USE OF VEGETABLE WASTES TO REMOVE NICKEL

M. Martínez[1], N. Miralles [1], I. Villaescusa[2], N. Fiol[2], J. Poch[2] and A. Florido[1]

[1)] *Departament d'Enginyeria Química, ETSEIB, Universitat Politècnica de Catalunya • BarcelonaTech (UPC), Av. Diagonal, 647, 08028 Barcelona, Spain, tel. +34 93 4010980, rosario.martinez@upc.edu*

[2)] *Dept. Eng. Química, Escola Politècnica Superior, Universitat de Girona, c/ Mª Aurèlia Capmany, 61, 17071 Girona, Spain*

INTRODUCTION AND OBJECTIVE

The ability of vegetable wastes such as grape stalks and exhausted coffee to remove metals ions from synthetic aqueous solutions has been demonstrated in various studies performed by our research group [Villaescusa et al. 2004; Valderrama et al. 2010]. The main objective of this work was to investigate the ability of these vegetable wastes to remove nickel ions from an exhausted electroplating bath of a metal finishing industry from Barcelona (Spain).

METHODOLOGY

The experiments were carried out at room temperature in packed bed flow-up columns of 250 mm length and 25 mm internal diameter (see set-up in Figure 1). The columns were packed with grape stalk (GS) and exhausted coffee wastes (EC) of particle sizes 0.5-1.0 mm and 0.8-1.0 mm, respectively. In all experiments nickel concentration was kept constant about 5500 mg L^{-1} and pH, flow rate (Q), and bed height (H) were varied in order to predict nickel ions transport in the column (Table 1). The Bed Depth Service Time (BDST), Thomas, and Yoon-Nelson models were applied to the experimental data to describe the breakthrough curves and determine the characteristic design parameters of the column [Zhe et al. 2013]. In desorption studies, a 0.1 mol dm^{-3} HCl as elution solution was used. Experiments were performed at the same flow-rate used for sorption experiments.

Exp.	Sorbent	C_0(mg/l)	pH	H(cm)	m(g)	Q(ml/h)
I	GS	5.346	1,83	14,5	20,0	15
II	EC	5.346	1,83	10,5	20,0	15
III	GS	5.479	5,56	13,0	20,0	15
IV	EC	5.790	5,56	10,5	20,0	15
V	EC	5.455	5,56	10,5	20,0	10
VI	EC	5.767	5,56	13,0	24,8	15
VII	GS	5.233	5,56	13,0	20,0	10

Table 1. Experimental conditions

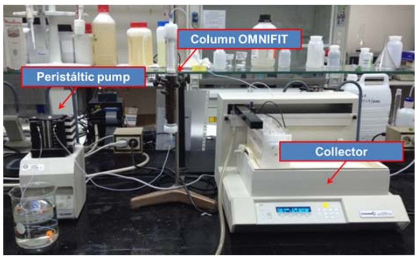

Figure 1. Experimental set-up

RESULTS

In Figures 2 and 3, experimental data points for Ni(II) sorption onto GS and EC and predicted breakthrough curves by Thomas model are plotted. Parameters obtained with the different models used in this work are presented in Table 2. Desorption results are shown in Table 3.

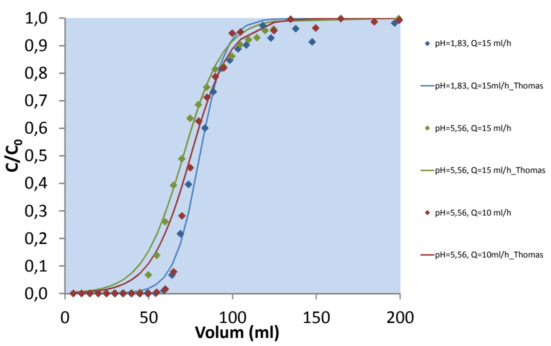

Figure 2. Breakthrough curves for nickel (II) sorption onto grape stalk waste at different initial pH values and flow rates

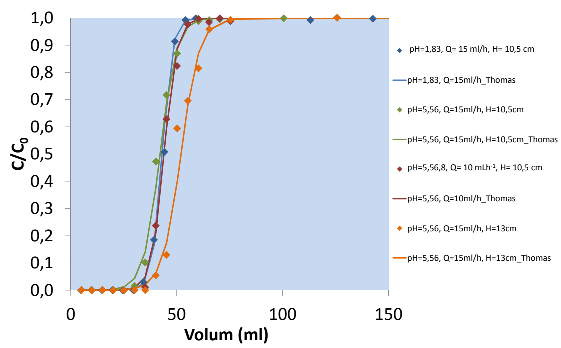

Figure 3. Breakthrough curves for nickel (II) sorption onto exhausted coffee waste at different initial pH values ,flow rates and bed height.

Table 2. Model parameters for GS and EC wastes

Exp.	Experimental	Thomas		BDST		Yoon	Nelson
	q mg g^{-1}	k_{Th} ml·mg^{-1}·min^{-1}	q_0 mg·g^{-1}	K_{BDST} ml·mg^{-1}·min^{-1}	No mg g^{-1}	K_{yn} min^{-1}	$t_{1/2}$ min
I	22,96	0,0059	21,53	0,0059	21,56	0,0318	327,8
III	20,82	0,0037	19,34	0,0037	19,30	0,0205	282,8
VII	21,19	0,0027	19,64	0,0027	19,65	0,0139	451,5
II	12,11	0,0192	11,56	0,0192	11,56	0,1024	175,9
IV	12,30	0,0112	12,22	0,0112	12,21	0,0651	167,7
V	12,13	0,0103	12,04	0,0103	12,03	0,0561	2633
VI	12,19	0,0100	12,11	0,0101	12,09	0,0580	206,8

Table 3. Desorption results

Exp.	% Desorption
I	10,39
III	49,14
VII	30,74
II	13,50
IV	13,87
V	16,30
VI	11,98

CONCLUSIONS

- Variation of initial pH, flow rate and bed height did not lead to significant differences on sorption capacity of the sorbents.
- Sorption capacity was higher for GS than for EC
- Metal desorption was favored at pH 5,5 and when GS are used
- The breakthrough curves are adequately described by Thomas, BDST and Yoon Nelson models. No significant differences were found between models fittings

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Acknowledgements: Thanks are due to Sara Rodriguez for their help in part of the experimental work. This work was supported by MINECO (Spanish Ministry of Economy and Competitiveness), projects CTM2012-37215-C02-01/02.