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The Potention of Chicken Egg Shell (Galus galus domesticus) as Mercury Adsorbent for Blood Cockle (Anadara granosa) by Stirring Chamber Engineering By Hadi Suryono

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DOI Number: 10.5958/0976-5506.2018.00446.1 The Potention of Chicken Egg Shell (Galus galus domesticus) as Mercury Adsorbent for Blood Cockle (Anadara granosa) by Stirring Chamber Engineering Hadi Suryono1, Narwati1, Heru Santoso Wahito Nugroho1 1Health Polytechnic of Ministry of Health at Surabaya, Indonesia ABSTRACT Blood cockle (Anadara granosa) was a type of clam that is widely consumed by society especially people who lived in coastal area incuding Surabaya. The mercury (Hg) level in blood cockle clam became a health problem for human who consumed it. The examples of mercury effect to human health was the case of Minamata Disease in Japan and Muara Angke case in Jakarta which caused several victims. The type of this research was experiment with one group pre-post test design. The object of this research was chicken egg shell that used such as adsorbent in stirrinng chamber. Stirring chamber was a food hygiene tool which can decrease mercury level in blood cockle using stirring principle. Samples were taken using purposive technique with five replication. The level of adsorbent which was used were 25 grams, 50 grams, and 75 grams in a liter of water then stirred for 15 minutes, 30 minutes, and 45 minutes using stirring chamber. Results showed that the level of mercury in blood cockle were reduced along with the increasing of the adsorbent dosage and the stirring duration. The highest number of mercury reduction were in the longest duration of stirring (45 minutes) with the highest dosage of adsorbent (75 grams). The level of mercury content in blood cockle which reduced were 0.545 ppm (93.64%) from 0.582 ppm before treatment into 0.037 ppm after treatment. The conclusion was the longer duration of stirring and the higher adsorbent dosage would be the lower level of mercury in blood cockle. It was recommended to the society to stirr blood cockle using chicken egg shell adsorbent before it was cooked. The next research about reducing mercury level can be done by adding another variables such as temperature, stirring speed, and adsorbent diameter variant to know the effective way to reduced mercury level in blood cockle. Keywords: Blood cockle, Mercury, Stirring chamber, Chicken egg shell INTRODUCTION Anandra Granosa was sea creature which has economical value because of its nutrition. Those potention make blood cockle was one of seafood which popular in Indonesian restaurants.(1). But unfortunately, the contamination of heavy metals in blood cockle need to beware to prevent the health disorders which may appear. A control for food quality is

needed based on the standard regulations. Based on SNI No. 7387 2009 the Corresponding author: Heru Santoso Wahito Nugroho Health Polytechnic of Ministry of Health at Surabaya, Campus of Magetan, S. Parman Street No. 1 Magetan, Jawa Timur, Indonesia, Email: heruswn@gmail.com maximum limit of Mercury (Hg) in blood cockle was 1 mg/kg, it means only 0.1 mg Mercury (Hg) which allowed in every 100 grams of blood cockle samples. But even in this level of Mercury contamination, the blood cockle still should not be consumed continously. Those limit only as a consument guide to estimate the toxic level of mercury contamination in food in period of time. However, any level of mercury contamination will still give negative impact for human health. Toxic effects which appeared because of mercury contamination in food are damaging body organs and also can cause death. As it happened in Japan called Minamata cases. So the accumulation of mercury must be our concern. Based on WHO, the threshold value of mercury level in blood was 5µg/l -10 µg/l.(2) Kenjeran is a coastal area located in Surabaya city. The pollution of mercury in Kenjeran comes from mercury contamination from some rivers that come down to there. The water in coastal area of Kenjeran has been polluted by heavy metal mercury (Hg), cromium (Cr), cadminum (Cd), and cobalt (Co), fish in Kenjeran also have been contaminated by mercury and crominum.(3) The contamination of mercury in blood cockle was 0.032 mg/kg dried weight in blood cockle's muscle and 0.01615 mg/kg dried weight in blood cockle's gill which taken from Kenjeran area.(4) This study would use chicken egg shell to decrease the level of Hg in blood cockle (Anadara granosa). Chicken egg shell will be used because it was easy to be found, and also considered society assumption that chicken egg shell was a waste so it needed to be exploited its benefits rather than just throw it away as a garbage. The use of chicken egg shell usually found as handycrafts and as adsorbent for water. The content of chicken egg shell was 98.5% of CaCO3, 0.85% Magnesium carbonate, and mostly contain organic matter. These was the reason we choose chicken egg shell as adsorbent to minimize mercury in blood cockle. Beside its content, pores in chicken egg shell have potention to be used as adsorbent. The larger of chicken egg shell surface, the more pores in there. It means the larger surface of chicken egg shell the more substances that can be adsorbed. Surface area of the adsorbent is determined by the size of the particles and the amount of adsorbent.