

## THE USE OF LOW COST MATERIALS FOR REMOVAL OF TOXIC POLLUTANTS FROM AQUEOUS ENVIRONMENT

K.S. Low and C.K. Lee

Faculty of Science and Environmental Studies  
Universiti Putra Malaysia, 43400 UPM, Serdang, Selangor,  
Malaysia

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### Introduction

The removal or reduction of organic and inorganic pollutants from industrial wastewaters could be achieved by using ion-exchangers or activated carbon. However, these materials are expensive and alternative must be sought especially in less developed countries. Various low-cost biological materials have been investigated for this purpose (Sharma and Forster, 1995; Low et al. 1995). To enhance their sorption capacities various chemical modifications on the sorbents were attempted (Low et al. 1996; Low et al. 1997). N-(3-chloro-2-hydroxypropyl)-trimethylammonium chloride was used to convert the surface hydroxyl groups to quaternary ammonium salt. This effectively converts the sorbent into anion exchangers. Their applications in removing acid dyes (textile effluent) and chromate (electroplating waste) were studied under both batch and continuous flow conditions. Sorbents studied include coconut and rice hulls as these materials possess high silica content, which in turn provides good mechanical strength.

### Materials and Methods

Rice hulls (coconut hulls) were ground to 1 mm size. They were modified according to the method reported by Laszlo (1996). In the batch experiments 0.1 g of sorbent in 20 ml of solution was agitated at 150 rpm at  $25 \pm 2^\circ\text{C}$  for various lengths of time. The sorbent mixture was centrifuged and the filtrate was analysed for its content. In the case of Cr(VI) the element was determined using an inductively coupled plasma-atomic emission spectrometer. When reactive dyes were used their concentrations was established using a spectrophotometer (Hitachi U20000) at the appropriate wavelengths of the dyes. In the column study a glass column of 1.0cm diameter packed with the relevant sorbent at various bed depths was used. Flow rates were adjusted using a peristaltic pump. Aliquots were collected and the analyte contents were determined. Per cent uptake is defined as  $((C_0 - C_t)/C_0) \times 100$  where  $C_0$  and  $C_t$  are the initial and at time ( $t$ ) of the analyte concentrations respectively. Textile waste was collected from Kemunting Textile Industries, Perak and chrome waste from Dole Electroplating Plant in Senawang, Seremban.

### Results and Discussion

Sorption of Cr(VI) by quaternised rice hulls(QRH) and coconut husks(QCH). The sorption is essentially an ion-exchange between the negatively charged Cr(VI) oxyanions and the chloride group of the quaternary amine. The high sorption

capacity of both modified materials across a wide range of pH means that the removal of Cr(VI) could be effectively carried out without having to adjust the pH of the solution as is necessary in the case of most other biological materials. The sorption was rapid and equilibrium was established in less than 30 min indicating that the sorbents are useful in continuous flow study, where the contact time between sorbate and sorbent is generally short. The maximum sorption capacities of QRH and QCH for Cr(VI) were 32.3 35.2 mg/g respectively. These values were extrapolated from Langmuir isotherms. The monovalent anions had very little very little effect on the sorption capacity of QRH at levels below 1 molar. The order of suppressing effect of the anions on the Cr(VI) uptake by QRH is phosphate>sulphate>EDTA>chloride, nitrate. The results of a flow study which contained a mixed bed of NRH and QRH showed that both Cu(II) and Cr(VI) could be successfully removed from electroplating waste. Sorption of reactive dyes by QRH and QGH without quaternisation both RH and GH had no affinity for reactive dyes. Their sorption capacities were greatly enhanced through quaternisation. Maximum sorption capacities for Reactive Blue 2 for QRH and QCH were 130 and 128.9 mg/g respectively. The sorption of hydrolysed Reactive Blue 2 on QRH and RCH was practically unaffected by the presence of sulphate and carbonate except when the concentration reached 1 M. NaCl did not show any effect up to a concentration of 1 M, while increasing NaOH concentration progressively decreased the binding capacity of the QRH.

The capability of the QRH and QCH to remove reactive dyes from a textile mill effluent was investigated. There was a 97% reduction in dye concentration after treatment.

### Conclusions

The results show that quaternised rice hulls and coconut husks were more effective than the corresponding untreated materials in removing Cr(VI) and reactive dyes over a broader pH range. This provides a wider workable pH range than had ever been reported for the removal of Cr(VI) in wastewater. Cr(VI) and Cu(II) from an electroplating waste without pretreatment could be successfully removed or reduced under continuous flow study.

### References

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