



Modelling of breakthrough curves of single and binary mixtures of Cu(II), Cd(II), Ni(II) and Pb(II) sorption onto grape stalks waste



Carlos Escudero^a, Jordi Poch^b, Isabel Villaescusa^{a,*}

^a Chemical Engineering Department, Escola Politècnica Superior, Universitat de Girona, c/M^{re} Aurèlia Campmany, 61, 17071 Girona, Spain

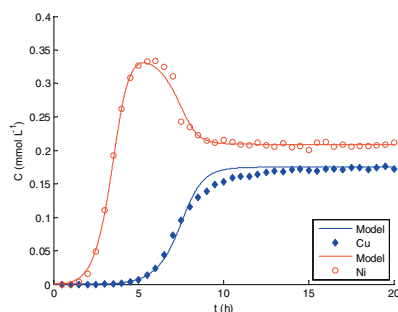
^b Applied Mathematics Department, Escola Politècnica Superior, Universitat de Girona, c/M^{re} Aurèlia Campmany, 61, 17071 Girona, Spain

HIGHLIGHTS

- ▶ Cu, Cd, Ni and Pb sorption in grape stalks packed columns.
- ▶ Metal sorption breakthrough curves modelling (single and binary mixtures).
- ▶ Except Pb all the other metal ions suffer overshoot in binary mixtures.
- ▶ Satisfactory fit of breakthrough curves.
- ▶ Satisfactory fit of elution profile of overshoot metal ion.

GRAPHICAL ABSTRACT

Experimental data and predictive breakthrough curves for metal sorption onto grape stalks from Cu–Ni binary mixture.



ARTICLE INFO

Article history:

Received 7 September 2012
Received in revised form 19 November 2012
Accepted 21 November 2012
Available online 29 November 2012

Keywords:

Homogeneous Surface Diffusion Model
Overshoot
Binary mixtures
Metal ions
Grape stalks packed columns

ABSTRACT

Few studies deal on metal sorption from multi-metal solutions, though in real situations more than one metal ion are present in solution and interactions between them occur. Interaction takes place when the different metal ions compete for the same sorbent active sites. In this work, sorption of Cu(II), Cd(II), Ni(II) and Pb(II) onto grape stalks waste in single and binary mixtures has been investigated. Sorption studies were carried out in continuous mode by using packed columns with grape stalks waste. The obtained metal ions breakthrough curves in binary mixtures showed that lead is not overshoot in binary mixtures with copper, cadmium and nickel. Copper is only overshoot in binary mixtures with lead. Nickel and cadmium suffer >60% overshoot metal sorption loose in binary mixtures with copper and lead. A model based on the Homogeneous Surface Diffusion Model (HSDM) has been developed to describe breakthrough curves. Langmuir model and Extended Langmuir Model (MEL) have been incorporated into the kinetic HSDM for breakthrough curves prediction of single and binary systems, respectively. The proposed model fits successfully the breakthrough curves of metal sorption from single and binary mixtures. In binary mixtures, the model also satisfactorily fits the elution profile of the overshoot metal ion.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

From the different methods used for removing metal ions adsorption is one of the most common and effective process for this purpose [1]. In the last years, most of research focused on me-

tal sorption from single metal solutions. In most of the studies the parameters that most influence metal adsorption (pH, time of contact, metal and sorbent concentration) and the mechanisms of sorption were investigated and the sorbent functional groups involved in the process elucidated [2]. Few studies deal on metal sorption from multi-metal solutions, though in real situations more than one metal ion are present in solution and interactions between them occur. Interaction takes place when the different metal ions compete for the same sorbent active sites.

* Corresponding author.

E-mail address: isabel.villaescusa@udg.edu (I. Villaescusa).