(5) Adsorption process while binding some compounds in a solution affected by contact time. Syauqiah, et al.(6) conclude that the more contact time the more amount of Fe which decrease because the adsorption process work better. This principle then becomes the background if contact between adsorbent and asorbat done using striing then it will increase adsorption process in a solution. The rate of adsorption affected by film diffusion and pore diffusion, and also stirring factor.(7) Adsorption limited primarily by film diffusion and pore diffusion process, depend with the amount of movement in its system.(8) If the movement in stirring process relatively low, it makes film layer around the adsorbent will be thick and decrease the adsorption process. Otherwise if the stirring process is enough the rate of film diffusion will increase. This underlise the writer to combine adsorption process in a tool that has principal to increase adsorption rate to decrease the level of mercury in blood coockle. This study aimed to analyze the potention of chicken egg shell as an adsorbent to decrease the level of Hg in blood cockle using engineering tool Stirring Chamber. MATERIAL AND METHOD This research conducted by using pre experimental design. The presence of the effect will be used as a base to achieve the aims in this research which to know the effect of chicken egg shell as an adsorbent using stirring chamber tool to decrease the level of Hg in blood cockle (Anadara granosa). This research conducted using one group pretest-posttest design. This design use only a group of subject which be given a treatment (X), the level of Hg then will be measured before treatment (O1) and after treatment (O2), the result will be known

more accurate because we can compare the level of Hg before and after treatment. The design form can be seen above: The independent variable of this studi was stirring duration process and adsorbent dosage. Stirring was done for 15 minutes, 30 minutes, and 45 minutes. While the adsorbent dosages were 25 grams, 50 grams, and 75 grams. Replication was calculated using Federer formula (K - 1) (r - 1) ≥ 15, so there would be four replications in each treatment. But this research used five replication. The dependent variable was the level of Hg in blood cockle. The mechanism in this research was implemented in two stage (the preparation stage and the process stage). The mechanism is described in diagram below. A. STAGE I : PREPARATION OF THE EXPERIMENT THE PRODUCTION OF ADSORBENT STAGE II: THE PROCESS OF EXPERIMENT The process of experiment is described schematically in Figure 3 and Figure 4 below. 1St REPLICATION 1St GROUP : Without adsorbent and stirring process. 1. KR1 = for 15 minutes (without the treatment) 2. KR1= for 30 minutes (without the treatment) 3. KR1= for 45 menit (without the treatment) 2nd GROUP: With adsorbent and stirring process A. 1st REPLICATION The information : K = Control A, B, C = Stirring Duration (for 15 minutes, for 30 minutes, and for 45 minutes). T 1,2,3 = Adsorbent dosage (25 grams, 50 grams, and 75 grams). R1, …. = 1st replication, 2nd replication, ... The 2nd until 5th replication would be done same as 1st replication. Stirring Chamber Model The anatomy of both inner and outer stirring chamber is shown in detail in Fig. 5 a and b. Part a: The inner of stirring chamber Part b: The outer of stirring chamber Figure 5. The Stirring Chamber RESULTS AND ANALYSIS a) The Average Results of Hg in Control Group: KA = 0.661 ppm, KB = 0.616 ppm, KC = 0.581 ppm. b) The Average Results of Hg in Before and After of The Treatment. Table 2. The Results of Anova Table 1. The Hg Level as The Results of The Experiment The Sam- ple's Code Average of Hg Level Differences Per- centage Before After (ppm) (%) AW1 0.661 0.532 0.129 19.52 AW2 0.616 0.357 0.259 42.05 AW3 0.582 0.24 0.342 58.76 BW1 0.661 0.248 0.413 62.48 BW2 0.616 0.214 0.402 65.26 BW3 0.582 0.132 0.450 77.32 CW1 0.661 0.244 0.418 63.16 CW2 0.616 0.162 0.455 73.78 CW3 0.582 0.037 0.545 93.64 Description : A, B, C = Stirring Process with Duration: 15 minutes, 30 minutes, and 45 minutes. W1,2,3 = Adsorbent dosage: 25 grams, 50 grams, and 75 grams. The highest number of average difference of Hg reduction was CW3 sample (45 minutes stirring duration and 75 grams adsorbent dosage) with the average difference was 93.64 ppm (93.64%). While the lowest differemce of Hg was AW1 sample with 19.52 ppm (19.52%) reduction. The more duration of stirring process and adsorbent dosage affect the Hg reduction higher. Two way anova analysis showed that stirring duration and adsorbent dosage has sig. 0.00<0.05, which means there were a significant effect of stirring duration and adsorbent dosage to the Hg reduction in blood cockle. Dependent Variable: The Hg Level Source Type III Sum of Squares df Mean Square F Sig. Corrected Model 3.088a 11 0.281 1210.954 0.000 Intercept 6.659 1 6.659 28727.765 0.000 Stirring_Duration 1.133 2 0.567 2444.323 0.000 Adsorbent_Dosage 1.728 3 0.576 2484.093 0.000 Stirring_Duration * Adsorbent Dosage 0.227 6 0.038 163.261 0.000 Error 0.011 48 0.000 Total 9.758 60 Corrected Total 3.099 59 a. R Squared = .996 (Adjusted R Squared = .996) Description : 1. Corrected Model: Sig. value 0.000 (<0.05), showed that there was an effect of independent variable (Stirring duration and chicken egg shell adsorbent dosage) to Hg level in blood cockle. 