

UNIVERSITI TEKNOLOGI MARA

**DELAMINATED MXENE FOR
EFFICIENT CHROMIUM REMOVAL
VIA PHOTOCATALYTIC PROCES**

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ABSTRACT

Hexavalent chromium (Cr(VI)) is considered a major hazardous heavy metal in water bodies that can cause severe effects to human health and the environment. Over the years, myriad photocatalysts have been used to remove Cr(VI) from wastewater. However, broad bandgap energy and high electron recombination rate of these photocatalysts have limited their photocatalytic performance. Therefore, an efficient photocatalyst for Cr(VI) removal in wastewater is strongly demanded. In this study, the structural, physicochemical and thermal properties of delaminated MXene have been successfully investigated. The performance of synthesised delaminated MXene on Cr(VI) removal was evaluated at different pHs, photocatalyst loadings, and initial concentrations of Cr(VI). After that, the adsorption isotherms and the kinetic models of synthesised delaminated MXene on Cr(VI) removal were also examined. Based on the results, the optimum operating conditions on Cr(VI) removal by the synthesised delaminated MXene were obtained at pH 4 with photocatalyst loading of 1.5 g/L, and Cr(VI) concentration of 5 mg/L. Under the optimized reaction conditions, the removal of Cr(VI) was 100%. The highest removal efficiency of Cr(VI) via photocatalysis over various concentrations was approximately 28.9% higher than adsorption, verifying a synergistic effect of adsorption and photocatalysis by the delaminated MXene. The isotherm of Cr(VI) adsorption was fitted by the Langmuir model ($R^2 > 0.9848$), which is better than the Freundlich model ($R^2 > 0.8824$). Furthermore, the time dependence of Cr(VI) adsorption was well expressed by the pseudo-second-order kinetic model with $R^2 > 0.9999$. The photocatalysis study presented a pseudo-first-order kinetic model to describe the removal of Cr(VI) under UV-light irradiation. The kinetic data showed that the kinetic constant using delaminated MXene was about 2.8 times higher with respect to MXene, suggesting that the delaminated MXene possesses a higher photocatalytic reduction of Cr(VI). In conclusion, the synthesised delaminated MXene has an excellent ability to reduce and remove Cr(VI) in water via photocatalysis and has a great potential to be used in industrial wastewater.

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