

Desorption of Naphtol Blue-Black from Humic Acid Modified Magnetite Using NaOH as Desorption Agent

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Abstract. Naphtol blue-black was a waste that is dangerous for the environment. The research aims to determine the effect of varied concentration of the NaOH as desorption agent on the percent of desorption of naphtol blue-black from humic acid modified magnetite ($\text{Fe}_3\text{O}_4\text{-AH}$). The result of this study showed that the variation of the NaOH concentration influenced the percent of naphtol blue-black desorption from humic acid modified magnetite. The percent of desorption was 15.71 % with a concentration of NaOH was 1 M.

Keywords: Desorption agent, humic acid modified magnetite, naphtol blue-black

INTRODUCTION

Naphtol blue-black is an aromatic diazo chemical compound which is dangerous for the environment because it is carcinogenic and mutagenic (Ferkous et al., 2015). Adsorption method is an alternative for treating waste that is economical and does not require pre-treatment. The advantage of the adsorption process is that it can clear up the color of the waste (Atkins, 1990) and the possibility for regeneration of the adsorbent by desorption (Wankasi et al., 2005).

Humic acid is a macro molecule of humic compound which has abundant functional groups, especially the -COOH, -OH phenolate, -OH alcohol groups which can adsorb dye waste (Stevenson, 1994). Modification of humic acid adsorbents with magnetite aims to stabilize the active surface of magnetite surfaces (Koesnarpardi and Daniel, 2014), prevent the occurrence of collisions between adhesion particles in the heating process, and increase nanodispersion stability through preventing agglomeration (Koesnarpardi et al., 2017) and to facilitate the filtering process of adsorbents without centrifugation and filtration.

Adsorption for the treatment of dye waste has not been able to completely solve the problem so the need for desorption of dyes from the adsorbent so that the adsorbent can be reused (Peng et al., 2012). Desorption can be done by contacting the adsorbent that has been used with a solution known as a desorption agent. The resorbing agent used in this study was NaOH. Sodium hydroxide is a base considered to be more effective for desorption of anionic dyes (Szigula et al., 2008).

MATERIALS AND METHODS

The tools used in this study include glass tools brand pyrex; oven, filter paper, pH indicator, magnetic stirrer,

hot plate, Fourier Transform Infra-Red (FT-IR), and UV-Vis Spectrophotometer. The materials used in this study are Riau peatlands, Sumatra, aquades, hydrochloric acid (HCl), sodium hydroxide (NaOH), and naphthol blue-black textile.

Naphtol blue-black adsorption uses pH 6 and a contact time of 60 minutes. 1.5 grams of $\text{Fe}_3\text{O}_4\text{-AH}$ mixed with naphtol blue-black solution as much as 150 mL and shaken for 60 minutes. The shaken solution was filtered and the resulting filtrate was analyzed using a spectrophotometer UV-Vis corresponding wave numbers of naphtol blue-black dyes and adsorbents were analyzed using FT-IR. $\text{Fe}_3\text{O}_4\text{-AH}$ which has adsorbed naphtol blue-black dye was put in the NaOH desorption agent with a variation of 0.5 M; 1 M; 1.5 M; and 2 M. The mixture is shaken with a speed of 125 rpm during the optimum time. The solution was filtered for the filtrate then analyzed using a UV-Vis spectrophotometer according to the wave number of naphtol blue-black dyes.

RESULTS AND DISCUSSION

Adsorption of naphtol blue-black dyes by humic acid adsorbent using an optimum pH of 6 and an optimum contact time of 60 minutes (Yunita, 2018). The adsorption filtrate was analyzed using a UV-Vis spectrophotometer at the maximum wavelength of 549 nm naphtol blue-black. Based on the calculation results obtained the percentage of adsorption of 80.57%. The adsorbent adsorption results were analyzed using FT-IR and the results obtained in Figure 1.

NaOH in solution will ionize into Na^+ and OH^- , where the OH^- ion will interact with H^+ from $\text{Fe}_3\text{O}_4\text{-AH}$. The presence of OH^- ions will bind to H^+ and will

replace SO_3^- so naphtol is blue-black. NaOH desorption agents make the electrostatic interaction between the adsorbent and naphtol blue-black weaker and the naphtol blue-black dye absorbed leaves the $\text{Fe}_3\text{O}_4\text{-AH}$ adsorption site. The existence of NaOH desorption agent can cause ion exchange between adsorbate and the desorption agent so that adsorbate can be released so that the base is considered more effective for desorption of anionic dyes (Szigula et al., 2008).

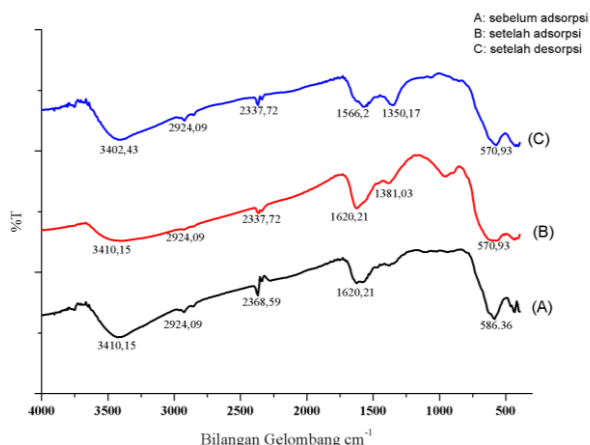


Figure 1. FT-IR spectra of $\text{Fe}_3\text{O}_4\text{-AH}$ before adsorption, after adsorption and after desorption with NaOH 1 M.

The results of FT-IR analysis (Figure 1.) absorption of the -OH group at wave number 3410.15 cm^{-1} after adsorption became more gentle and after desorption became sharper and a shift occurred to 3402.43 cm^{-1} . The presumption that might occur is the interaction of $\text{Fe}_3\text{O}_4\text{-AH}$ with naphtol blue-black through electrostatic bonds because the changes tend to be insignificant. This occurs in the -OH functional group of the adsorbent interacting with the anion of naphtol blue-black. The alleged interaction of the S=O functional group due to the presence of desorption agents showed an absorption shift at the number 1381.03 cm^{-1} to 1350.17 cm^{-1} . This is possible with the exchange of ions -OH with $-\text{SO}_3^-$ so that the naphtol blue-black dye can be released. The existence of the wave number S=O shows that naphtol blue-black is still attached to the $\text{Fe}_3\text{O}_4\text{-AH}$ adsorbent. The optimum desorption percentage is 15.71% with a NaOH concentration of 1M.

CONCLUSIONS

The characteristics of $\text{Fe}_3\text{O}_4\text{-AH}$ using FT-IR after adsorption and after a desorption showed differences in uptake. The FT-IR results after desorption showed a shift in the wave numbers of the S=O and -OH groups. The ability of adsorption of naphtol blue-black dyes using $\text{Fe}_3\text{O}_4\text{-AH}$ adsorbent was 80.57% and optimum desorption was 15.7101% at a concentration of 1 M NaOH.

ACKNOWLEDGEMENTS

Thanks to the supervisor who always directs and motivates the writer.

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