2. Stirring Duration: Sig. value 0.000 (<0.05), showed that there was a significant effect of stirring duration to the Hg level in blood cockle. 3. Adsorbent dosage: Sig. value 0.000 (<0.05), showed that there was a significant effect of adsorbent dosage stirring to the Hg level in blood cockle. 4. Stirring duration* Adsorbent dosage: sig-value 0.000 (<0.05), showed that there was a significant effect of stirring duration and adsorbent dosage to the Hg level in blood cockle. 5. R Squared = 0.996 ? strong corelation. CONCLUSION 1. The results of Hg level difference in

blood cockle before and after treatment based on stirring duration and chicken egg shell adsorbent dosage using stirring chamber described above: a) The average difference of Hg level in blood cockle using 15 minutes stirring duration with 25 grams adsorbent dosage was 0.219 ppm (19.52%), with 50 grams adsorbent dosage was 0.259 ppm (42.05%), and with 75 grams adsorbent dosage was 0.342 ppm (58.76%). b) The average difference of Hg level in blood cockle using 30 minutes of stirring duration with 25 grams adsorbent dosage was 0.413 ppm (62.48%), with 50 grams adsorbent dosage was 0.402 ppm (65.26%), and with 75 grams adsorbent dosage was 0.450 ppm (77.32%). c) The average difference of Hg level in blood cockle using 45 minutes stirring duration with 25 grams of adsorbent dosage was 0,418 ppm (63.16%), with adsorbent dosage 50 grams was 0.455 ppm (73.78%), and with 75 grams adsorbent dosage was 0.545 ppm (93.64%). 2. There were effect of stirring duration and chicken egg shell as adsorbent dosage to the level of Hg in blood cockle. RECOMMENDATION 1. Stirring chamber need a better design with stronger and more solid materials to prevent damages while experiments. Repairing the damages needed to prevent another unspesific effect to the samples. 2. Advanced research to analyze another variables which might affect the Hg level in blood cockle are needed, another variables for example temprature, pH, stirring speed, or adsorbent diameter. Modification can be done to the stirring chamber such as heater and speed regulator. Modification to the pH solution also can be another option in order to increase effectiveness to reduce Hg level in blood cockle. Conflict-of-Interest, Source of Funding and Ethical Clearance: The authors declare that there is no conflict of interest in this research. All funds of this research comes from the authors. This research has passed in ethical assessment at Health Polytechnic of Ministry of Health at Surabaya. 1. REFERENCES Sekarsari B. Is Healthy Eating Shells? (Sehatkah 2. Makan Kerang?). 2016. http://1health.id/id/article/ category/diet-dan-nutrisi/sehatkah-makan-kerang. html, accessed: December 1st, 2016, 10.05 WIB. WHO. Early Detection of Occupational Diseases. 3. Geneva: World Health Organization; 2016. Taftazani A, Sumining, Muzakky. Evaluation 4. of Heavy Metal Distribution In Water Samples, Sediments, Grouper Fish and Green Shells In The Waters of Kenjeran Beach Surabaya (Evaluasi Sebaran Logam Berat Dalam Cuplikan Air, Sedimen, Ikan Krapu Dan Kerang Hijau Di Perairan Pantai Kenjeran Surabaya). Ganendra Majalah Iptek Nuklir. 2001;4(1). Indrakusuma A. The Level of Heavy Metals 5. “Mercury (Hg)” on Muscles and Gills of Dara (Anadara granosa) at Ria Kenjeran Beach Surabaya (Kandungan Logam Berat Merkuri (Hg) pada Otot dan Insang Kerang Dara (Anadara granosa) di Pantai Ria Kenjeran Surabaya). Intertide Ecological Community-Laboratoriom of Ecology Department of Biology Institute of Technolgy Sepuluh Nopember; 2008. Reynold TD. Unit Operation and Process in Environmental Engineering. Texas: Woods Worths Inc; 1982. 6. Syauqiah I, Amalia M, Kartini HA. The Analysis of Time Variation and Stirring Speed on The Adsorption Process of Heavy Metal Waste with Active Charcoal (Analisis Variasi Waktu dan Kecepatan Pengaduk pada Proses Adsorpsi Limbah Logam Berat Dengan Arang Aktif). Info Teknik. 2011; 12(1). 7. Asip F, Mardhiah R., Husna. Test Effectiveness of Egg Shell in Adsorcing Fe Ion with Batch Process (Uji Efektivitas Cangkang Telur dalam Mengadsorpsi Ion Fe dengan Proses Batch). Jurnal Teknik Kimia. 2008;15(2), 22-26. 8. Webber. Adsorption Analysis: Equilibria and Kinetics. Queensland: Imperial College Press; 1972. Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5 239 240 Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5 Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5 241 242 Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5 Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5 243 244 Indian Journal of Public Health Research & Development, May 2018, Vol. 9, No. 5