

ABSTRACT

Aluminium oxide (Al_2O_3) is a metal oxide material widely used as an adsorbent and catalyst support due to its good thermal stability, surface area, and surface properties. One potential source of Al_2O_3 is Lapindo mud, a material produced from the hot mud eruption that remains abundant and continues to pose environmental problems. In addition, wastewater pollution from synthetic dyes, such as methylene blue, can degrade water quality and disrupt aquatic ecosystems. In this study, Al_2O_3 extracted from Lapindo mud was utilized as a $\gamma\text{-Al}_2\text{O}_3$ precursor to support CuO in the $\text{CuO}/\gamma\text{-Al}_2\text{O}_3$ composite. CuO was selected because of its relatively narrow band gap, while $\gamma\text{-Al}_2\text{O}_3$ helps adsorb methylene blue and disperse CuO. The synthesis was carried out by microwave irradiation, with stearic acid added as a templating agent. This study aimed to synthesise, characterise, and evaluate the photodegradation activity of $\text{CuO}/\gamma\text{-Al}_2\text{O}_3$ composites with varying Cu/Al molar ratios toward methylene blue. Characterization was conducted using XRF, FTIR, XRD, UV-Vis DRS, and a UV-Vis spectrophotometer. The XRF results showed an Al_2O_3 content of 87.189%. FTIR indicated the presence of Al-O, Al-O-Al, and Cu-O bonds, while XRD confirmed the $\gamma\text{-Al}_2\text{O}_3$ and CuO phases. The band gap values of CA-0, CA-1, CA-2, and CA-3 were 2.10, 1.95, 1.82, and 1.73 eV, respectively. CA-2 showed the best photodegradation activity of 29.59% within 120 minutes, with a pseudo-first-order rate constant of 0.0055 min^{-1} and an R^2 value of 0.9621.

Keywords: $\gamma\text{-Al}_2\text{O}_3$, CuO, $\text{CuO}/\gamma\text{-Al}_2\text{O}_3$, lumpur Lapindo, methylene blue, fotodegradasi, microwave irradiation