UNIVERSITI TEKNOLOGI MARA
Cawangan Perak
Kampus Seri Iskandar

e-Proceeding

v-GOGREEN2020 29 - 30 SEPT

VIRTUAL GO-GREEN: CONFERENCE & PUBLICATION

"SUSTAINABLE ENVIRONMENT, RESILIENCE AND SOCIAL WELL-BEING"

Organiser :
Research, Industrial Linkages, Community & Alumni Network (PJIM&A)

Co-organiser :
Faculty of Architecture, Planning and Surveying (FSPU)
& Centre for Post Graduate Studies (CGS)

Publication Date : 22nd February 2021

Virtual Go-Green Conference and Publication 2020

UNIVERSITI TEKNOLOGI MARA, PERAK BRANCH
February 2021

Main Committee
Virtual Go-Green Conference and Publication 2020

Advisor 1	*: Prof Sr Dr Md Yusof Hamid, AMP*
Advisor 2	*: Assoc Prof Dr Nur Hisham Ibrahim*
Chairman	*: Sr Dr Asmalia Che Ahmad*
Co-Chairman	*: 1. Sr Dr Yuhainis Abdul Talib* *2. Sr Dr Haryati Mohd Isa*
Treasurer	*: Mohamad Haizam Mohamed Saraf*
Secretary	*: Noorliza Musa*
Head of v-Conference	*: Sr Dr Nor Suzila Lop*
Head of e-Proceeding	*: Dr Junainah Mohamad*
Head of Scopus Indexed Journal Planning Malaysia Journal (PMJ)	*: Assoc Prof Gs Dr Mohd Fadzil Abdul Rashid*
Head of Scopus Indexed Journal Malaysian Construction Research Journal (MCRJ)	*: Sr Dr Natasha Khalil*
Head of Paper Reviewer	: *Dr Asniza Hamimi Abdul Tharim*

Committee Members
Virtual Go-Green Conference and Publication 2020

E-Proceeding Paper Reviewer

Noraini Md Zain
Shafikah Saharuddin
Nur Fatiha Mohamed Yusof
Farrah Rina Mohd Roshdi

E-Proceeding Formatting

Nurulanis ahmad @ Mohamed
Jannatun Naemah Binti Ismam
Najma Binti Azman

E-Proceeding Language Reviewer

Dr Hjh Shazila Abdullah
Dr Daljeet Singh Sedhu A/L Janah Singh
Zarlina Mohd Zamari
Dr Mary Thomas
Iza Faradiba Mohd Patel
Farahidatul Akmar Awaludin
Wan Faridatul Akma Wan Mohd Rashdi
Jeyamahla Veeravagu
Wan Nurul Fatihah Wan Ismail
Nazirul Mubin Mohd Noor
Noor Aileen Ibrahim
Noraini Johari
Dr Hajah Norakmarwati Ishak

Virtual Conference

Norazlin Mat Salleh	*Registration*
Shahela Mamter	*Auditor*
Mohd Esham Mamat	*Auditor*
Noor Anisah Abdullah @ Dolah	*Auditor*
Mohamad Tajudin Saidin	*Certificate & Conference Kit*
Fairiz Miza Yob Zain	*Logistic*
Mohd Firdaus Zainuddin	*Logistic*
Farah Hanna Ahmad Fuad	*Promotion & Publicity*
Mohamad Shahin Shahdan	*Promotion & Publicity*
Mohd Asrul Hassin	*Liason Officer*

Organiser:
Research, Industrial Linkage Community and Alumni Network Office (PJIM&A)
Universiti Teknologi MARA, Perak Branch, Seri Iskandar.
Malaysia

Co-Organiser:
Faculty of Architecture, Planning and Surveying (FSPU)
and,
Centre for Post Graduate Studies (CGS)
Universiti Teknologi MARA, Perak Branch, Seri Iskandar.
Malaysia

e ISBN 978-967-2920-06-9

SUGARCANE BAGASSE: A POTENTIAL OF LOW-COST BIOSORBENT FOR REMOVAL OF HEAVY METALS FROM WATER

Zildawarni Irwan[1*], Wan Farahiyah Wan Kamarudin[1], Mardhiah Abdullah[1], Muhammad Aqil Firdaus Faizal[2],
Muhammad Azrin Mohamad Yamin[2], Farah Nur Syahira Nordin[2] and Nor Azrina Natasya Ismail[2]
[1]Faculty of Applied Science, Universiti Teknologi Mara UiTM Terengganu, 23000 Dungun, Terengganu Darul Iman, Malaysia
[2]Faculty of Chemical Engineering, Universiti Teknologi Mara UiTM Terengganu, 23000 Dungun,Terengganu Darul Iman, Malaysia

