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DOI Number: 10.5958 /0974-1283.2019. 00054.9 Stirring Chamber Design Development to Increase the Potention of Chicken Egg Shells to Decrease Cadmium (Cd) Level in Blood Cockle (Anadara Granosa) Narwati1, Hadi Suryono1 1Department of Environmental Health, Health Polytechnic of Surabaya, Indonesia ABSTRACT A study about chicken egg shells as an adsorbent to decrease Hg level in blood cockle (Anadara granosa) has been done by Suryono in 2017, its results showed that chicken egg shells could decrease Hg level in blood cockle. The lowest level of Hg (0.545 ppm or 93.64%) was using 45 minutes of stirring process with 75 grams of chicken egg shells, there was a significant difference of Hg level in blood cockle before and after the process. The Hg level decrease from 0.582 ppm to 0.037 ppm. Those processes include the use of chicken egg shells as adsorbent cannot reduce all the level of Hg. This study used One Group pretest-posttest Design. Samples were blood cockle (Anadara granosa). Stirring chamber was a food sanitation tool, it had ability to decrease heavy metal level such as Cd in blood cockle using the stirring and adsorbent temperature principles. Samples were taken using purposive sampling. There were 9 treatments and 3 replications. The stirring process was done in 15 minutes using 50 rpm, 150 rpm, and 250 rpm of speed. The adsorbent temperature were 35°C, 50°C and 65°C, it

used 50 grams of chicken egg shells (adsorbent) in 1 liter of water. The results showed that blood cockle (Anadara granosa) which was taken from Kenjeran coastal area, Surabaya contain 0.93 ppm of Cd level in average. The level of Cd in the control group was 0.82 ppm. While the average level of Cd in the blood cockle in the treatment groups were 0.15 ppm. The amount of Cd level decreasing in treatment groups were 82.1% (0.67 ppm). The stirring speed and adsorbent temperature were contributed to give significant difference of Cd level in blood cockle. From the results we could conclude that the intervention stirring and adsorbent temperature can decreased Cd level. We suggest that societies can use stirring and heating using chicken egg shells as an adsorbent to control food contamination of Cd. Keywords: Stirring chamber, Stirring speed, Adsorbent temperature, Chicken egg shells INTRODUCTION Food quality that is not fulfil health requirements was a main problem of food safety. It needs awareness to understand that this was some parties responsibility. They were governments, food industries, food producer, and also consumer(1). The regulation in Indonesia (UU No.18, 2012) mention that farmers, fishermen, fish farmers, and food business actors are obliged to apply food safety norms, standards, procedures and criteria. Corresponding Author: Hadi Suryono Department of Environmental Health, Health Polytechnic of Surabaya, Indonesia Pucang Jajar Tengah Street-56, Surabaya, Indonesia Email: suryonohadi.2008@gmail.com Food safety intend to prevent the possibility of biological, chemical and other contaminants that can interfere, harm and endanger human health. Seafood was potential to contaminate by heavy metal(2). Suryono et al. reported that blood cockle that was taken from Kenjeran coastal area in Surabaya contain 0.620 ppm of Mercury (Hg). Mercury contamination also was found in Asian green mussel (Mytilus viridus) (3). Trisnawati mention that the level of Cadmium (Cd) in Asian green mussel was 50.23-70.39 pmm inside its gill, 31.08-44.53 pmm in its liver, and 6.73-7.37 ppm on the sea water(4). Fransiska et al. also proved that there were 0.76073 mg/kg of lead (Pb) in blood cockle that was taken from Kenjeran coastal area, Surabaya(5). Simple and inexpensive efforts to decrease the level of heavy metal that can be done were using chicken egg shells. Suryono found that the use of 75 grams chicken egg shells powder and 45 minutes of stirring process can decrease 93,64% of Hg level(3). Aimi et al. mention that this due to chicken egg shells contains $CaCO_3$. It can absorb metals(6). Besides Hg, blood cockle also contain Cd. The level of Cd in blood cockle which was taken from Kenjeran, Surabaya was 0.93 ppm(3). This level is still safe based on SNI No.7387, 