Proposal Coversheet

Application Submitted

To:	Dr. Arlene Courtney
Program:	Ch 462 Experimental Chemistry
Title of Project:	Analysis of copper in drinking water
Suggested Timeline:	2-8 hours
Date Submitted:	1-26-2009
Principle Investigator	Proposal #3
Applicant's Contact Information	

Signatures:

Abstract:

Copper is a necessary part of the human diet. However, too much copper can cause serious health problems and even death. A client from Oklahoma has had problems with staining around the faucets in her home. This is cause for question as to the amount of copper in her drinking water. To analyze samples of the water obtained from her well and home, we will be using ultra-violet/ visible spectroscopy to determine the amount of copper in the water to ascertain any possible health threats to her or her pets. We also are suggesting various acidic solutions to remove the stains and that she raise the pH of her water in her well to avoid further copper contamination of her water.

Introduction

The copper analysis team is requesting approval to analyze the water samples from the client using ultra-violet/visible spectroscopy. Concerns have been raised from a client about blue-green stains around faucet and shower fixtures and in the bathtub of her home. The client has tried numerous methods to clean the stains and has had no success. The client has also inquired as to weather or not the levels of copper are high enough to cause harm to herself or her pets. The team's objectives are (1) to obtain and test a sample of the client's tap water and (2) to find an easy, safe way to clean the stains. Our goals are to determine the level of copper in the water to ascertain any possible health threats, and provide a cost effective solution to remove the copper from the water and prevent further staining.

About Copper /Aqueous Copper

Copper is a natural part of diets for nearly all higher orders of life. It is in the food we eat and the water we drink. Too much copper, however, can cause many health problems, and even death. This is why it is important to monitor copper levels in water, both in community reservoirs and in homes. Levels of copper found naturally in ground water and surface water are typically very low; about 4 micrograms per liter or less. However, drinking water may contain higher levels of copper. This can be caused by corrosive water (water with a pH less than seven) being in contact with brass fittings and/or copper pipes used in pluming for periods of six hours or more. There are three types of copper that can be found in water, pure copper particulates, which are not as common, and two ionic forms copper (I) and copper (II). Copper (I) is less stable than copper (II) and tends to disproportionate in solution into copper (II) and copper metal.

Justification

Since copper is a potential health hazard, water quality tests must be performed on drinking water. Copper in drinking water is usually a sign of copper pluming which, depending on the year the plumbing was installed, could also be a sign of lead in the drinking water as well. The staining typically occurs when copper levels in the water are at approximately 1 mg/L. This can be cause for alarm since the EPA has deemed anything over 1.3 mg/L as an actionable level. To achieve our goals our sample will be mailed to us and tested using the Hitachi U-2000 UV/VIS spectrometer. The spectrometer will allow the team to analyze the water sample and determine the concentration of copper in the sample. We can then compare our results to the standards set by the EPA to ascertain any health threats. Our second goal will be met using a combination of knowledge about the solubility of various copper compounds under various conditions and tabulated information.

Literature Review

The solubility of different copper compounds was found in chapter four of *Chemistry Seventh Edition* by Raymond Chang. The equation and method for the process was derived using chapter thirteen and fourteen from *Principals of Instrumental Analysis* by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch. The secondary analysis of copper in drinking water was derived using information from chapter 18 from *Exploring Chemical Analysis* by Daniel C. Harris. The EPA's standards for copper in drinking water were obtained from the EPA's website accessed online at http://www.epa.gov/safewater/contaminants/index.html.

Method for Determining Copper Levels

First we will need to find the wavelength at which copper (II) absorbs light. To do this we will first use a solution of copper (II) nitrate, and a solution of copper (II) sulfate. We then will make four samples of each solution with concentrations of 0.05M, 0.10M, 0.15M, and 0.20M. We will be using two different compounds incase the nitrate ion or sulfate ion absorbs at or near the same wavelength as copper (II). With these samples made we will then use the UV-Vis spectrometer and measure the absorbance of each sample across the UV-Vis spectrum to determine at which wavelength copper (II) absorbs light and to determine the molar absorptivity which will be used in Beer's law to determine the concentration of copper (II) in the water sample. After the UV-Vis spectrum of the samples is complete we will then repeat the test with a water sample from the client and use the information obtained coupled with the information from the previous samples along with Beer's law to determine the amount of copper in the client's drinking water.

Potential Problems

The main problem with this method is that the sample of water may contain other compounds that may absorb at the same frequency as copper (II), resulting in a false reading. Should an accurate reading of the water sample not be obtained we will repeat the process by determining other possible compounds that may be present such as various metal compounds and prepare standard solutions of the possible interfering compounds to determine their various absorption patterns. Should this method of correction not work, another alternative for testing the level of copper can be done by reducing the copper (II) to copper (I), and combining the copper with neocuproine hydrochloride and extracting it using isoamyl alcohol. The extractant can then be run through the UV-Vis

where the copper neocuproine compound absorbs at a wavelength of 454 nm. This method can be expensive however because neocuproine is about $113 for five grams.

Method for Cleaning Copper Stains

Our client has tried a number of solvents and cleaning agents to try to clean the copper stains from her bathtub and shower to include bleach, Comet cleanser, Tilex, scour pads, gas and varnish remover, none of which had any effect. This is not a surprise since these compounds have either high pH or are organic solvents which have no effect on copper compounds. The copper compound that forms in bathrooms from copper dissolved in water is copper (II) carbonate. It can be cleaned using strong acids such as hydrochloric acid. If hydrochloric acid is not available solutions of white vinegar or concentrated lemon juice can be used, however these two compounds will require a few minutes to soak into the copper compound followed by a lot of scrubbing, especially for old stains. The process will need to be repeated several times to have an adequate effect. Once the stain is gone, it can be prevented from returning by removing the copper from the houses water. The way this can be done is to either replace any copper pluming. This can be costly however, so alternative measures are to raise the pH of the incoming water above 8.4. This will sufficiently reduce the corrosiveness of the water and help to prevent any further corrosion copper pluming fixtures.

Timeline

The expected timeline to run the experiment once we obtain the water samples should be anywhere from 2-4 hours depending on any problems that may arise. .

References

1. Raymond Chang. *Chemistry* Seventh Edition; Publisher: McGraw-Hill, 2002

2. Douglas A. Skoog, F. James Holler, and Stanley R. Crouch, *Principals of Instrumental Analysis,* Sixth Edition; Publisher: Tomson Brooks/Cole, 2007

3. Daniel C. Harris. *Exploring Chemical Analysis* Third Edition; Publisher: W.H. Freeman Co, 2005

4. Environmental Protection Agency. Drinking Water Contaminants. http://www.epa.gov/safewater/contaminants/index.html (accessed Jan 24, 2009).