# Desorption of Zinc (II) and Copper (II) from Palm Oil Fuel Ash and Activated Carbon

by

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*To my family*
*especially my beloved wife*
*and my little cuddy, Jing Yi*

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# ABSTRACT

The effectiveness of nitric acid as a desorbing agent for stripping adsorbed zinc and copper from two adsorbents derived from agricultural wastes, namely palm oil fuel ash (POFA) and coconut shell-based activated carbon, was investigated in this study. Kinetic experiments showed that a contact period of approximately three hours was generally sufficient to allow the metal-adsorbent systems to reach equilibrium. Studies involving single cycle of adsorption-desorption resulted in identifying nitric acid solution with an acid strength of 0.125% as an efficient desorbing agent for releasing zinc sequestered on the two adsorbents into solution. The 0.125% nitric acid was capable of desorbing more than 95% and 92% of the adsorbed zinc from the POFA and activated carbon adsorbents, respectively. However, it was a poor desorbing agent in the case of copper desorption, stripping only 62% and 2% of the adsorbed copper from the POFA and activated carbon adsorbents, respectively. The reusability of the two adsorbents was tested in five consecutive cycles of zinc adsorption-desorption. Almost complete recovery of the adsorbed zinc over the five cycles from the two adsorbents was readily achieved. However, a significant reduction in the zinc reloading capacity of the

two adsorbents was observed from the second cycle onwards. It was shown that less than 15% of the original adsorption capacity of the POFA adsorbent and less than 11% of the original adsorption capacity of the activated carbon for zinc could be reused in Cycles 2 - 5. The 0.125% nitric acid solution therefore does not appear to be attractive as a desorbing agent for the zinc-POFA and zinc-carbon systems in multiple cycles of adsorption-desorption although it possesses excellent desorption efficiency.

# ABSTRAK

Keberkesanan asid nitrik sebagai agen penyahjerapan untuk menanggalkan zink dan kuprum yang terjerap pada kedua-dua penjerap terbitan sisa pertanian iaitu abu kelapa sawit (POFA) dan karbon teraktif berasaskan tempurung kelapa telah dikaji di sini. Eksperimen-eksperimen kinetik menunjukkan bahawa masa perhubungan selama lebih kurang tiga jam secara umumnya mencukupi untuk membolehkan sistem penjerap-logam mencapai keseimbangan. Kajian-kajian yang melibatkan kitaran tunggal penjerapan-penyahjerapan mengenalpasti larutan asid nitrik dengan kekuatan asid pada 0.125% sebagai agen penyahjerapan yang berkesan untuk menanggalkan zink yang terjerap pada kedua-dua penjerap ke dalam larutan. Asid nitrik berkeupayaan menyahjerap lebih daripada 95% dan 92% zink yang terjerap keatas penjerap POFA dan karbon teraktif. Walau bagaimanapun, ia merupakan agen penyahjerapan yang lemah dalam kes penyahjerapan kuprum dimana penanggalan kuprum yang terjerap pada penjerap POFA dan karbon teraktif hanya setakat 62% dan 2% sahaja. Kemampuan penggunaan semula kedua-dua penjerap diuji secara berterusan dalam lima kitaran penjerapan-penyahjerapan zink. Perolehan semula zink yang terjerap pada kedua-dua penjerap adalah

hampir sempurna bagi kesemua lima kitaran. Walau bagaimanapun, pengurangan secara ketara dalam keupayaan pembebanan semula kapasiti zink pada kedua-dua penjerap telah diperhatikan bermula dari kitaran kedua dan keatas. Ia menunjukkan bahawa kurang daripada 15% keupayaan penjerapan asal penjerap POFA dan kurang daripada 11% keupayaan penjerapan asal karbon teraktif ke atas zink boleh diguna semula pada kitaran-kitaran 2 hingga 5. Larutan asid nitrik 0.125% menjadi kurang berfungsi sebagai agen penyahjerapan di pelbagai kitaran penjerapan-penyahjerapan dalam sistem zink-POFA dan zink-karbon walaupun ianya mempunyai keupayaan penyahjerapan yang cemerlang.

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