2009. But consume food that is contaminated by Cd have potential to damage the organs or death due to the accumulation of Cd inside the body. The aim of this research is to analyse the difference of Cd level in blood cockle (Anadara granosa) after it is given a treatment by using the stirring speed and adsorbent temperature principles. MATERIALS AND METHOD This was experimental research using one group pretest-posttest design. Independent variables were the speed of stirring and adsorption temperature. We used 50 rpm, 150 rpm, and 250 rpm of speed. The adsorption temperature was 35°C, 50°C, and 65°C. The dependent variable was Cd level. Samples were blood cockle from Kenjeran coastal area, Surabaya. The stages to make the chicken egg shells adsorbent were: 1) Washed the chicken egg shells then take the membrane and all the dirt, 2) Soaked with hot water in 15 minutes then let it dry, 3) The egg shells then be mashed using blender, 4) Sifted the chicken egg shells powder with 120 mesh sieve, 5) Put the powder in the oven for 15 minutes 100 ºC, 6) Activated the powder using 0.1 M of HCl in 48 hours, 7) After 48 hours drain well and wash until the pH 7 or neutral, 8) Put the powder in oven again to make it dry for 30 minutes 100 ºC. If the chicken egg shells powder as adsorbent was ready, put 50 grams of the powder to a liter of water and 250 grams blood cockle inside the stirring chamber. Adjust the adsorbent temperature and stirring speed, then analyze the Cd level in blood cockle using Atomic Absorption

Spectrophotometry. FINDINGS AND DISCUSSION The results of Cd level test in blood cockle (Anadara granosa) with 50 grams of chicken egg shells as adsorbent before and after the treatment using stirring speed and adsorption temperature can be seen below. We use three replication. Table 1: The average Level of Cd in Blood Cockle (Anadara granosa) with 50 grams of chicken egg shells as adsorbent before the treatment Samples Stirring Adsorption Results Code Speed (rpm) Temperature (°C) Cd (ppm) KAT1 35 0.93 KAT2 50 50 0.87 KAT3 65 0.75 KBT1 35 0.79 KBT2 150 50 0.80 KBT3 65 0.80 KCT1 35 0.82 KCT2 250 50 0.82 KCT3 65 0.79 Total 7.37 Average 0.82 Based on SNI (Indonesian Standard) No. 7387, 2009, the level of Cd in blood cockle after it soaked with adsorbent chicken egg shells powder was below the maximum allowable threshold value (1 ppm). But we need to consider the effect of blood cockle consumption continuously in short time. The accumulation of heavy metal in seafood can be happen due to food chain cycle. Palar explained that in the body of aquatic biota, the amount of heavy metal will accumulated and continue to increase (biomagnification) in the food chain, where biota at the higher level in the food chain will experience more accumulation(7). Table 2: The average level of Cd in Blood Cockle (Anadara granosa) with 50 grams of chicken egg shells as adsorbent after the treatment Samples Stirring Adsorption Results Code Speed (rpm) Temperature (°C) Cd (ppm) AT1 35 0.48 AT2 50 50 0.31 AT3 65 0.15 BT1 35 0.12 BT2 150 50 0.09 BT3 65 0.08 CT1 35 0.07 CT2 250 50 0.04 CT3 65 0.03 Total 1.37 Average 0.15 Medico-legal Update, January-June 2019, Vol.19, No. 1 271 The average difference of Cd level in blood cockle before and after the treatment using stirring speed and adsorption temperature was 0.82 ppm in before treatment group and 0.15 ppm in after treatment group. While the amount of Cd level decreasing can be seen in table 3. Table 3: The amount of Cd level decreasing in Blood Cockle (Anadara granosa) with 50 grams of chicken egg shells as adsorbent before and after the treatment Samples Stirring Adsorption Cd Results Decreasing Decreasing Code Speed Temperature (ppm) Total Total (ppm) (°C) Before After (ppm) (%) AT1 35 0.93 0.48 0.45 48.4 AT2 50 50 0.87 0.31 0.56 64.4 AT3 65 0.75 0.15 0.60 80.0 BT1 35 0.79 0.12 0.67 84.8 BT2 150 50 0.80 0.09 0.71 88.75 BT3 65 0.80 0.08 0.72 90.0 CT1 35 0.82 0.07 0.75 91.5 CT2 250 50 0.82 0.04 0.78 95.1 CT3 65 0.79 0.03 0.76 96.2 Total 7.37 1.37 6.00 739.2 Average 0.81 0.15 0.67 82.1 The difference of average Cd level before and after treatment was 0.67 ppm (82.1%). It indicated that there was Cd level decreasing that is caused by stirring speed and