**Utilization of Chitosan Clam Bloodshells as a Coagulant**

**for Processing Electroplatting Waste**

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**Abstract** Utilization of coagulants with natural ingredients has been widely developed, the advantage of using biocoagulant is the availability of abundant material, easy to obtain it, from renewable materials, and low toxicity. This research compare chitosan clam bloodshells (*Anadara granosa*) coagulan and alum coagulan, to reduce concentration total chrome, nickel and turbidity in electroplating waste. The variations used concentration of chithosan and alum, 300 mg/l and 600 mg / l, variation of the speed used is 1500 rpm and 300 rpm. Results of the research, Alum and Chitosan can reduce the concentration of TSS, Nickel and Total Chrome. Alum can increase the percentage of TSS removal by 93.75% with a coagulant dose of 300 mg / l at a stirring speed of 150 rpm, and for the percentage of removal of Nickel by 32.49% at a coagulant dose of 600 mg / l with a stirring speed of 300 rpm and the percentage of total Chrome removal of 64.09% at a coagulant dose of 600 mg / l with a stirring speed of 300 rpm. While the addition of coagulant chitosan increase the percentage of TSS by 97.79% with a dose of coagulant 300 mg / l and 600 mg / l at a stirring speed of 150 rpm, and nickel removal 50, 73% at a coagulant dose of 600 mg / l with a stirring speed of 150 rpm, a percentage of the total chromium removal of 72.88% with a coagulant dose of 600 mg / l at a stirring speed of 72.88%. The addition of alum coagulant and chitosan chlam Bloodshells (*Anadara granosa*) has the ability to neutralize the pH in accordance with the standard quality standard of electroplating waste, from 6.2 to 7.6.

**Keywords: Chitosan, Chromium, Electroplating, Nickel, TSS**

Introduction

The electroplating industry is one of the industries that develops following market. To get a metallic impression on the material, a plating process using Chrome and Nickel is required. After the gilding process, washing is carried out to remove the remaining material. The content of chromium and nickel will be carried in the residual waste of production. Chrome and nickel are heavy metals that can cause toxicity when discharged into the water. For this reason, it is necessary to process them before being discharged into the environment.

The use of coagulants with natural ingredients has been developed, the advantages of using biocoagulants are abundant availability of materials, easy to obtain, from renewable materials, and low toxicity. Chitosan from shrimp shells is tried for drinking water treatment, increasing chotisan concentration affects the final water quality. The turbidity parameter can reduce up to 50%, TDS 27.16%, and electrical conductivity 48.23%. Meanwhile, microbiological parameters can be dissolved to zero (Jabbar, 2017).

The flocculation coagulation method is one of the easy and inexpensive waste treatment methods, the use of biocoagulants to reduce the turbidity concentration and TSS of domestic waste, using the Oyster Mushroom Chitin as a coagulant can reduce the turbidity concentration up to 84% while TSS can be reduced up to 96% with a dose optimal 600 mg / L with a stirring speed of 150 rpm (Pardede, 2017).

Chitosan is a polymer material that has many benefits, chitosan is widely used in agriculture, food and beverages to cosmetics. In the environmental field chitosan is utilized not only for drinking water treatment, but also for wastewater treatment. Chitosan from shrimp shells is used to treat textile waste, chitosan can reduce phosphate by 60%, COD is more than 90%, chitosan can work efficiently in a freer pH range to 5.25, more flexible than commercial polymers that are efficient at pH below 4.5 (Nechita, 2016).

Chitosan is a biomaterial, mainly produced from alkaline deacetylation (40-50% NaOH) chitin in which N-deacetylation is almost never complete. Chitosan is considered to be a partially deinetylated derivative of chitin. It is an abundant natural biopolymer obtained from a crustacean and arthropod exoskeleton which is a non-toxic copolymer consisting of β- (1,4) -2-acetamido-2-deoxy-D-glucose and β- (1,4) - 2 -anaino-2-deoxy-D-glucose unit (Al-Manhe, 2016). This biopolymer offers a variety of unique applications including bioconversion for the production of value-added food products, preservation of food from microbial damage, formation of biodegradable films, recovery of waste materials from processing disposal food, water purification and clarification and acidification of fruit juices (Shahidi et al., 1999, Abd and Niamah, 2012, Luo and Wang, 2013).

2.Method

This reserch used a jar test, using chitosan from blood clam shells as a coagulant.The research variables consisted of independent variables, namely the chitosan concentration of 300 mg / L and 600 mg / L, the fast stirring speed of 150 rpm and 300 rpm, as a comparison, alum with the same concentration was used. Meanwhile, the dependent variable was the concentration of total chromium, nickel and TSS. As a comparison, alum with the same concentration was used.The chromium and nickel analysis method used ASS while the TSS concentration used the gravity method.

3. Result

Initial analysis was carried out to determine the concentration of electroplating waste before processing, the initial data were as follows:

Table1. Initial Analisys of Electroplating Waste

|  |  |
| --- | --- |
| **Parameter** | **Result (mg/l)** |
| Nikel (Ni) | 20,62 |
| Total Crom (Cr-T) | 28,54 |
| TSS | 45,25 |
| pH | 1,2 |
| Temperature | 30 °C |

The results of the preliminary analysis are compared with the Quality Standards for the Governor of East Java Regulation Number 72 of 2013. The results of the initial analysis of electroplating waste concentrations exceed the predetermined quality standards, therefore it is necessary to process them before being discharged into water bodies. After conducting a preliminary analysis, research was carried out to obtain the final concentration values ​​of TSS, Nickel (Ni) and Total Chromium (Cr-T) in electroplating waste after chemical processing with coagulation-flocculation with variations in the types of alum coagulants and blood shell chitosan, coagulant dose and stirring speed. The final concentration values ​​for TSS, Nickel (Ni) and Total Chrome (Cr-T) can be seen in the following table

Table 2. Percentage of TSS Concentration Removal

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Coagulan** | **Coagulan Dose (mg/l)** | **Rapid Mixing (rpm)** | **Initial Concentration (mg/l)** | **Final Concentration (mg/l)** | **Percentage Removel (%)** |
|
| Alum | 300 | 150 | 45,25 | 2,83 | 93,75% |
| 300 | 45,25 | 5,25 | 88,40% |
| 600 | 150 | 45,25 | 3,42 | 92,44% |
| 300 | 45,25 | 3,67 | 91,89% |
| Chitosan | 300 | 150 | 45,25 | 1 | 97,79% |
| 300 | 45,25 | 3,5 | 92,27% |
| 600 | 150 | 45,25 | 1 | 97,79% |
| 300 | 45,25 | 5,33 | 88,22% |

Figure 1. Percentage of TSS Removal after Coagulation-Flocculation

Table 3 . Percentage of Nikel Concentration Removal

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Coagulan** | **Coagulan Dose (mg/l)** | **Rapid Mixing (rpm)** | **Initial Concentration (mg/l)** | **Final Concentration (mg/l)** | **Percentage Removel (%)** |
|
| Alum | 300 | 150 | 20,62 | 15,38 | 25,41% |
| 300 | 20,62 | 15,1 | 26,77% |
| 600 | 150 | 20,62 | 14,22 | 31,04% |
| 300 | 20,62 | 13,92 | 32,49% |
| Chitosan | 300 | 150 | 20,62 | 11,42 | 44,62% |
| 300 | 20,62 | 11,98 | 41,90% |
| 600 | 150 | 20,62 | 10,16 | 50,73% |
| 300 | 20,62 | 10,92 | 47,04% |

Figure 2. Percentage of Nikel Removal after Coagulation-Flocculation

Table 4. Percentage of Cromium Concentration Removal

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Coagulan** | **Coagulan Dose (mg/l)** | **Rapid Mixing (rpm)** | **Initial Concentration (mg/l)** | **Final Concentration (mg/l)** | **Percentage Removel (%)** |
|
| Alum | 300 | 150 | 28,54 | 13,09 | 54,13% |
| 300 | 28,54 | 12,9 | 54,80% |
| 600 | 150 | 28,54 | 10,94 | 61,67% |
| 300 | 28,54 | 10,25 | 64,09% |
| Chitosan | 300 | 150 | 28,54 | 11,56 | 59,50% |
| 300 | 28,54 | 11,72 | 58,93% |
| 600 | 150 | 28,54 | 7,77 | 72,78% |
| 300 | 28,54 | 7,74 | 72,88% |

Figure 3. Percentage of Nikel Removal after Coagulation-Flocculation

4**. Discussion**

From the three test parameters, the efficiency of using chitosan as a coagulant over alum was obtained, with the results for TSS being able to set aside up to 97.79%, 50.73% Nickel while 72.78% for chromium.

Total suspended solid (TSS) is a total solid substance found in water, which can be either a biotic or an abiotic component (Ainy, 2011). TSS is an important factor in water quality. Changes in the quality of TSS can cause physical, chemical and biological changes. Physical changes to water can cause reduced penetration of sunlight into water bodies. Chitosan is a biocoagulant that can reduce TSS, this is because chitosan is a multi-biological polymer, has a positive charge and contains free amine groups that provide a high ability for chemical relevance to molecules with negative charges such as protein, fat and mineral ions (Shahidi et al. , 1999).

The percentage of TSS that can be removed can reach 97.79%, this is due to the high content of amine groups in chitin which provides a cationic charge at acidic pH and can destabilize colloid suspensions to form floc nuclei. Chitin is a long-chain polymer with a positive charge at the pH of natural water, while colloidal material is negatively charged with the help of stirring, destabilization of colloidal particles will occur. Furthermore, there will be neutralization or reducing the negative linkages in the particles so that it is possible to have van der waals forces to encourage colloid agragmentation and fine suspended substances to form microfloc (Meicahayanti, 2018).

In addition to the dose of chitosan 300 mg / l, the optimal TSS concentration decreased, when compared to the 600 mg / l dose, high doses allow more reactions to occur. However, the formation of flocculent particles did not run perfectly. This can be seen from the percentage of TSS that can be removed.

The use of chitosan as a coagulant is more effective when compared to alum, at the same dose the percentage of TSS for alum is 93.74%, while for chitosan it can reach 97.79%, this shows that chitosan coagulant is one of the reliable biocoagulants and has the same ability with chemical coagulants.

The amino groups presented in chitosan also make good chelating ligands that are able to firmly bind various metal cations, and the lone pairs on the nitrogen atom and the oxygen atom are donated to the metal ion to form coordination bonds, since several amino groups and hydroxyl groups are present on the chain. long polymeric, the chain can wrap around metal ions and adopt a configuration such as several amino groups bonded to a metal atom at the same time; this type of class leads to the formation of highly stable metal complexes, and this property makes them useful for the concentration of radioactive metal removal and other hazardous heavy metal contaminants (Bassi et al., 2000).

Compared with the effect of chitosan dose and pH, mixing time plays an important role in floc formation and growth in the flocculation process. The polymer flocculants are scattered throughout the media and adsorbed on the surface of the colloid particles for bridging between particles or neutralization of charges during the mixing period. In addition, longer mixing times will increase floc breakage. Hence, it decreases the flocculation rate. On the other hand, if the mixing time is too short, the collision between the flocculant and the colloid is not efficient at settling the suspended solid in the wastewater. Thus, the flocculation rate is not optimal in this condition. Therefore, a research was conducted on the effect of mixing time in flocculation. Analysis of the effect of mixing time on chitosan dose of 30 mg / l and keeping a constant pH of 4 with a mixing speed of 175 rpm (fast mixing) for 10 minutes and a settling time of 30 minutes (Rao, 2015).

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References

1. Al-Manhel, [Alaa Jabbar](https://www.sciencedirect.com/science/article/pii/S1658077X16300224#!),[Asaad Rehman SaeedAl-HilphyAlaa KareemNiamah](https://www.sciencedirect.com/science/article/pii/S1658077X16300224#!), 2018, Extraction of chitosan, characterisation and its use for water purification, Journal of Saudi Society of Agricultural Science, Vol 17, Issue 2, page 186-190
2. Bassi Raman, Shiv.O.Prasher & B.K.simpson, 2000, Removel of Selected Metal Ions from Aqueous Solutions using Chitosan Flakes, Journal Separation Science and technology,Volume 35, Issue 4, page 547-560
3. Meicahayanti Ika, Marwah Marwah, Yunianto Setiawan, 2018, Efektifitas Kitosan Limbah Kulit Udang dan Alum Sebagai Koagulan dalam Penurunan TSS Limbah Cair Teksti, Juornal Chemurgy Volume 2 Issue 1 Page
4. Nichita Petronela, 2017, Application of Chitosan in Wastewater Traetment, Open Access-perr reviewed Chapter DOI: 10.5772/65 289
5. Roa, Dr L.Nageswara, 2015, Coagulation and Flocculation of Industrial Wastewater by Chitosan, International Journal of Engineering and Applied Sciences (IJEAS) ISSN: 2394-3661, Volume-2, Issue-7.