosion.

However, copper is necessary for a good health. In fact copper is an essential nutrient that the human body needs in small amounts. Normally, the level of consuming is about 1000 micrograms of copper daily. Drinking water supply nearly 15 ug of copper to the body. However, copper levels should not exceed 1300 ug/L in drinking water; otherwise, adverse health effect would be seen if this level is exceeded. Copper can create several complications at high levels. Shorter periods of exposure to high levels can cause nausea, vomiting, stomach cramps, diarrhea, and gastrointestinal disturbances. Prolonged exposure can cause kidney or liver damage. Therefore, since excess copper can cause health risks and people are likely to be exposed to copper-contaminated water, monitoring the amount of copper in drinking water is essential. In addition to health concerns, copper can also cause some general quality and acceptability concerns, specifically; water with a high amount of copper may have a metallic taste. Moreover, this type of water can leave blue-green stains on plumbing material and sinks. However, the only way to verify the level of copper in drinking water is to try it. Specifically, water must be tested in a certified laboratory to determine the exact copper level. Public water system that serve a majority of the population must conduct copper sampling to ensure that copper levels do not exceed the specified limit. Considering the risk associated with copper contamination and the increased amount of copper that is often found in drinking water, most drinking water is checked frequently to ensure that it is safe to drink. Nevertheless, issues with contaminated water due occur.

Method

Pre-analytical experiment:

Basically, understanding the mechanism that lead to concentrated levels of copper in water is essential when developing in effective sample collection plan. The main water supply comes from Sydney through Epping road into the main meter on campus, which located close to W1 parking (see Figure 2 – campus map). there is secondary meter close to university housing. In the main meter, the copper concentration is maintained at less than 0.2 mg/L by Sydney water group or quality assurance department in the university. Since the main meter is routinely tested by quality assurance department in the university. The water distributed in all building through concrete pipes. There is copper pipes network inside all building. This study evaluates copper levels and copper elevated in the drinking water from campus fountain bubblers. Macquarie university campus contains 70 drinking fountain bubblers located in 22 buildings (Figure.2). 29 of them are refrigerated and units in kitchen. Forty one are as town water. Five of them are located in the basement floor and represented as (0). The rests are located inside buildings; 24 are on the first (ground) floor and are represented as (1). Sixteen are located on the second floor and represented as (2), while eleven are on the third floor and represented as (3). five are located on the fourth floor and represented as (4), three are on five floor represent as(5), two units in six, seven and eight floor and represent respectively as (6,7,8,), and three are on the ninth floor and represented as (9). The sample collection was designed to provide samples that

would enable studying the amount of copper present in motionless water. Therefore, three sets of samples were collected following different collection criteria. The first two set of samples were collected in the early morning before the normal start of the business day, i.e., at 7:30 am the approval of the office facilities management was sought to allow access to the building bubblers at an earlier time than when the building typically open and security staff was presented to provides access to the buildings. Samples were taken at this time in 10 different containers. The third sample was collected in the afternoon at 01:30 pm. For this sample collection time, only the third void was collected. Plastic sterile 500 ml polypropylene bottles were used as sample containers. A blue-green color on the bubbler was a significant sign for high copper levels in the drinking water. As previously mentioned, the factors that enhance copper contamination are air corrosion and hardness. A thermometer (0 – 100 °C) and a pH meter were used to measure the temperature and pH, respectively, on site to ensure the accurate measurement of these factors. The complete address of the samples, temperature, pH, and any physical observations were recorded on each sample bottle. The pH meter, i.e., a glass electrode to detect H⁺ ion, was previously calibrated in the laboratory such that it would be ready to use on site is mainly. The advantage of this electrode is that it does not interfere with the water.



Drinking Fountains location

7 / 03 / 02
leydon on BGC/aya2/ucsr N:water

Building	Location	Number Units	Refrigeration Units	Under/sink Hot/cold	Town water
C1A	306 lunch room	1	1		
C3A	Level 3456789	7			7
C4A	Level 2	2			1
C5A	Courtyard	2			2
C3B	Entrance	1			1
E3A	Level 1/2	8	2	Billi 6	
E5A	Level 0/1/2/3	4			4
E5B	Level 1/2	2			2
E6A	Level 0/1/2/3	4	4		
E6B	Level 1/2	2	2		
E8A	Level 1/2/3	6			6
E8C	Level 1/2/3	3			3
E11A	Level 1	1		Zip 1	
Library	Level 1/3/4/5	4	1		3
W5A	Level 1/2	4			3
W6B	Level 1/2/3 /2	6			6
W10A	Hallway	1	1		
X5B	Level 0/1/2/3	4	4		
F8A	W/shop Office	2	2		
Lincoln	Level 1/2/3/4	4		Zip 4	
Y6A	Level 2	1		Zip 1	
X5A	courtyard	1			1

units in
kitchens
machined
straight out
of tap - no
refrigeration

TABLE 1 : LOCATION OF DRINKING FOUNTAINS AND A DESCRIPTION.

Figure 1 : location of drinking fountain and a description