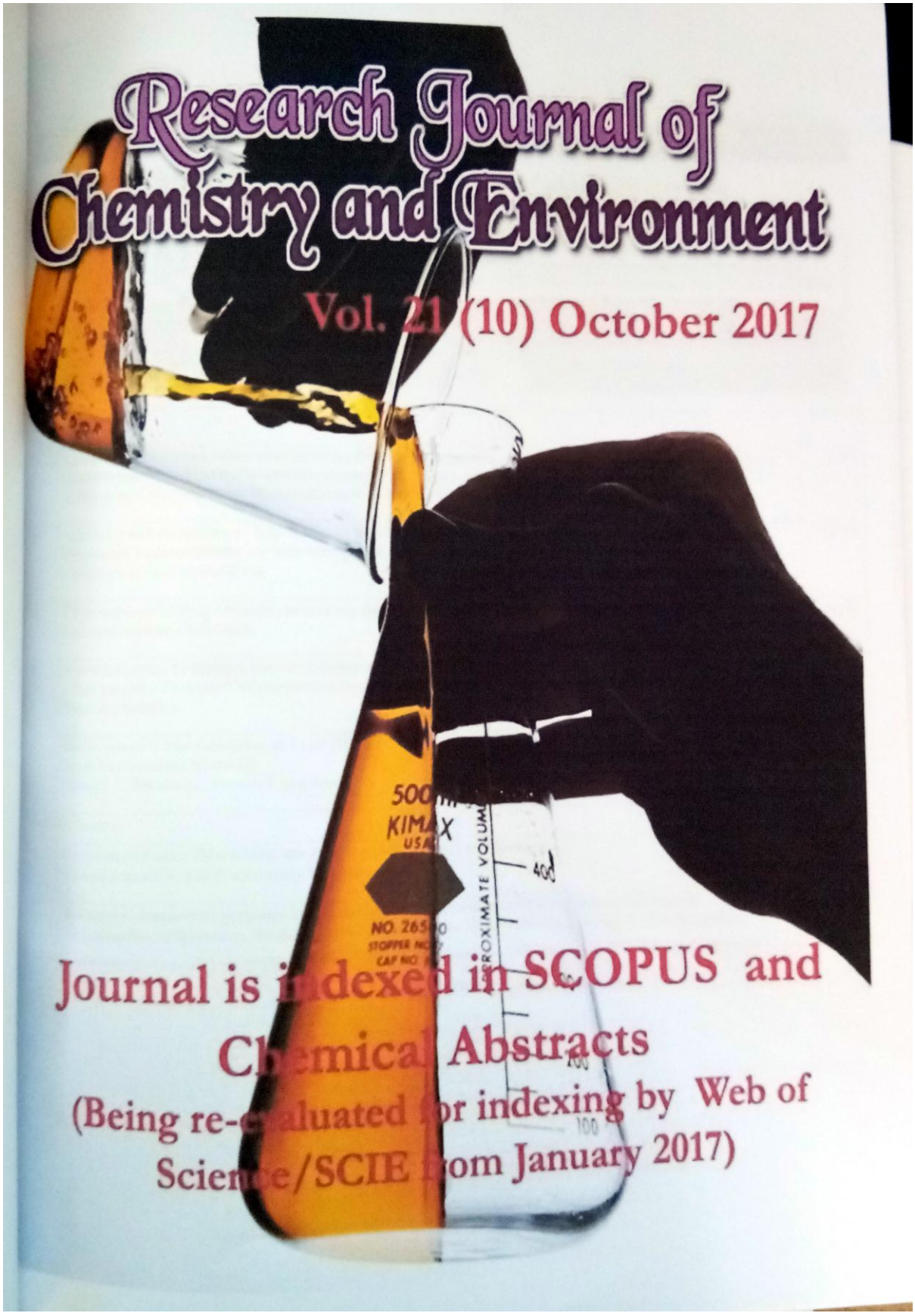

Research Journal of Chemistry and Environment

Vol. 21 (10) October 2017

Journal is indexed in SCOPUS and Chemical Abstracts

(Being re-evaluated for indexing by Web of Science/SCIE from January 2017)

GOD IS.

E-ISSN: 2278 – 4527 PRINT-ISSN No. 0972-0626

RESEARCH JOURNAL OF CHEMISTRY AND ENVIRONMENT

An International Research Journal of Chemical Sciences and Environmental Sciences

Res. J. Chem. Environ., Volume **21(10)**, Pages 1-64, **October (2017)**

Editor- in- Chief (Hon.)
Dr. D.K. VARDHAN
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CONTENTS

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Chitosan from shrimp (*Peneaus monodon*) skin waste as natural coagulant to remove heavy metal Hg

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Abstract

This study aimed to isolate chitosan from waste of shrimp skin and applied as environmentally friendly natural coagulant. This study included the isolation, characterization and application of chitosan in the adsorption of heavy metal Hg. Chitosan was obtained from waste of shrimp (Peneaus monodon) skin via deproteination, demineralization, depigmentation and deacetylation.

