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STUDY OF BENTONITE ACTIVATION USING SULFURIC ACID AND ITS APPLICATION AS AN ADSORBENT OF RHODAMINE B DYE

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ABSTRACT

A study about activated bentonite with 2M, 3M, 4M Sulfuric Acid and its application as a Rhodamin dye adsorbent had been done. Bentonite was saturated with 3M NaCl before activated by acid. Performance determination of adsorbent is done by using Uv-Vis Spectrophotometric method. Concentrate determination of Rhodamin B dye made at a wavelength of 554 nm. The result obtained showed that the 2M sulfuric acid bentonite is the best adsorbent.

Keywords: _Acid activator; Activated bentonite; Adsorbent_

1. INTRODUCTION

The development of weaving home industry throughout the Moluccas province increased. This resulted in an increase in the use of dyes which is a major requirement. Abundant use of dyes which can be a pollutant to the environment, because in the dyeing process the dye is only partially absorbed by the textile material and the remainder (2-50%) will be in the rinse (effluent) textiles. If the concentration of the dye in the effluent is large enough, it can pollute the environment. Rhodamine B dye is widely used by the textile industry. These compounds contain an amino group which is alkaline and benzene nucleus, so that the rhodamine B includes a hard compound degraded by microorganisms naturally. The entry of rhodamine B dye in water is a serious environmental problem.

One alternative waste management is the use of the adsorbent as a binder hazardous waste material that is not easily degraded. Use of the adsorbent is relatively simple and can be regenerated. Bentonite adsorbent is abundant in Indonesia. Bentonite acid activation is required to increase the surface area of bentonite (Gates, 2007). This treatment is highly dependent on the acid strength, time and temperature of the system (Rozic 2008). The chemical changes that occur in the structure of the bentonite during treatment with acids to produce an octet vacancy in the crystal lattice, so results of accretion Lewis acid site.

2. EXPERIMENTAL

Materials and Chemicals

Magnetic stirrer, Sentrifuge, Spektrofotometer UV-Vis, Bentonite, H_2SO_4, $AgNO_3$, $BaCl_2$. Rhodamin B. Aquadest.

Experimental Procedure

Bentonite amount of 50 grams put in to 250 ml of 3M NaCl and stirrer for 24 hours. Bentonite washed with distilled water and then tested the free chloride with $AgNO_3$ solution. Na-Bentonite filtered and dried at 80 °C. Na-Bentonite 10 grams each put in 50 ml of 2M, 3M, 4M H_2SO_4. By stirring the mixture for 24 hours, one then washed with aquadest. Sulfate-free test was performed using $BaCl_2$ solution. Na-Bentonite activated acid 5 grams put in a 25 ml solution of Rhodamine B 50 ppm. Mixture stirrer for 6 hours, and then filtered. Determination of Rhodamine B adsorbed concentration was determined by UV-Vis spectrophotometer at a wavelength of 554 nm.

3. RESULTS AND DISCUSSION

Textile dye adsorption on bentonite can generally be categorized as an ion exchange reaction, because the dye molecules are generally large that it is not possible to enter into the pores, although porous adsorbent has been raised. Surface protonation at low pH resulted bentonite surface positively charged. Acidity surface (Bronsted acid) bentonite is relatively high so that it can adsorb dye more. In studying the surface chemistry, acid-base properties are very important in the formation of interfacial bonding (E. McCafferty, 1998: 549 in Endang, 2007). Chemical changes that occur in the structure of clay during treatment with acids will produce octet vacancy in the crystal lattice, resulting in the increase of the Lewis acid. It is known that during the acid activation, to balance the charge, the proton of the acid will replace the exchangeable cations such as Na^+ and Ca^{2+}, which position is located in between the two layers. Bentonite saturation with Na intended to expel other cations in bentonite and replace with cations Na. Thus facilitating proton ion exchange with Na cation. Proton of the hydroxyl group is located on the corner of the octahedron becomes more unstable as a result of structural deformation due to acid activation so that it can increase the acidity of Bronsted (Alemdaroglu, 2003; Rozic, et al., 2008). Clay treatment using mineral acids to release Al and other cations are in octahedral position, based on the order the release of the cation $Mg^{2+} > Fe^{2+} > Fe^{3+} > Al^{3+}$.

