Uttaranchal University Journal of Applied and Life Sciences
UU. J. App. Life. Sci. Vol: 3 (1): 39-44 **Dec 2020**

Synthesis of Coconut husk-SnO_2 Nanoparticles for sorption of Cu(II)

Shivangi omer and Ajay singh
Department of Chemistry, School of Applied and Life sciences
***Corresponding author:**shivangomer@gmail.com

Received: (14 Sept. 2020) Revised: (17Oct 2020) Accepted: (18 Dec 2020)

Abstract*:* Coconut husk or coir is mesocarp part of the coconut fruit which is considered as agriculture waste. This fibre is dumped but rich in nutrients like cellulose, hemicellulose and lignin. So, this study represents a effective utilization of coconut husk fibre for sorption of Cu(II) metal ions. In this study nanoparticles of coconut husk-SnO_2 was prepared by functionalization of coconut husk with oxidising agents and then nanoparticles were prepared by redox initiation system, which was characterized by FTIR, FESEM, TEM. The sorption capacitywere evaluated by AAS and parameters such as the effect of pHwere optimized. The maximum percent removal obtained is 85.81% for Cu(II) at pH 7.2. In the endCH-$SnO_2$is found to be an effective adsorbent for the sorption of Cu(II) metal ions.

Keywords*: coconut husk, copper, sorption, agriculture waste, nanoparticles*

INTRODUCTION

Coconut (*Cocos nucifera L*.) is extensively grown palm tree in India (FAO Statistics). The outermost part of fruit is covered with ductile, fiber, spongy husk which is called as coconut husk or coir, that is mesocarp part of the fruit (Bello et al, 2015; Omer et al, 2020). Coconut husk or coir is mesocarp part of the coconut fruit which is considered as agriculture waste. This husk are enriched with nutrients like cellulose (40–45%), lignin (30–40%), and hemicelluloses (24%) and shows absorption behaviour in regards of metal ions and plays a dominant role in the removal of different ionic dyes such as methylene blue. Apart from that, these fibers are used as reinforcement compound in composites and building materials (Danso, H. 2017; Omer et al, 2019a).

As the adsorption capacity of coconut fiber is not greater than modified adsorbents or modified ion exchange resins hence that can be enhanced by modification in chemical constituents, which activate the functional group present at the surface of adsorbent and leads to immediate availability for the bonding with metal ions (Bello et al, 2019; Sreedhar and Anirudhan, 2000; Omer et al, 2019b; Singh et al, 2018).

In this study nanoparticles of coconut husk-SnO_2 was prepared by functionalization of coconut husk with oxidising agents and then nanoparticles were prepared by redox initiation

system and then tts sorption capacity was evaluated in terms of optimised variables such as pH and contact time.

Fig. 1: Images of coconut husk

MATERIAL AND METHOD

CH has been collected from a local coconut shop and outside of the Hindu temples which were dumped as waste. $SnCl_2$ (Sigma-Aldrich 98%), Ethylene Glycol (Sigma-Aldrich 99.8%), Thiourea di oxide (Sigma-Aldrich 99%), Citric acid and all other chemicals were used of analytical grade.

Activation of Coconut Husk

CH was collected, cleaned and dried in 100°C in an electrical oven to remove its moisture. CH was grounded, sieved and sifted through 80 and 100 mesh. 15 g/L CH was taken and functionalized with 150 ml of NaOH (18% w/v) by heat treatment at water bath with continuous stirring at 55-65 $^{\circ}$C for 90 mins (Monserate et al. 2016) then it is treated with5% NaOCl solution for 12 hours to extract lignin and cellulosic content of husk. The resulting residue thoroughly washed with DI water several times then dried in an oven at 80°C for 3 hours and stored in a dry place.

Preparation of CH-SnO_2 Nanoparticles

CH-SnO_2nanoparticles were prepared by adding extra pure $SnCl_2.2H_2O$ to a solution of Ethylene Glycol/Citric acid in of ratio 4:1with continuous stirring until a transparent solution is obtained(Ferreira et al., 2015)and mixed with 0.5 g of the above obtained functionalized CH and mix it well for 15 mins in order to obtain a brown-coloured homogenous suspension with continuous heating at 60°C for 1 hour which is followed with subsequent heat treatment at 250°C for 4 hrs. The residual mixture got thick and dense and the quantity of mixture was reduced to spherical shaped coconut husk-SnO_2 particles which was separated, washed and subjected for its evaluation for sorption of Cu(II) metal ions.