Abstract

Water pollution is a major environmental problem faced by modern society that leads to ecological disequilibrium and health hazards. Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater causing water pollution. Heavy metal ions such as copper, cadmium, lead, nickel, and chromium, often found in industrial wastewater, present acute toxicity to aquatic and terrestrial life, including humans. Thus, the discharge of effluents into the environment is a chief concern. Active carbon has been frequently used as an adsorbent, but it remains as an expensive material. Therefore, there is an urgent needfor all possible sources of agro-based inexpensive adsorbents. In this study, our objective is to study the preparation of natural adsorbent heavy metal from sugarcane bagasse and investigate the effectiveness of sugarcane bagasse as a natural adsorbent to remove copper from wastewater. Adsorption processes are being widely used by various researchers for the removal of heavy metals from waste streams. Therefore, a methodology is developed for the removal of ion metal copper (Cu^{2+}) from its aqueous solution using sugarcane bagasse as filter paper. Samples were analyzed by the technique of the Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The result showed that the preparation of filter paper out of sugarcane bagasse was successfully obtained.

Keywords: *sugarcane bagasse, natural adsorbent, heavy metal, copper*

1.0 INTRODUCTION

Heavy metals can be emitted into the environment by both natural and anthropogenic causes. The major causes of emission are the anthropogenic sources specifically mining operations (Hazrat Ali et. al., 2018). All heavy metals, including those that are essential micronutrients (e.g. Copper, Zinc, etc.), are toxic to algae at high concentrations. One characteristic feature of heavy-metal toxicity is the poisoning and inactivation of enzyme systems. Many of the physiological and biochemical processes, viz., photosynthesis, respiration, protein synthesis and chlorophyll synthesis, etc., are severely affected at high metal concentrations (Yang et. al., 2020). The industrial effluents liquid, containing heavy metals pose a serious environmental problem, because of the insufficiency of our water resources, and the degradation of living conditions in this natural environment, which is translated by deep changes of the watery flora and fauna and by various nuisances (Elanza et. al., 2014). Heavy metals are serious hazardous because of their non-degradable characteristics and therefore persistent. The major sources of it are products of industries such as metal plating, phosphate fertilizers, mining, pigments, stabilizers, metallurgy, ceramics, photograph, textile printing, lead mining, sewage sludge, alkaline batteries, and electroplating (Pham et. al., 2015).

Copper is a persistent, bio-accumulative and toxic heavy metal which does not break down in the environment, it is not easily metabolized and can harm human health. The various potential sources of copper pollution are metallurgical and metal finishing, corrosion inhibitors in cooling and boiler systems, drilling mud's catalysts, primer paints, fungicides, copper plating and pickling, corrosion of copper piping, copper release from vehicle brake pads. Acute poisoning from ingestion of excessive copper can cause temporary gastrointestinal distress with symptoms such as nausea, vomiting, and abdominal pain. Liver toxicity has been seen in doses high enough to cause death. High levels of exposure to copper can destroy red blood cells, possibly resulting in anaemia. Mammals have an efficient mechanism to regulate copper stores such that they are generally protected from excess dietary copper levels. However, at high enough levels, chronic overexposure to copper can damage the liver and kidneys. Symptoms of liver toxicity (jaundice, swelling, pain) usually do not appear until adolescence (Rana et. al., 2014). The influence of Copper (II) ions on the growth and bioaccumulation properties of adapted and growing cells of *Saccharomyces cerevisiae, Kluvyveromycesmarxianus, Schizosaccharromycespombe* and *Candida sp.* was studied (Dönmez & Aksu, 1999). Live animals can detoxify solutions of limited Cu(II) content. Heat-killed homogenates are also effective in detoxifying solutions of limited Cu(II) content (Scott & Major, 1972).