Optimization of adsorbent mass was carried out by varying the adsorbent mass of 0, 0.3, 0.6, 0.9, 1.2 and 1.5 g. In addition, the effect of pH was conducted by performing the adsorption under different pH of 2, 6, 7, 8 and 9. The results showed that the use of 1.2 g of chitosan gave Hg(II) removal of 99.86% or 9.986 µg/L. It could be concluded that chitosan as natural coagulant could adsorb Hg(II) in water.

Keywords: Chitosan, Peneaus monodon, Mercury, Waste, Adsorbent.

Introduction

Mercury (Hg) is one of global pollutant which may give bad impacts to human health and ecosystem[4]. Several techniques have been applied to remove this heavy metal such as ion exchange, solvent extraction, ultra-filtration, adsorption and coagulation[19].

Coagulation is one of effective methods in minimizing the heavy metal concentration in waste water[3]. One of widely employed natural coagulant is chitosan (β-(1-4)-2-amino-2-dioxy-D-glucose). Chitin and chitosan could be abundantly found from crustaceans like shrimp and cram[7].

Natural coagulants have several advantageous comparing to commercial ones such as availability of the raw material, cheap, environmentally friendly and biodegradable[6]. Both chitin and chitosan are not toxic and biodegradable[5,16]. Lukum et al[11,12] reported that chitosan obtained from Gorontalo shrimp skin wastes has deacetylation degree of 80% and was able to adsorb Pb(II) from sugar factory Tolanghua, Gorontalo. Several reports demonstrated that chitosan was effective to reduce COD level and turbidity of textile industry liquid waste as much as 72.5% and 94.9%. The efficiency of chitosan in reducing the turbidity of seawater was higher than ferro sulfate and was similar with that of alum[2].

Chitosan and its derivatives displayed good adsorption capacities toward arsenic[17]. Adsorption of Hg(II) onto chitosan probably occurred via single or mixture interaction: coordination with amino group or combination with vicinal hydroxyl group, electrostatic in acidic media or ion exchange with protonated amino group[14].

According to Lertsutthiwong et al[10], chitosan could be obtained from chitin via deacetylation process. It has free amino group which might be able to bind metal ions. It has been employed to remove heavy metal ion from the effluent. Chitosan and its derivatives are cheap and effective as heavy metal adsorbent[23]. Shrimp is abundant natural resources particularly in Gorontalo Province. In several traditional markets in Gorontalo, it was observed that the shrimp skin was discarded and was left to rod without any further treatment and may lead to environmental pollution and damage environment. These problems might be solved by applying the shrimp waste as the source of chitosan. Several reports showed that chitosan displayed good activities in the adsorption of Hg(II)[18] and Pb(II)[20] ions.

This research aimed to prepare chitosan from the shrimp skin waste and to apply it as environmentally friendly natural coagulant. The produced chitosan would be applied in the adsorption of Hg(II) ions. In addition, the effect of pH and mass adsorbent would be evaluated.

Material and Methods

Materials: The shrimp skin was obtained from Gorontalo. The chemicals employed for this study were standard solution of $Hg(NO_3)_2$, HCl, NaOH, hydrogen peroxide, acetic acid, ammonia, sodium sulfate, nitric acid, aquadest, filtered paper and universal indicator.

Tools: The used instruments in this study were laboratory glassware, oven, magnetic stirrer, hotplate, stirrer, centrifuge, sieve (90 mesh), desiccator, furnace, atomic absorption spectrometer (AAS, AA240FS VARIAN), infrared spectrometer (FTIR), analytical balance, mortar and pestle.

Isolation of chitosan from shrimp *(Peneaus monodon)* skin: Shrimp skin was washed and dried on the open air. It was then grinded by using mortar and sieved to give 90 mesh size. Isolation of chitosan[11] was carried out with the

Conclusion

Chitosan isolated from *Peneaus monodon* could be applied as environmentally friendly natural coagulant. It could be also applied as adsorbent of Hg(II) ion. The results showed that the optimum mass and pH values were 1.2 g and 8 respectively. Under the optimum condition, the percent removal of Hg(II) was 99.86%.

Acknowledgement

The authors would acknowledge Ministry of Research, Technology and Higher Education for the funding as well as to research members and students who have contributed to this study.

References

Agustina S. and Kurniasih Y., Pembuatan Kitosan dari Cangkang Udang dan Aplikasinya sebagai Adsorben untuk Menurunkan Kadar Logam Cu, Universitas Pendidikan Ganesha, Seminar Nasional III FMIPA Undiksha **(2013)**

Altaher H., The Use of Chitosan as a Coagulant in the Pre-treatment of Turbid Sea Water, *Journal of Hazardous Materials*, **183–234(30)**, 97–102 **(2012)**

Bina B., Mehdinejad M.H., Nikaeen M. and Attar M.H., Effectiveness of Chitosan as Natural Coagulant Aid in Treating Turbid Waters, *Iranian Journal of Environmental Health Science Engineering*, **6(4)**, 247-252 **(2009)**

Driscoll C.T., Mason R.P., Chan H.M., Jacob D.J. and Pirrone N., Mercury as a Global Pollutant: Sources, Pathways, and Effects, *Environ Sci Technol.*, **47(10)**, 4967–4983 **(2013)**