adsorption temperature. This is the graphic which shows the percentage of Cd level in blood cockle (Anadara granosa) after the treatment using 3 variations of stirring speed and adsorption temperature with 50 grams of chicken egg shells as adsorbent. Figure 1: The Graphic of Cd Level Percentage in blood cockle (Anadara granosa) after the treatment using 3 variations of stirring speed and adsorption temperature with 50 grams of chicken egg shells as adsorbent. From the Figure 1, we can understand that the highest decreasing total was CT3 sample using 250 rpm of stirring speed and 65°C. The total decreasing in sample CT3 was 96.2%. Ancova test was used to assess the difference of each stirring speed and adsorption temperature variation. This test also was used to know the amount of difference of Cd level before and after the treatment. The decreasing of Cd level has a positive correlation with the increasing of stirring speed and adsorption temperature. This means that the higher the speed of the stirring and adsorption temperature, will lead to the increasing of Cd level in blood cockle (Anadara granosa). Table 4: Tests of Between-Subjects Effects Dependent Variable: Cd Level After Treatments Source Type III Sum of Squares Df Mean Square F Sig. Partial Eta Squared Noncent. Parameter Observed Powerb Speed 0.163 2 0.081 568.125 0.000 0.985 1136.250 1.000 Adsorption Temperature 0.084 2 0.042 293.468 0.000 0.972 586.937 1.000 Speed * Adsorption Temperature 0.072 4 0.018 125.149 0.000 0.967 500.595 1.000 a. R Squared =. 995 (Adjusted R

Squared =. 993) b. Computed using alpha = 0.05 Table 5: Pairwise Comparisons Dependent Variable: Cd Level After Treatments (I) Stirring Speed (J) Stirring Speed Mean Difference (I-J) Std. Error Sig.b 95% Confidence Interval for Differenceb Lower Bound Upper Bound 50 RPM 150 RPM 0.222* 0.010 0.000 0.201 0.243 250 RPM 0.272* 0.008 0.000 0.254 0.289 150 RPM 50 RPM -0.222* 0.010 0.000 -0.243 -0.201 250 RPM 0.049* 0.006 0.000 0.037 0.062 250 RPM 50 RPM -0.272* 0.008 0.000 -0.289 -0.254 150 RPM -0.049* 0.006 0.000 -0.062 -0.037 Based on estimated marginal means *. The mean difference is significant at the 0.05 level. b. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments). This test shows that chicken egg shells can be use as heavy metal adsorbent. Chicken egg shells can decrease Hg level in blood cockle. This indicates that activated chicken egg shells can absorb heavy metal. Napitapulu explain that physical activation can enlarge chicken egg shells pores. It happened due to chemical bonds breaking or surface oxidizing molecules so that the surface area increases and affects the adsorption potency(8). HCl as activator in chicken egg shells activation process can clean up the pores surface, remove impurities (non-carbon) compounds and rearrange the location of atoms exchanged. We can said that chemical activation was a process to add certain reagents to clean and eenlarge the surface of the chicken egg shell so that it can be used as an adsorbent. Chemical activation method was the best way for adsorbent, in that research zeolite was used as adsorbent. It can adsorb water up to 13.77% after it is activated by chemical method(9). Fitriyana & Safitri reported that chicken egg shells adsorbent potency test to ion, it results shows that non-activated chicken egg shells can adsorb 18.73% while physical activated chicken egg shells can adsorb 31%. This result indicated that activated chicken egg shells can adsorb ion better than non activated chicken egg shells(10). Aidha explained that activating adsorbent using HCl for 80 minutes can decrease up to 78.99% of calcium. Acid adding lead to cation exchange with H+ thus enlarges the cavity in the adsorbent zeolite and increases the adsorbent power due to the increased porosity of the adsorbent(11). Beside of that, stirring speed and adsorption temperature contribute to decrease Cd level in blood cockle. Statistic analysis shows that there was an influence of stirring speed and adsorption temperature to the Cd level decreasing. The increasing stirring speed and adsorption temperature lead a greater decrease of Cd level in blood cockle. Stirring causes turbulent liquids which is containing adsorbents. The