In this article, the technical feasibility of various low-cost adsorbents for heavy metal removal from contaminated water has been reviewed. Instead of using commercial activated carbon, researchers have worked on inexpensive materials, such as chitosan, zeolites, and other adsorbents, which have high adsorption capacity and are locally available (Babel, & Kurniawan, 2003). The elimination and the recovery of heavy metals from waters are carried out employing the physicochemical conventional methods of recovery such as liquid-liquid extraction, membrane system, opposite osmosis, and precipitation. The latter prove very expensive, especially not very powerful for little concentrated solutions. During these last years, many works were focused on the use of resins of natural origins to depollute the solutions loaded with industrial effluents of efficient manner and economically (Elanza et al., 2014). As a general trend, up until now, most studies on the biosorption of heavy metal ions by miscellaneous biosorbent types such as sugarcane bagasse have been directed toward the uptake of single metal in preference to multicomponent systems (Manh et. al., 2019).

Sugarcane bagasse has been widely chosen as an extractant matrix for some reason. It is high in cellulose, hemicellulose and lignin, which are contained in their structures of the grouping's hydroxyls and phenol hydroxides, which play an important role at the level of extraction mechanisms of heavy metals (Halysh et. al, 2020). Another essential reason is that the sugarcane bagasse is available and less expensive. It is well-known that cellulosic waste materials can be obtained and employed as cheap adsorbents and their performance to remove heavy metal ions can be affected upon chemical treatment (Ngah et.al., 2008). Sugarcane bagasse also,thanks to the mechanical properties of bagasse, can regenerate this material in several cycles of extraction - deextraction of heavy metals, and in wastewater treatment in general. The current trend of research on sugarcane bagasse as biosorbent is using chemically modified methods of sugarcane bagasse as an alternative material for Cd (II) removal from water environment by using sodium hydroxide (SHS), citric acid (CAS) and tartaric acid (TAS) (Manh et. al., 2019). A methodology treatment also has been developed for the removal of toxic metals as Cu(II) and Mn(II) from its aqueous solution using sugarcane bagasse (Ken et al., 2020). Therefore, in this work, sugarcane bagasse as a cheap and effective biosorbent was used for copper ions (Cu(II)) removal and sugarcane bagasse has been modified with HCl chemical washing and mercerization with strong NaOH to improve the removal capability of Cu(II) from aqueous solution.

2.0 MATERIALS AND METHODS

2.1 Materials

All materials in this experiment were prepared in the laboratory and of analytical grade. The sugarcane bagasse was purchased from the night market and a stock solution of the copper ion (Cu^{2+}) prepared in distilled water. The instrument Inductively Coupled Plasma Mass Spectrometry (ICP-MS) was used in this experiment. All materials were prepared in the laboratory.

2.2 Methodology

- **Objective 1: To Study the Preparation of Filter Paper from Sugarcane Bagasse**

Sugarcane bagasse was dried with the air and under the action of solar rays for two or three days. The dried sugarcane bagasse was cut into smaller pieces and washed it repeatedly using tap water and rinsed it with distilled water. Sodium hydroxide solution was prepared by added 100g of sodium hydroxide pellets into 900ml of distilled water to obtain 10% of sodium hydroxide. The sugarcane bagasse was cooked with 10% sodium hydroxide for 50 minutes then washed it with hot water and distilled water repeatedly. The sugarcane bagasse was ground for five minutes with the ratio of water 1:4 to obtain the pulp. The pulp was poured into the basin and some distilled water was poured into the basin until the pulp dispersed through the water. The pulp was sieved and shakes horizontally in the basin to have a smooth and straight surface of the paper and dry it under the sun.

- **Objective 2: To Evaluate the Effectiveness of Sugarcane Bagasse as Natural Adsorbent.**

Preparation of $CuSO_4$ solution in different concentrations by diluting the stock solution of $CuSO_4$ 1000 ppm to 10 ppm, 15 ppm, 20 ppm, 25 ppm and 30 ppm. Pour 50 ml of 10 ppm CuSO4 into the burette and filter using a double layer of sugarcane bagasse paper. The sample is collected in a conical flask. Repeat the following steps using 15 ppm, 20 ppm, 25 ppm and 30 ppm of $CuSO_4$. Measure 4 ml and collect it in bottles for each sample. All samples are analyzed using the Inductively Coupled Plasma Mass Spectrometry (ICP-MS) technique.