Elhefian E.A. and Yahaya A.H., Rheological Study of Chitosan and Its Blends: An Overview, *Maejo Int. J. Sci. Technol.*, **4(2)**, 210-220 **(2010)**

Fatehah M.O., Hossain S. and Teng T.T., Comparative Study on Natural and Commercial Coagulants: Treatment of Semiconductor Wastewater in Sludge Production and Removal of Heavy Metals, *JSME*, **1(7)**, 1-8 **(2013)**

Hasan M.A.A., Li T.P. and Noor Z.Z., Coagulation and Flocculation Treatment of Wastewater in Textile Industry Using Chitosan, *Journal of Chemical and Natural Resources Engineering*, **4 (1)**, 43-53 **(2009)**

Khan T.A., Peh K.K. and Ching H.S., Reporting Degree of Deacetylation Values of Chitosan: The Influence of Analytical Methods, *J. Pharm Pharmaceut Sci.*, **5(3)**, 205-212 **(2002)**

Kovacevic G., Kastori R. and Merkulov L.J., Dry Matter and Leaf Structure in young Wheat Plants as Affected by Cadmium, Lead Nickel, *Bio. Plant*, **42(1)**, 119-123 **(1999)**

Lertsutthiwong P., How Ng C., Chandrkrachang S. and Stevens W.F., Effect of Chemical Treatment on the Characteristics of Shrimp Chitosan, *Journal of Metals, Materials and Minerals*, **12(1)**, 11-18 **(2002)**

Lukum A., and Usman A., Isolasi dan Karakterisasi Kitosan dari Kulit Udang Windu (Peneaus monodon) yang Dibudidayakan di Gorontalo, *J. Entropi.*, **5(1)**, 56-73 **(2009)**

Lukum A., and Djafar F., Application of Chitosan from Peneaus monodon as Coagulant of Pb(II) in Waste Water from Tolangohula Sugar Factory Kabupaten Gorontalo, *Indo J Chem.*, **12(3)**, 297-301 **(2012)**

Mekawati F.E. and Sumardjo D., Aplikasi Kitosan Hasil Tranformasi Kitin Limbah Udang (Penaeus merguiensis) untuk Adsorpsi Ion Logam Timbal, *Jurnal Sains and Matematika*, **8(2)**, 51-54 **(2000)**

Miretzky P. and Cirelli AF., Hg(II) Removal from Water by Chitosan and Chitosan Derivatives: A Review, *Journal of Applied Polymer Science*, **79(3)**, 466–472 **(2009)**

Onundi Y.B., Mamun A.A., Al Khatib M.F. and Ahmed Y.M., Adsorption of Copper, Nickel and Lead Ions from Synthetic Semiconductor Industrial Wastewater by Palm Shell Activated Carbon, *Int. J. Environ. Sci. Technol.*, **7(4)**, 751-158 **(2010)**

Palpandi C., Shanmugam V. and Shanmugam A., Extraction of Chitin and Chitosan from Shell and Operculum of Mangrove Gastropod Nerita (Dostia) crepidularia Lamarck, *J. Med. Sci.*, **255(1)**, 64-74 **(2009)**

Pontoni L. and Fabbricino M., Use of Chitosan and Chitosan-Derivatives to Remove Arsenic from Aqueous Solutions--A Mini Review, *Carbohydrate Research*, **356**, 86–92 **(2012)**

Rahayu L.H. and Purnavita S., Optimasi Pembuatan Kitosan dari Kitin Limbah Cangkang Rajungan (*Portunus pelagicus*) untuk Adsorben Ion Logam Merkuri, *Jurnal Reaktor*, **11(1)**, 45-49 **(2007)**

Rahbar N., Jahangiri A., Boumi S. and Khodayar M.J., Mercury Removal from Aqueous Solutions with Chitosan-Coated Magnetite Nanoparticles Optimized Using the Box-Behnken Design, *Jundishapur J Nat Pharm*, **9(2)**, e15913 **(2014)**

Sanjaya I. and and Yuanita L., Adsorption of Pb (II) by Chitosan Resulted from Bakau Crab's Shell (Scylla sp) Chitin Isolation, *Jurnal Ilmu Dasar*, **8(1)**, 30-36 **(2007)**

Sukma S., Lusiana S.E., Masruri and Suratmo, Kitosan dari Rajungan Lokal Portunus pelagicus Asal Probolinggo, Indonesia, *Kimia Student Journal*, **2(2)**, 506-512 **(2014)**

Vani R. and Shaleesha A.S., Studies on the Extraction of Chitin and Chitosan from Different Aquatic Organisms, *Advanced BioTech.*, **12(12)**, 12-15 **(2013)**

Wan Ngah W.S., Teong LC. and Hanafiah M.A.K.M., Adsorption of Dyes and Heavy Metal Ions by Chitosan Composites: A Review, *Carbo Hydr Polim*, **83(4)**, 1446-56 **(2011)**.

(Received 21st July 2017, accepted 30th August 2017)