

**UNIVERSITI TEKNOLOGI MARA**

**REMOVAL OF TOTAL CHROMIUM  
USING AGRICULTURE WASTE IN  
GROUNDWATER**

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Dissertation submitted in partial fulfillment  
of the requirements for the degree of  
**Master of Science in Environmental Engineering**

**Faculty of Civil Engineering**

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I certify that a Panel of Examiners has met on 15<sup>th</sup> June 2016 to conduct the final examination of Nurul Huda Binti Daud on her Master of Science thesis entitled “Removal of Total Chromium Using Agriculture Waste in Groundwater” in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examiners recommends that the student be awarded the relevant degree. The panel of Examiners was as follows:

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**AUTHOR’S DECLARATION**

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as references work. This thesis has not been submitted to any other academic institution on non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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## ABSTRACT

The pollution of groundwater by chromium used in the industry and manufacturing activities caused serious problems. This study investigated the removal of total Cr in anaerobic condition using different agriculture waste. The main objective of this study was to identify the most reactive agriculture waste that can be used as green adsorbent to remove heavy metals in groundwater. In the present study, different low cost adsorbent such as tea waste (TW), rice husk (RH) and empty fruit bunch (EFB) were selected. Experimental work was conducted using batch experiment method in a lab-scale condition. The characteristics study of all adsorbents was investigated using Scanning Electron Morphology (SEM) and Fourier-Transfer Infrared (FTIR). SEM analysis reveals that TW has wider pore distribution and it contained more reactive sites compared to RH and EFB. Although, all adsorbents have almost similar surface chemical functional groups of hydroxyl and carboxyl as predominant chemical species, TW shows the most efficient for total Cr removal at different environmental condition. The influence of initial pH solution and initial concentration of total Cr on the removal process were investigated. Adsorption process was found to be highly pH dependent. The optimum pH for adsorption on TW, RH and EFB were observed to be at 7, 5 and 9 respectively. Removal kinetics of total Cr using TW was the highest compare to RH and EFB in 30 minutes at neutral pH ( $k_{TW} > k_{RH} > k_{EFB}$ ) with zeta potential value of -25mV, -21mV and -15mV respectively. However, the percentage removal decreases with the increase of initial total Cr concentration (1ppm to 5 ppm). Experimental data for all adsorbent were fitted with Freundlich isotherms while only TW and RH fitted with Langmuir isotherm. This study provides significant knowledge on the potential of agriculture waste as a low cost, environmental friendly and highly effective adsorbent for removal of toxic heavy metals in groundwater.

**Keywords:** *Adsorption, agriculture waste, total Cr, heavy metals, Freundlich isotherm*

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