3.0 RESULT AND DISCUSSION

- *Objective 1: To Study the Preparation of Filter Paper from Sugarcane Bagasse*

Figure 1 below shows that our first objective of the experiment which is to prepare paper from sugarcane bagasse has been achieved. The results show that sugarcane bagasse can be made as paper and has the potential to be used as a filter paper (natural adsorbent) to remove the copper ion.

Figure 1: Sugarcane Bagasse Paper

The paper produced from the sugarcane bagasse has a different mass. The mass of paper produced was shown in Table 1 below.

Table 1: Mass of paper produced

Concentration of $CuSO_4$ solution (ppm)	Paper mass (g)		
	First	Second	Total Mass
10	1.211	1.532	2.743
15	0.984	1.450	2.434
20	1.741	1.181	2.922
25	0.680	1.889	2.569

- *Objective 2: To Evaluate the Effectiveness of Sugarcane Bagasse as Natural Adsorbent*

The efficiency of sugarcane bagasse as a natural adsorbent to remove Cu^{2+} in wastewater (solution) can be affected by many parameters such as contact time of adsorbent and the solution, the pH value effect, the temperature of the solution, and the mass of adsorbent support. However, in our study, we choose the mass of Sugarcane Bagasse paper as the parameter to be observed**.** .From this project, the result achieved met with the second objective experiment which is to investigate the effectiveness of Sugarcane Bagasse as a natural adsorbent to remove Copper (II) Cu^{2+} from water as shown in Table 2.

Table 2: Mass of paper

Initial concentration $CuSO_4$ solution(ppm)	Final concentration of $CuSO_4$ after filtered (ppm)	Percent of removal ion copper (Cu^{2+} (%)	Mass of sugarcane bagasse paper (g)
10	0.95	90.46	2.743
15	1.88	87.467	2.434
20	1.50	92.5	2.922
25	2.65	89.4	2.569

Figure 2 showed the correlation between the concentration of $CuSO_4$ and the percentage of adsorption ion Copper (ii) Cu^{2+}. At the concentration $CuSO_4$ solution 20 ppm, the efficiency of adsorption is the highest. This is because the highest mass of Sugarcane Bagasse which is 2.922g is used to filter the solution. Next, for the copper solution that has concentration 15 ppm, the mass of sugarcane paper used is 2.434g and this cause the efficiency of adsorption for this concentration to become the lowest because it has low contact surface area between the sugarcane bagasse and the solution. The adsorption efficiency for 25 ppm solution is lower than 10 ppm solution because a 10 ppm solution has a lower concentration than 25 ppm solution but filtered with sugarcane bagasse that has higher mass (2.743g). Thus, this affects efficiency.

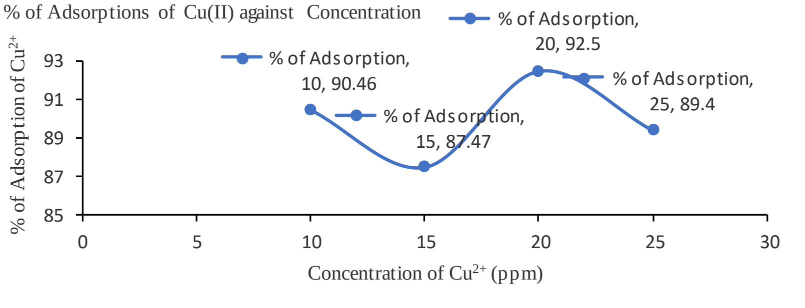

Figure 2: Percentage of adsorption of Cu(II) against the concentration of Cu^{2+} solution

Figure 3 showed the percentage of adsorption of Cu^{2+} ion when the different mass of sugarcane bagasse paper was used (2.743g, 2.434g, 2.922g, 2.569g). From this graph, we can conclude that the higher the mass of sugarcane bagasse paper used, the more the efficiency the sugarcane bagasse as a natural adsorbent to remove the ion Cu^{2+}. This is because as the mass of sugarcane bagasse paper increases, the surface area that will be in contact with the ion Cu^{2+} will increase. As the surface of sugarcane bagasse paper increases, the availability of active sites that are responsible for complexation Cu^{2+} ion increases. So, this result shows that the mass of adsorbent (sugarcane bagasse paper) is the important parameter that affects the efficiency of sugarcane bagasse as a natural adsorbent to remove ion Cu^{2+} in CuSO4 solution.

