**Investigation of copper leaching from *Chrysopogon zizanioides* (L.) Roberty biomass by citric acid**

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**Introduction**

Heavy metal contamination of soil and water has become a problem worldwide. Copper (Cu) is one of the heavy metals which is naturally found in earth and becomes concentrated resulting from human activities such as industrial production, mining, agriculture and transportation (Nazir *et al.*, 2015). The release of Cu by industries in year 2000 was about 640,000,000 kg and found near mines, smelters, industrial settings, landfills, and waste disposal sites (Gerberding, 2004). Cu is essential to living organisms, but can be toxic in high doses and can cause chronic anaemia, brain and liver damage and Wilson’s disease (Nazir *et al.*, 2015).

Different technologies have been applied for the remediation of this metal including phytoremediation. It is an effective and affordable technological solution as it is cheaper by 50-80% compared to other methods of bioremediation, which is used to extract or remove inactive metals and metal pollutants from contaminated soil and water (Elekes, 2014). However, the disposal of harvested biomass produced from phytoremediation application is still considered to be a problem.

Various methods have been introduced for heavy metals recovery from plant biomass. It includes; incineration, composting, pyrolysis, and combustion. However, the aforementioned methods pose some significant disadvantages, which include: need for special equipment, high operational cost, and production of hazardous waste (Sas-nowosielska *et al.*, 2004). Thus, this study aims to 1) investigate the effects of different factors, such as solid/liquid ratio, reaction time, stirring speed and temperature on the leaching of Cu from vetiver grass biomass, and, 2) assess the viability of citric acid (CA) as leaching agent.

**Materials and Methods**

Vetiver grass slips were obtained from Gumaca, Quezon, Philippines and grown in soil for 1 month in a screenhouse in Task Force Solid Waste Management facility, University of the Philippines Diliman (UPD). The plants were then exposed to 50 ppm Cu in a hydroponic set-up for 7 days, harvested and dried at 80oC in a laboratory oven for 24 hours. Cu concentration of the biomass were analysed by Atomic absorption spectroscopy (AAS) in the Analytical Services Laboratory, Institute of Chemistry, UPD.

0.3 g dried biomass were ashed for 90 minutes at 450oC. The ashed biomass were transferred to 125 ml Erlenmeyer flasks with CA solution and covered with parafilm. The flasks were placed in a water bath shaker to provide the necessary stirring and to keep the temperature constant. At the end of each leaching experiment, the solution was filtered using Whatman no. 42 and analysed for Cu concentration using UV-Vis Spectrophotometer.

**Results and Conclusions**

Table 1 shows that when the solid:liquid ratio was changed, Cu recovery is highest in the 0.3 g/5 ml level with a value 119%. As for varying reaction time, Cu recovery reached 136% at 30 min, decreased a little in 90 min, then increased to 158% in 150 min. Results show that Cu leaching is inversely proportional to stirring speed. At 50 rpm, Cu recovery reached 154%. However, as the speed is increased to 150 rpm, Cu recovery decreased to 113%. Data also revealed that Cu dissolution from vetiver grass biomass is temperature dependent since there is low Cu recovery at 300C. On the other hand, as the temperature is increased to 50oC, Cu recovery rose to 128%. A reduction in Cu recovery was observed at 70 ◦C, which may be due to the decomposition of citric acid and its reaction with Cu ions (Habbache *et al.*, 2009).

**Table 1.** Cu recovery with varying levels of the different factors

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| factors | levels | Cu recovery, % | | | | | |
| average | range | | | | |
| solid: liquid ratio (g ash/ml solution) | 0.3/5 | 118.52 | ( | 96.14 | - | 138.91 | ) |
| 0.3/15 | 118.34 | ( | 96.00 | - | 138.70 | ) |
| 0.3/25 | 110.55 | ( | 89.68 | - | 129.57 | ) |
| reaction time (min) | 30 | 136.68 | ( | 110.88 | - | 160.21 | ) |
| 90 | 124.95 | ( | 101.36 | - | 146.45 | ) |
| 150 | 158.13 | ( | 128.28 | - | 185.34 | ) |
| stirring speed (rpm) | 50 | 153.84 | ( | 124.80 | - | 180.31 | ) |
| 100 | 129.03 | ( | 104.68 | - | 151.24 | ) |
| 150 | 112.65 | ( | 91.38 | - | 132.03 | ) |
| temperature ( 0C) | 30 | 122.23 | ( | 99.16 | - | 143.27 | ) |
| 50 | 128.06 | ( | 103.89 | - | 150.10 | ) |
| 70 | 123.07 | ( | 99.84 | - | 144.25 | ) |

Based from the results of this experiment, it can be concluded that CA, is a viable leaching agent for Cu extraction from vetiver grass biomass. Moreover, its biodegradability, non-toxicity and ease of handling and storage add to its practicability as leaching agent.

**References**

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