RESULTS AND DISCUSSION

SEM analysis

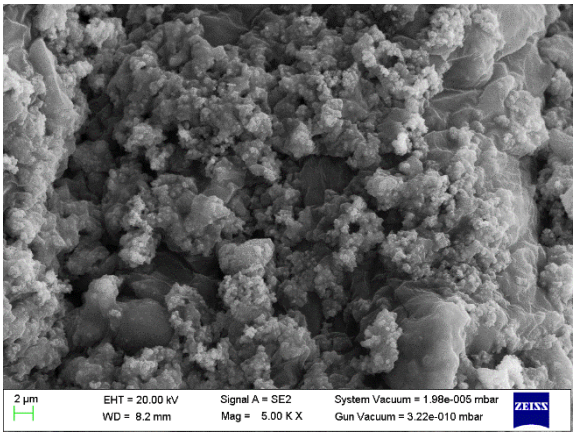


Fig. 2: SEM image of CH-SnO_2 Nanoparticles

Fig.2 SEM images showed uniformly dispersed spherical shaped particles while wrinkled structures indicates about its structural modification and binding with metal oxide. which increases its surface area and adsorptive activity towards heavy metals.

FT-IR analysis

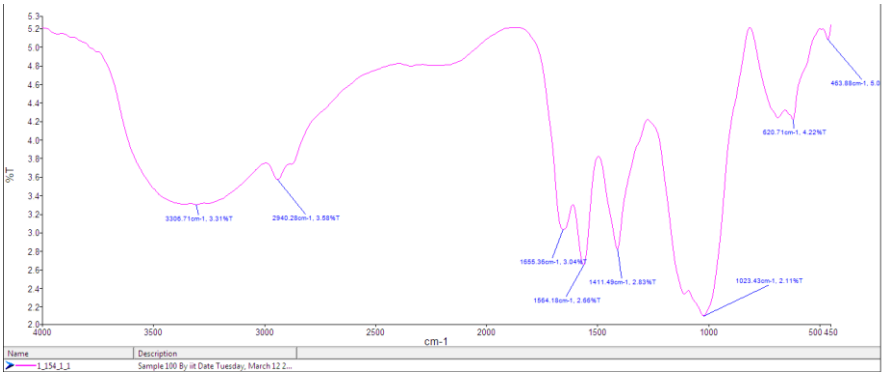


Fig. 3: FTIR spectrum of CH-SnO_2 Nanoparticles

Fig. 3 of FT-IR spectra represents the interaction between Coconut husk and SnO_2. The major characteristic peaks at 3306 cm^{-1}, attributed to the O-H groups in CH. A new peak appear 620.71 and1023.43 cm^{-1} for the Sn–O– Sn symmetric and asymmetric vibration.

TEM analysis

TEM analysis is required in order to gain more detailed information about the morphology of synthesised material. The TEM images showed that the average mean size of particles was in the range between 300 to 100 nm and the particles of the hydrogel were spherical in shape as confirmed by the images fig 4.

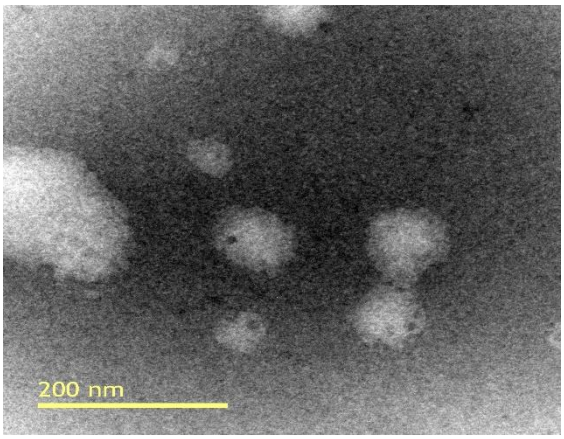
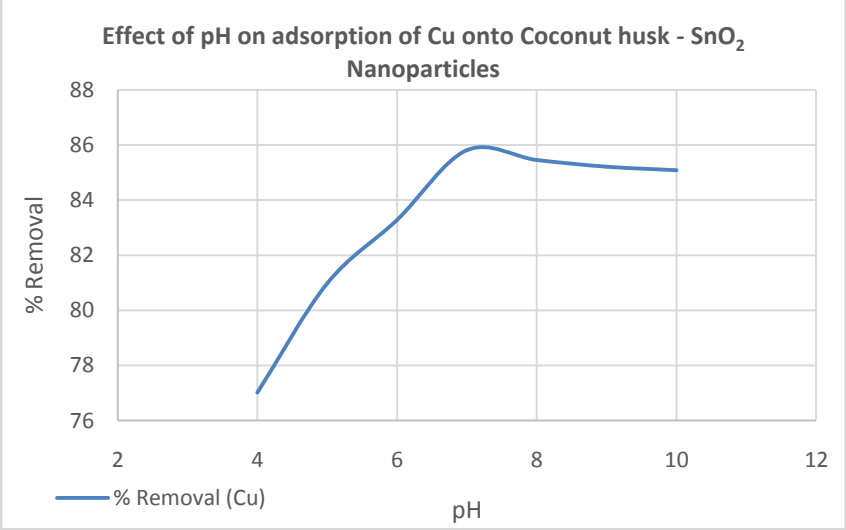