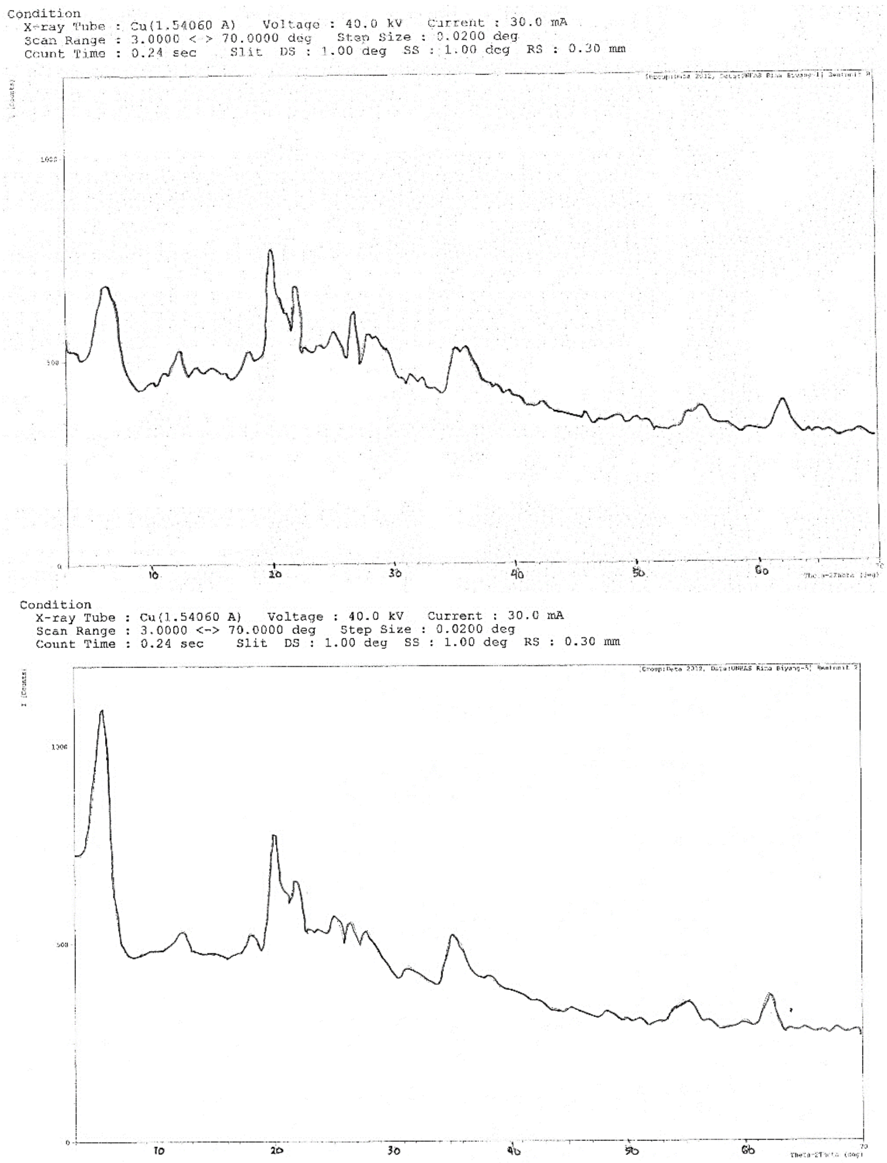

Figure 1. Difraktogram of Bentonite (upper) and Bentonite –Acid 2M (lower).

Bentonite treatment with various concentrations of 2M, 3M and 4M, then used as adsorbent Rhodamine B gives the results as shown in Table 1. Treatment with 2M sulfuric acid concentration gives maximum adsorption results.

Figure 1 give information about increased of basal spacing Bentonite-Acid rather than bentonite. Bijang (2015) stated that the membrane biosensor made from 2M acid activated bentonite had better performance than the untreated bentonite membrane biosensor. Figure 2 give the reaction of acid of bentonite with Rhodamin B. Treatment with sulfuric acid concentration of 3M and 4M give lower yields caused by damage to the bentonite lattice, so the ability to adsorb rhodamine B to be reduced. Ravichandran (1997) and Rozic, (2008) states that treatment of excess acid can cause the bentonite lattice SiO4 destroyed but the group remained largely stable.

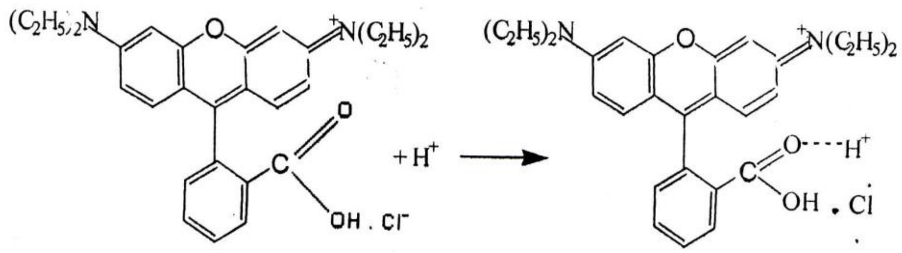

Figure 2. The Reaction of Rhodamine B with Protons at the Surface of Acid Activated Na-Bentonite.

Table 1. Adsorption of Rhodamin B.

Adsorbent	**Concentration (ppm)**
Bentonite 2M	49,4766
Bentonite 3M	49,3438
Bentonite 4M	49,1641

CONCLUSION

Activation of Na-bentonite with sulfuric acid can increase the adsorption capacity of bentonite to the Rhodamine B dye but the use of sulfuric acid at a concentration greater than 2M tend to damage the bentonite lattice so that Rhodamine B adsorption ability to be more reduced.

REFERENCES

Alemdaro T. Akkus G. 2003, Investigation of the Surface Acidity of a Bentonite Modified by Acid Activation and Thermal Treatment, Turki Journal Chemistry, 27, 675 – 681

Anggit Indra Kusuma (2006), Pola Adsorpsi Rhodamin B oleh Monmorilonit, *Skripsi*, Jurdik Kimia, FMIPA, UNY

Catherina Bijang, Abd.Wahid Wahab, Maming, Ahyar Ahmad, Paulina Taba. Design of Bentonite Acid Modified Electrodes in Cyanide Biosensors. *International Journal of Materials Science and Applications.* Vol. 4, No. 2, 2015, pp. 115-119. doi: 10.11648/j.ijmsa.20150402.17

Endang Laksono (2007), Kajian Penggunaan Adsorben sebagai Alternatif Pengolahan Limbah Zat Pewarna Tekstil, Jurdik Mimia FMIPA, UNY

Gates W.P., J.S. Anderson, M.D. Raven dan G.J. Churchman, (2002), Mineralogy of Bentonite from Miles, Queensland, Australia, and Characterization of its Acid Activation Products, Applied Clay Science, 20, 189 - 197

Rozic L.,Novakovic T.,Petrovic S.,Vukovic Z.,Cupic Z., 2008, Fractal Analysis of Physical Adsorption on Surfaces of Acid Activated Bentonite from Serbia, Chemical Industry & Chemical Engineering Quarterly 14 (4) 227−229