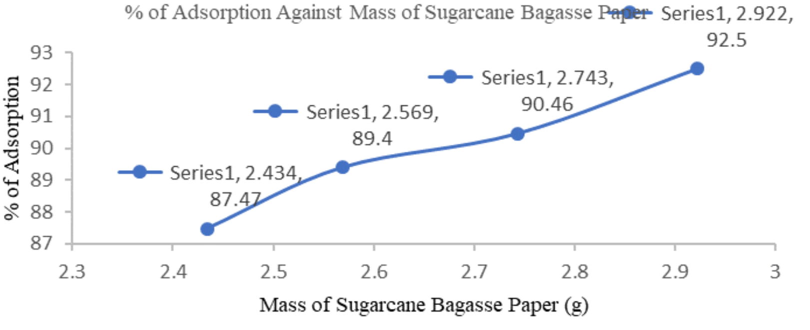

Figure 3: Percentage of adsorption of Cu(II) against mass of sugarcane bagasse paper

REFERENCES

Dönmez, G., & Aksu, Z. (1999). The effect of copper (II) ions on the growth and bioaccumulation properties of some yeasts. Process Biochemistry, 35(1-2), 135-142.

Elanza, S., Lebkiri, A., Marzak, S., Rifi, E. H., Lebkiri, M., & Satif, C. (2014). Removal of lead ions from aqueous solution by the sugarcane bagasse. J Mater Env. Sci, 5(5), 1591-1598.

Halysh, V., Sevastyanova, O., Pikus, S., Dobele, G., Psalskiy, B., Gun'ko, v.m., & Kartel, M. (2020). Sugarcane bagasse and straw as low-cost lignocellulosic sorbents for the removal of dyes and metal ions from water. Cellulose https://doi.org/10.1007/s10570-020-03339-8

Hazrat Ali, Ezzat Khan & Ikram Ilahi. (2018). Environmental Chemistry and Ecotoxicology of Hazardous Heavy Metals: Environmental Persistence, Toxicity, and Bioaccumulation. Journal of Chemistry, Volume 2019, 1-14. https://doi.org/10.1155/2019/6730305

Ken Yip Yam, Woon Chan Chong & Ying Tao Chung. (2020). Modified sugarcane bagasse as effective biosorbent for copper ions removal IOP Conference Series: Earth and Environmental Science, Volume 463, International Conference on Sustainable Energy and Green Technology 2019 11-14 December 2019, Bangkok, Thailand

Manh, K.N, Minh, T.H, Thi, T.P, Bart, V.B. (2019). Performance Comparison of Chemically Modified Sugarcane Bagasse For Removing Cd(II) in Water Environment. Journal of Renewable Materials, 7(5), 414-427. http://www.techscience.com/jrm/v7n5/30550

Ngah, W. W., & Hanafiah, M. A. K. M. (2008). Removal of heavy metal ions from wastewater by chemically modified plant wastes as adsorbents: a review. Bioresource technology, 99(10), 3935- 3948.

Pham, T. T., Hoang, M. T., Nguyen, M. K., Dinh, T. H., Han, L. P., & Bruggen, B. V. (2015). Evaluation of chemical modified sugarcane bagasse for cadmium removal in aqueous environment. International Proceedings of Chemical, Biological and Environmental Engineering.

Rana, K., Shah, M., & Limbachiya, N. (2014). Adsorption of copper Cu (2+) metal ion from waste water using sulphuric acid treated sugarcane bagasse as adsorbent. Int. J. Adv. Eng. Res. Sci, 1(1), 55-59.

Scott, D. M., & Major, C. W. (1972). The effect of copper (II) on survival, respiration, and heart rate in the common blue mussel, Mytilus edulis. The Biological Bulletin, 143(3), 679-688.

Yang Y, Zhang L, Huang X, Zhou Y, Quan Q, Li Y, et al. (2020) Response of photosynthesis to different concentrations of heavy metals in Davidia involucrata. PLoS ONE 15(3): e0228563. https://doi.org/10.1371/journal.pone.0228563

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

UNIVERSITI TEKNOLOGI MARA PERAK
TERIMA
25 JAN 2023
Tindakan
Universiti Teknologi MARA Perak
PEJABAT REKTOR

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR