# Determination of the Concentration of CU IONS Present in the Flooring Basement Water Sample

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DOI: 10.56201/ijemt.v9.no3.2023.pg164.172

### Abstract

A Determination of the concentration of cu ions present in the flooring basement water sample was investigated. samples of flooding basement at different level that had been flooded previously by the water to determine the concentration of copper ion (Cu2+) in the flooding basement sample water using colourimetric and AAS analysis, determine the extent of contamination or dilution of the flooding sample basement water by organism (yeast), report on any high level concentration of Cu2+ and viable bacteria present in the sample basement water and their likely impact on the health of the people if need be proffer solution to the problems. Three various test was carryout at different time at different lab and with three result. These tests include two absorption test to analyze the copper concentration in the basement water influx while comparing to minimum adopted given value (100mg/L). It was deduce from the analysis result both the AAS and spectrophotometric copper concentration in the basement water is less than the adapted value of 100mg/L standing against the position of the bookseller. Contaminated water was excellently discharge due to ecotoxiocological analysis that take place to know if the water is safely discharge in the local water way treatment system. This area is found to be small, showing the serious altering effect of the copper despite its low concentration in the water. My client is expected to engaged in further investigation and if he so desire to make the water use able he is expected to oxidise the copper. The samples showed remarkable variation in scale appearance and mineralogy, demonstrating the diversity of pipe scales present within a single distribution system. A mix of highly soluble and relatively insoluble copper phases was identified in the real world scale. Both stable scales, such as malachite, and relatively instable solids, such as cupric hydroxide appear in pipes irrespective of age. In many samples cupric hydroxide and cuprite appeared on the surface of the scale while malachite was in the bulk.

Keywords: Spectrophotometry, Atomic Absorption Spectroscopy, Copper Concentration

#### **1.0 INTRODUCTION**

Copper is a metal that is ductile, soft and conduct electricity. However it is occurs naturally as ore, and a noble metal. In oxidation state, copper is very reactive thereby forming water-soluble salts than any other metal in the periodic group (Shim, 2004), Conversely, copper has four oxidation states namely: Cu, Cu<sup>+1</sup>, Cu<sup>2+</sup>, Cu<sup>3+</sup>. Cu<sup>+1</sup> is not stable and easily oxidized to Cu2+ or reduced to Cu in water. Cu<sup>2+</sup> happens to be the most important oxide of copper.

However there are various use of copper which consist of copper tubing in conveying water in buildings and appliances. Copper is used in water distribution which is corrosion resistance

(Lane, 1993; CDA, 2005); which can be easily installed and kill bacteria species in water (Shim, 2004). Conversely it is noble in the galvanic series and it is highly corrosion resistance compared to other metals used in water distribution system (AWWA, 1985).

Copper sulphate is majorly to regulate algae in water storage tanks (Rajaratnam, 2002)

One of the essential applications of copper is in making pipes and fittings for water distribution systems. However, water flowing through the pipes corrodes the copper by releasing it in drinkable water (USC, 1991).

Copper is an important heavy metal, required for the human body, however, it can result to problems when taking in excess amounts (Behbahani et al., 2014). Copper get into the environment through diverse human and natural activities (Ozzeybek *et al.*, 2017).

The use of copper polluted water at a dosage level higher than legal level  $(1.3 \mu g/ml)$  can result to health challenges like vomiting, nausea, blood cell damage, and kidney failure (Behbahani et al., 2014).

Basement water flooding in any particular environment act as pollution either to the water bodies land or surface of domestic environment in which it occurred. It is normal to say that as flood occur it carries along large amount of material to the water therefore, making it unfit for the intended purpose. Such water is considered polluted. Point source of pollution water and environment occur when harmful substance are emitted directly into the body of water surrounding environment such as school, building, farm land etc. this includes effluent sewage treatment work or of waste directly from factories. Non-point source delivers pollution indirectly through environmental changes for instance fertilizer and herbicide application is carried into water bodies, home by water in the form of flooding which in-turn affect both aquatic and human lives . However, Technology exists for the point source of pollution to be monitored and regulated. Non- point sources are much more difficult to control. Pollution arising from non- point source account for majority of contamination in water bodies and homes (Palit and Pehkonen, 2000)

However almost everything produced by man can be considered as a potential pollutant. These can be toxic or non -toxic pollutants ,some of these may be acid or alkali; anions (e.g sulphide, cyracids suphites),detergents, domestic sewage and farm manures, food processing, waste, gasses (e.g chlorine ammonia), heats, metals (e.g Copper, iron) plant nutrients(phosphate and nitrates), organic toxic waste polychlorinated biphenyls, radionuclide and organic pollutants

Among environmental pollutant metal are of most concern due to their potential toxic effects and ability to bio accumulate in aquatic ecosystem. Unlike many organic contaminant that lose toxity with biodegradation, metals can't be degraded further and their toxic effect can be long lasting more so, their concentration can be increased via bioaccumulation. Heavy metals are known to have deleterious effect at low concentration; for instance lead (Pb) Heavy metals in aquatic ecosystem are usually monitored by measuring their concentration in water sediment and biota. The general exist in low level in water and high in sediments and biota. Heavy metals including essential and non -essential elements have a particular significance in ecotoxicology since they are highly persistent and all have the potential to be toxic to living organism (Edwards *et al.*, 2012)

The flooding of many buildings in some part of the world not only affect furnishings and fabrics by water damage and soiling with silt and mud but may be contaminated` with sewage animal waste and chemicals. In this case building that were flooded would be contaminated by a range of micro-organism some of which may be harmful to human health due to some biological origin particulates in flooding basement water and human health care been affected. It is equally helpful for building occupants and owner to be fully aware of the health implications and have guidance on a way of reducing or deposing the harmful elements fungi and bacteria by way of screening the basement water.

When the potential was changed in the cathodic direction, a rise in the cathodic current was observed due to the acceleration of the electrode position of Cu2+ ions at the Pt electrode, while the concentration of Cu2+ ions near the electrode reduced. Although , when the cathodic polarization (and with time) depleted the solution layer near the Pt electrode of Cu2+ ions, the cathodic current increased more and more slowly. When the surface concentration of Cu2+ ions approached zero, a limiting diffusion current (id) was established, and the so-called "current plateau" on polarization curve had formed(S. Gudić and N. Krišto,2022)

# 2.0 METHODOLOGY

Material used for this analysis are test tubes, p ipette, 250ml beaker, retort stand, 100ml volumetric flask, flooded sample basement water, deionized water, 10ml ammonia solution, 0.1molar concentration CuSO<sub>4</sub>, AAS, Yeast, Sodium Alginates, CaCl, Calcium Solution ,hydrogen peroxide. Using Spectrophotometry (colourimetric) and Atomic absorption spectroscopy.

# 2.1 SPECTROPHOTOMETRY (COLOURIMETRIC)

A sample series of 0.01m solution of CUSO<sub>4</sub> to prepare the sample calibration. In a  $100 \text{cm}^3$  volumetric flask pipette 0, 5, 10, 15, 20,  $25(\text{cm}^3)$  of the CuSO<sub>4</sub> was taken and mixed with deionized to  $100 \text{cm}^3$  point.  $5 \text{cm}^3$  water basement was taken in a different volumetric flask pipette of  $50 \text{cm}^3$  and  $10 \text{ cm}^3$  of ammonia solution was added and the flask was filled with deionized water to of  $50 \text{cm}^3$ 

To get concentration of (Cu) mg/l =0.010 xvolume Added (cm<sup>3</sup>) x atomic wt x1000/100.

The whole sample (six samples) passed through the UV/V Spectrophotometer by up to 600nm wavelength to get the absorption of light so as to create a calibration curve. UV/V is spectrophotometer by setting up to 600nm wavelength to measure the absorption of light to create a calibration curve. Using the table below (Table 1) calibration curve is plotted where absorbance is in the Y- axis while Cu(mg/l) is the X- axis calibration curve is plotted then water basement can be obtain from the graph.

Next, 60 mL and 250 mL water samples were collected. The 60 mL sample was later acidified (within 24 hours) in accordance with EPA method 200.7 for ICP analysis. The

250 mL was not acidified and was later used for wet chemistry analysis to determine total inorganic carbon (TIC), alkalinity, nitrate, and ammonia levels. Next, the water was tested using a colorimetric field test kit for pH, free chlorine residual and total chlorine residual. After testing the first six buildings in the study and finding consistently identical readings for free and total chlorine, only free chlorine readings were taken for the remainder of the sample locations. Next, the faucet was wrapped in a clear plastic bag which was taped around the faucet neck, and marked "temporarily out of order" with a sign. The plastic bag allowed identification of any human interference during the stagnation time (none was found) and also identified leaky faucets which slowly released water overnight instead of stagnating completely (two faucets in the study).

After 16 hours of stagnation the bag was observed for tampering or leaking and removed from the faucet. Any irregularities were noted and photographed. Two 250 mL bottles were filled with first and second draw water from the faucet. Both the first and second 250 mLs of water were collected in order to compare the results of water that had stagnated in or near the faucet fixture itself, and were perhaps influenced by the fixture materials (1st draw) with water that had stagnated in the copper distribution pipes immediately leading up the faucet (2nd draw). Both samples were acidified and analyzed for total copper concentration according to EPA method 200.7 by a certified lab. Water from the first draw sample (20~30 mL) was also analyzed colorimetrically to determine pH and free/total chlorine with the field test kit. The 60 mL sample for ICP analysis and the two 250 mL samples for AAS analysis were acidified within 24 hour per EPA methods 200.2, 200.7, and 200.9. EPA method 200.2 section 8.1 states the requirement to acidify drinking water samples for total recoverable metals analysis to pH<2 using 1+1 nitric acid. The acidification must be done within two weeks of field collection and then the sample must be held for at least 16 hours before analysis.

### 2.2 Atomic absorption Spectroscopy (AAS)

Atomic absorption Spectroscopy (AAS) is techniques used to expose the concentration of substance and it used to identify the presence and concentration of substances by analyzing the spectrum produced when a substance is vaporized and absorbs certain frequencies of light. Flame atomic absorption is a very common technique for detecting metals in environmental samples. It is very reliable and simple to use. The technique is based on the fact that metals absorb light at specific wavelengths. Metal ions in a solution are converted to atomic state by means of a flame. Light of the appropriate wavelength is supplied and the amount of light absorbed can be measured against a standard curve.

A stock solution of 100ppm (100mg/1000ml) is provided from which all standard solutions will be prepared. From this solution, make up solutions of 0, 1, 2, 3 and 4ppm in 100ml volumetric flasks and make up to the mark with de-ionised water. Use the formulae  $C_1V_1 = C_2V_2$  [Conc<sub>1</sub>Vol<sub>1</sub> = Conc<sub>2</sub>Vol<sub>2</sub>, where 1 = stock soln and 2 = new dilution] to determine the correct volume of the stock solution to add to each flask in Table 2

# **3.0 RESULT (SPECTROPHOTOMETRY)**

Table 1 Working Results (CU) mg/l=0.010Xvol. Added (cm<sup>3</sup>) X Atomic wt. X 1000/100

| Volume              | CuSO <sub>4</sub> | Added | [Cu] <sub>mg/l</sub> | Absorbance |
|---------------------|-------------------|-------|----------------------|------------|
| (cm <sup>3</sup> )* |                   |       |                      |            |
| (0)                 | 0  ml             |       | 0.00                 | 0.000      |
| (5)                 | 5 ml              |       | 31.76                | 0.023      |
| (10)                | 10 ml             |       | 63.55                | 0.043      |
| (15)                | 15 ml             |       | 95.33                | 0.063      |
| (20)                | 20 ml             |       | 127.1                | 0.083      |
| (25)                | 25 ml             |       | 158.88               | 0.105      |

\*:- note down actual volume added.



Figure 1: COLOURRIMETRIC

• Absorbance of the 5cm<sup>3</sup> dilute basement water was measured to be 0.014. (*Dr. Collin Hunter*, 2020) Therefore using C1V1=C2V2. C1=22.6, V1=5cm3, V2=50, C2=?(22.6x5)=C150 113/50=2.26mg/l

Since the concentration is far smaller than 100mg/L then it is therefore deduce that will probably not because damage but it is not safe for industrial and home use since WHO and USEPA standard is 1.0mg/L.

Results

| ppm   | in   | mg    | copper/ | Voluujjm | e of | absorbance | SD       | RSD/% |
|-------|------|-------|---------|----------|------|------------|----------|-------|
| 100ml | Vol. | flask |         | stock    | soln |            |          |       |
| flask |      |       |         | required |      |            |          |       |
| 0     |      | 0     |         | 00       |      | 0.000010   | 0.000067 | 625.4 |
| 1     |      | 1     |         | 10       |      | 0.04153    | 0.000176 | 0.424 |
| 2     |      | 2     |         | 20       |      | 0.07875    | 0.000171 | 0.218 |
| 3     |      | 3     |         | 30       |      | 0.1192     | 0.000632 | 0.531 |