Fig. 4: TEM images of CH-SnO_2 Nanoparticles

Effect of pH

The adsorption efficiency of nanoparticles in the 3-8 pH range is depicted in Fig. 5, which indicates the percent removal of metal ions increases with an increase in pH and maximum adsorption occurs at pH 7.2 with 85.81 for Cu (II).



CONCLUSION

This study represents the synthesis of Coconut husk-SnO_2 nanoparticles by modification of nano Coconut husk-SnO_2 particles for the sorption of Cu(II) metal ions, which was characterized by FTIR, FESEM, TEM. The sorption capacitywere evaluated by AAS and parameters such as the effect of pHwere optimized. The maximum percent removal obtained is

85.81% for Cu(II) at pH 7.2. In the endCH-$SnO_2$is found to be an effective adsorbent for the sorption of Cu(II) metal ions.

REFERENCES

1. FAOSTAT, F. (2014). Statistics of the Food and Agriculture Organization of the United Nations [WWW Document] *URL< http://faostat. fao. org/site/567/default. aspx# ancor*>[access 27 sept 2014].
2. Bello, S., Adegoke, K. A., Fagbenro, O. S., Lameed, O. S. (2019). Functionalized coconut husks for rhodamine- B dye sequestration. Applied Water Science. 9(8):189.
3. Omer, S., Anand, S., Singh, S. K., Singh, A. (2020) 'Review Study on Waste Tire as an Adsorbent to Remove Toxic Metals from Waste Water. International Journal ofPharmaceutical and Medicinal Research, 8(1):1-5.
4. Danso, H. (2017). Properties of coconut, oil palm and bagasse fibres: as potential building materials. Procedia Engineering, 200:1-9.
5. Omer, S., Singh. A. and Upadhyay S. (2019a). Synthesis of Chitosan-g-Biomass Ash/Graphene Oxide Nanocomposite for the Removal of Copper and Chromium from Industrial Waste Water. Clay Research, 38(1): 19-28.
6. Sreedhar, M. K., & Anirudhan, T. S. (2000). Preparation of an adsorbent by graft polymerization of acrylamide onto coconut husk for mercury (II) removal from aqueous solution and chloralkali industry wastewater. Journal of applied polymer science, 75(10): 1261-1269.
7. Omer, S., Singh, A., Rose, S. and Singhal, A. (2019b). Adsorption studies on chitosan and guargum nanocomposite by application of agriculture waste – A review. International Journal of Research and Analytical Reviews, 6(1):1059-1062.
8. Singh, A., Omer, S., Singhal, A. and Sasmal, R. (2018) 'Adsorption of Heavy Metal Using Biomass Ash and Guar Gum Nanocomposite from Waste Water Effluent – A Review', International Conference on New Horizons in Green Chemistry & Technology (ICGCT), http://dx.doi.org/10.2139/ssrn.3301822
9. Monserate, J.J., Salazar, J.R., Jr, A.M.T. and Capariño O.A. (2016). Synthesis and characterization of nanocomposites from coconut waste (coconut husk): A new potential material for nano-filteration system. Asian Journal of Applied Sciences, 4(5):1163-1171.
10. Ferreira C.S., Santos P.L., Bonacin J.A. and Passos R.R. (2015). Rice Husk Reuse in the Preparation of SnO_2/SiO_2 Nanocomposite. Materials Research, 18(3): 639-643.

© 2021 by the authors; licensee Uttaranchal University, Dehradun, India.