Available online at www.sciencedirect.com
SCIENCE DIRECT®
Bioresource Technology 96 (2005) 1578–1583
BIORESOURCE TECHNOLOGY

Adsorption characteristics of malachite green on activated carbon derived from rice husks produced by chemical–thermal process

I.A. Rahman *, B. Saad, S. Shaidan, E.S. Sya Rizal

School of Chemical Sciences, Universiti Sains Malaysia, 11800 Penang, Malaysia

Received 20 November 2003; received in revised form 13 December 2004; accepted 26 December 2004
Available online 16 February 2005

Abstract

Phosphoric acid (H_3PO_4) and sodium hydroxide (NaOH) treated rice husks, followed by carbonization in a flowing nitrogen were used to study the adsorption of malachite green (MG) in aqueous solution. The effect of adsorption on contact time, concentration of MG and adsorbent dosage of the samples treated or carbonized at different temperatures were investigated. The results reveal that the optimum carbonization temperature is 500 °C in order to obtain adsorption capacity that is comparable to the commercial activated carbon for the husks treated by H_3PO_4. It is interesting to note that MG adsorbed preferably on carbon-rich than on silica rich-sites. It is found that the behaviour of H_3PO_4 treated absorbent followed both the Langmuir and Freundlich models while NaOH treated best fitted to only the Langmuir model.

Keywords: Adsorption; Malachite green; Activated rice husks

1. Introduction

Many countries have given prominence to the development of aquaculture as a long term strategy in providing sufficient source of protein to their ever growing population. The raising of large numbers of fish, prawns and others in confined space as in modern aquaculture practice necessitates the use of an extensive range of chemicals for the prevention and treatment of diseases, thus posing as a source of water pollution. The used of malachite green (triphenylmethane) in aquaculture industry has a long history, dating back to 1933, when it was first introduced. The compound, originally extensively used for the dyeing of textiles, has since found wide applications in the aquaculture industry as it is relatively cheap, effective and easy to obtain. Its use in the aquaculture practice in many countries, including Malaysia has not been regulated. Many adverse effects from the consumption of the dye due to its carcinogenic, genotoxic, mutagenic and teratogenic properties in animal studies have been reported (Sandra et al., 1999).

Adsorption on activated carbon has long been recognized to be one of the most effective methods for the removal of pesticides and organic compounds from aqueous solutions. Agriculture wastes such as oil palm nut shell (Chan et al., 1980), rice husks (Rahman et al., 2000), olive-waste cakes (Bcaoui et al., 2001), acorns and olive seeds (Lafi, 2001), corncobs (El-Hendawy et al., 2001), coconut shells or palm seeds (Hu and Srinivasan, 2001), and guava seeds (Rahman and Saad, 2003) have been used as low-cost adsorbents. These materials were activated either by chemicals, steam, gas or their combinations. The use of adsorbents derived from rice husk to adsorb some phenolic compounds (Mbui et al., 2002) and the herbicide paraquat (Rahman et al., in press) had been reported. Relatively little work had been reported on the absorption of

* Corresponding author. Fax: +60 4 6574854.
E-mail address: arismail@usm.my (I.A. Rahman).

0960-8524/$ - see front matter © 2005 Elsevier Ltd. All rights reserved.
doi:10.1016/j.biortech.2004.12.015