faster the stirring will cause the greater movements so that it will make the film layer that surrounds the adsorbent particles thinner which makes the adsorption process run fast. Webber explained that adsorption was limited by film diffusion and pore diffusion process, it depent on movements in the system. If the movements was slow, the film which is coating the particles will be thick so adsorption will be slow. If the stirring process was enough, the film diffusion process will run faster(12). Syauqiyah et al. explained that increased temperature causes the energy and reactivity of the ions to increase so that more ions are able to pass through the energy level to interact chemically with the active layer on the surface, so that more ions can be adsorbed on the surface. The heating treatment in this process can increase the adsorbent power to decrease Pb and Cd level in blood cockle(13). Heating or adsorbent activating would increase adsorbent power due to the adsorbent's pores will be larger. But if the temperature was too high it could damage the adsorbent(12). Flores et al. stated that adsorption power in chicken egg shells will increase on 15-35°C due to endotermic process. The absorption of Cd (II) occurs mainly in the calcareous layer (which contains CaCO3) and slightly in the membrane layer. This shows that the absorption of Cd (II) is irreversible and the main absorption mechanism is ion precipitation and exchange. CONCLUSION Stirring speed and adsorption temperature can increase the potention of chicken egg shells to decrease Cd level in blood cockle by develop stirring

chamber tool. Medico-legal Update, January-June 2019, Vol.19, No. 1 273 Source of Funding: Author Ethical Clearance: Yes Conflict of Interest: No REFERENCES 1. Hariyadi P, Andarwulan N. How to Stop Problematic Food in Markets: Food Safety System Consolidation in Indonesia. Depok: Piramedia Publisher; 2007. 2. Republic of Indonesia. Law of the Republic of Indonesia, Number 18 of 2012 concerning Food. Jakarta: Republic of Indonesia; 2012. 3. Suryono H, Narwati, Nugroho HSW. The Potention of Chicken Egg Shell (Galus-galus domesticus) as Mercury Adsorbent for Blood Cockle (Anadara granosa) by Stirring Chamber Engineering. Indian Journal of Public Health Research & Development. 2018;9(5). 4. Trisnawati A. Study of Cadmium Heavy Metal Content in Green Shellfish (Mytilus viridus) in the Waters of the Surabaya Kenjeran Beach. Thesis. Malang: Maulana Malik Ibrahim State Islamic University; 2008. 5. Fransiska M, Arief M, Cahyoko Y. Study of Lead Heavy Metal (Pb) in White Shrimp (Penaeus merguiensis) and Blood Shells (Anadara granosa) in the Waters of Kenjeran Beach Surabaya and Waters of Sumenep Saronggi. Journal of Aquaculture and Fish Health. 2012;1(3). 6. Aimi N, Norhafizah, Wong CS. Removal of Cu (II) from Water by Adsorption on Chicken Eggshell. International Journal of Engineering and Technology. 2013;13(01):40-45. 7. Palar H. Heavy Metal Pollution and Toxicology. Jakarta; Rineka Cipta Publisher; 2004. 8. Napitupulu A. Activated Carbon Impregnation Using Sulfide to Binding Copper (II) and Cadmium (II) in the Water. Thesis. Medan: Postgraduate School, USU; 2009. 9. Affandi F, Hadisi H. The Effect of Nature Zeolit Activation Method to Decrease Warm Paved Mixture Temperature. Jakarta: PU; 2011. 10. Fitriyana, Safitri E. The Use of Chicken Egg Shells as Adsobent to Increase Used Cooking Oil. Konversi. 2015;4(1):12-16. 11. Aidha N. Activation of Physically and Chemically Zeolites to Reduce Hardness Levels (Ca and Mg) in Groundwater. JKK. 2013;35(1):58-64. 12. Webber. Adsorption Analysis: Equilibria and Kinetics. Queensland: Imperial College Press; 1972. 13. Syauqiah I, Amalia M, Kartini HA. Analysis of Variations in Time and Speed of Stirrers in the Process of Heavy Metal Waste Adsorption with Active Charcoal. Jur.Inf.Tek. 2011;12(1):11-20. 14. Flores CJ, Leyva RR, Mendoza BJ, Guerrero CR, Aragon PA, Lebrada DG. Sorption Mechanism of Cd (II) from Water Solution Onto Chicken Eggshell. Journal of Applied Surface Science. 2013;276:682-690. 270 Medico-legal Update, January-June 2019, Vol.19, No. 1 272 Medico-legal Update, January-June 2019, Vol.19, No. 1 274 Medico-legal Update, January-June 2019, Vol.19, No. 1