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SCALE-UP OF A BIOSORTION FIXED-BED COLUMN FOR WASTEWATER PURIFICATION: CALCULATION OF MASS TRANSFER PARAMETERS

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PURPOSE OF THE ABSTRACT

Environmental pollution is causing a serious deterioration of water quality, mainly due to the proliferation of industrial activity and its polluting effect. Among the pollutants present in water are heavy metals. The contamination of water by heavy metals causes important concerns about health and the environment, since most metals are not biodegradable and cause serious disorders and diseases in living organisms. In recent years, biosorption has been presented as a technology suitable for the purification of aqueous media containing heavy metals, which has certain advantages over conventional methods. However, the use of this technology on an industrial scale requires more in-depth study of aspects such as process scale-up and optimization.

In this work, the scale-up of the biosorption process for the elimination of lead from aqueous media using olive tree pruning was studied. In the tests, a laboratory column with a height of 23 cm and internal diameter of 1.5 cm and a pilot column with a height of 60 cm and an internal diameter of 5 cm were used. In the scale-up, three types of similarity (geometrical similarity, kinematic similarity and dynamic similarity) were considered (Inglezakis and Poulopoulous, 2006). Contact or residence time, incorporated into the continuity equation, was one of the more critical parameters in scale-up. The results allowed to determine the parameters of mass transfer and to compare the behavior of laboratory-scale and pilot scale columns. Concretely, overall, external and internal mass transfer coefficients (Kc?a, ke?a, ki?a) between the fluid and the surface of the solid phase, and number of transfer units (NTU) were determined for each experimental test (McCabe, 2007). Figure 1 shows some characteristic parameters and the values of the mass transfer coefficients for one of the tests carried out in both columns. In general, similar values of mass transfer coefficients were obtained for laboratory-scale and pilot-scale tests. Finally, under specified conditions, the data of the laboratory-scale and pilot-scale unit were used for the evaluation of the large-scale unit performance.

FIGURES

Parameter	Laboratory-scale	Pilot-scale
Q, mL/min	8	89
Z, cm	11,3	11,3
a, cm^2/cm^3	43,4	43,4
K_c·a, min^{-1}	2,31	1,82
k_e·a, min^{-1}	3,30	3,30
k_l·a, min^{-1}	7,67	4,03
NUT	5,76	4,53
Q, flow rate Z, bed height a, mass transfer area		

FIGURE 1

Characteristic parameters and values of the mass transfer coefficients for one of the tests carried out

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FIGURE 2

KEYWORDS

Biosorption | Heavy metals | Wastewater purification | Scale-up

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