#### International Journal of Engineering and Modern Technology (IJEMT) E-ISSN 2504-8848 P-ISSN 2695-2149 Vol 9. No. 3 2023 www.iiardjournals.org



• The concentration of copper in the original *Basement Water* sample is 148.5mg/L (*Dr. Collin Hunter*, 2020)

Absorbance is 0.059 at 1.485Mg/L concentration

Table 3: Raw data information

| Tube       | Basement Time |             |             |             |           |  |
|------------|---------------|-------------|-------------|-------------|-----------|--|
| number     | water         | (seconds)   | time        |             |           |  |
|            | (% v/v)       | Replicate 1 | Replicate 2 | Replicate 3 | (seconds) |  |
| 1 "neat"   | 100.00        | 300         | 300         | 300         | 300       |  |
| 2 "1/10"   | 10.00         | 175         | 203         | 186         | 188       |  |
| 3 "1/100"  | 1.00          | 23          | 17          | 19          | 19.6      |  |
| 4 "1/1000" | 0.10          | 10          | 7           | 7           | 8         |  |
| 5 "blank"  | 0             | 4           | 5           | 6           | 5         |  |

• (Dr. Collin Hunter, 2020)



Reference to the graph plot above it was discovered that the volume basement water cause a ten -fold hampering of bacterial activity is about 1/120(V/V). This result was realised by correlating ten-fold reduction in the time for the yeast ball to reach the surface of the test tube mark.

### DISCUSSION

The experiment was carried out to determine the presence of cooper in a water basement sample from a flood and to assess the toxicity of this heavy metal on a living organisms the presence of copper in the sample was ascertain via coloration analysis which involve the use of spectrophotometer and the beer lamberts law of absorption. A five calibration series of a known copper concentration of copper sulphate solution was employed in the process.

The viability and toxicity of the water basement sample was detected using mobile ice yeast balls gotten from baker's yeast in the laboratory. The ability of the Bakers yeast to breakdown toxic compounds like hydrogen peroxide was inhibited when added to the sample.

Sequel to instruction behind the practical, wish says that if the copper content is less than 100Mg/L then the EHO will be convinced that plating shop is not to be causes. Spectrophotometric result of the evaluation of diluted samples of the basement water from industrial has shown that real basement water which is said to be regular flood at bookseller shop has approximately 2.26Mg/L as concentration of copper this figure is far lesser than giving adapted concentration which is 100Mg/L. Therefore we can conclude that the plating shop in the industrial unit is not the cause of the damage that happen to the bookseller in the course of contact with copper contaminated water. However they will no need for further investigation, but precaution has to be taken by plating shop owner to avoid re-occurrence.

Already given value of copper concentration using AAS machine is not far from what is obtained using spectrophotometric. The minimum required concentration value required of bookseller to substantiate his claim is 100Mg/L but we have is 1.485Mg/L, therefore it can also be conclude that plating shop of industrial unit is not the cause of the menace. However my

client can go for further investigation but the platting shop must take precaution to avoid future occurrence.

The value shown by ecotoxicological evaluation 1/120 (0.00833) basement water has proved to be less concentrated to cause physical damage.

Finally, According to report generated by AAs machine, the copper concentration of diluted water basement is 1.485mg/l as stated in the result generated by AAS machine and is above WHO and USEPA standard there is not recommended for but home and industrial use and there is need for copper to be ionize from the water body ion exchange resins parked in a water treatment mold or oxidation of the copper ion from copper 2 to copper 3.

After the initial copper concentration data were analyzed from the 16 buildings in the sample, questions arose about the source of the copper in the water from the first and second draw samples.

Briefly, the researcher desired to determine if the high copper levels found in the first draw samples was a result of stagnant water contact with the faucet fixture (usually brass, not pure copper), while the lower copper levels found in the second draw samples were attributable to overnight contact with the copper distribution system. To attempt to answer the question of where the copper contamination was coming from, another series of water samples was collected for a single building.

The researcher flushed the faucet for one minute and sampled the free chlorine and pH levels, consistent with the experimental protocol. The following day two 30 mL samples, followed by six 60 mL samples were collected from the faucet and analysis

### CONCLUSION

The water basement sample contained a significant amount of copper (0.014abs) and its ability to inhibit baker's yeast shows it possible adverse effect on living organisms. But it has been proven that plating shop of industrial unit is not the causes of the menace to the bookseller shop but further investigation is hereby recommended to my client, however will advise the plating shop of industrial unit to take further precaution against future occurrence.

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