

ABSTRACT

The adsorption method is an effective solution in dealing with liquid waste containing synthetic dyes such as *methylene blue*. Lapindo mud is rich in Al_2O_3 content which has the potential to be used as a raw material for the synthesis of mesoporous $\gamma\text{-Al}_2\text{O}_3$ which has a large surface area and high porosity. This study includes three stages, namely Al_2O_3 extraction through the reflux method, mesoporous $\gamma\text{-Al}_2\text{O}_3$ synthesis using hydrothermal methods with variations in the mole ratio of stearic acid (0; 0.1; 0.2; 0.3; and 0.4), and methylene blue adsorption test. Characterization was carried out with XRF, FTIR, XRD, BET, and acidity tests. The extraction results showed an Al_2O_3 content of 80.95%, while the synthesis results showed that the entire sample led to the $\gamma\text{-Al}_2\text{O}_3$ phase. Samples with a ratio of 1:0.1 provided the best characteristics with a pore diameter of 12.47 nm, a pore volume of $0.352 \text{ cm}^3.\text{g}^{-1}$, a surface area of $199.976 \text{ m}^2.\text{g}^{-1}$, and a highest acidity of $7.995 \text{ mmol}.\text{g}^{-1}$. The optimal adsorption process occurred within 10 minutes with an adsorption capacity of $11.926 \text{ mg}.\text{g}^{-1}$ and followed a pseudo-order kinetics model with a rate constant of $0.0606 \text{ g}.\text{mg}^{-1}.\text{min}^{-1}$. These results show that $\gamma\text{-Al}_2\text{O}_3$ mesoporous synthesized from Lapindo sludge has the potential to be an effective adsorbent for the treatment of dye waste products.

Keywords: Alumina mesoporous, Lapindo mud, stearic acid, hydrothermal, adsorption, *methylene blue*