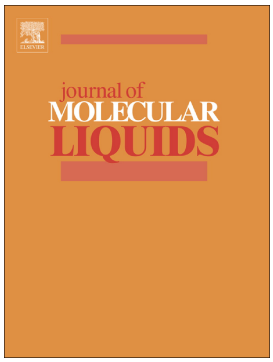

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PII: S0167-7322(17)31816-0
DOI: doi: 10.1016/j.molliq.2017.05.148
Reference: MOLLIQ 7440

To appear in: *Journal of Molecular Liquids*

Received date: 26 April 2017
Revised date: ###REVISEDDATE###
Accepted date: 31 May 2017

Please cite this article as: L.E. Hernández-Hernández, A. Bonilla-Petriciolet, D.I. Mendoza-Castillo, H.E. Reynel-Ávila , Antagonistic binary adsorption of heavy metals using stratified bone char columns, *Journal of Molecular Liquids* (2017), doi: 10.1016/j.molliq.2017.05.148

ANTAGONISTIC BINARY ADSORPTION OF HEAVY METALS USING STRATIFIED BONE CHAR COLUMNS

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ABSTRACT. This manuscript introduces the application of reverse stratified bone char adsorbers for the binary adsorption of copper and zinc from aqueous solution. The impact of adsorbent bed layering on the antagonistic adsorption of these heavy metals ions using bone char has been studied. Breakthrough parameters of stratified columns have been calculated and analyzed for the removal of tested heavy metals. Results showed that the stratified adsorption columns have better breakthrough parameters for the antagonistic adsorption of these heavy metals in comparison to conventional packed bed columns. The competitive adsorption effect caused by co-ion can be reduced in stratified packed columns in contrast to the conventional bed configuration enhancing the bed utilization and adsorption capacities besides a reduction in the selectivity (i.e., the adsorbent preference for the adsorption of a specific adsorbate) for heavy metal removal. The improvements in the adsorption process were more evident for Zn^{2+} removal, which was very sensitive to the presence of Cu^{2+} ions. These benefits have been obtained even operating at column conditions where the presence of axial dispersion and mass transfer resistances has a significant impact on adsorption effectiveness. On the other hand, an artificial neural network (ANNs) model was used for correlating the breakthrough curves of stratified bone char adsorbers. The modeling of the binary adsorption breakthrough curves of these metals with stratified columns was challenging even for the ANNs approach, which has been recognized as an effective intelligent algorithm for data processing. In particular, ANNs model displayed the highest modeling errors in the breakthrough zone of C_t/C_0 patterns. This finding highlighted the importance of developing alternative and robust modeling approaches for simulating and predicting the performance of multicomponent adsorption systems using intensified processes such as stratified packed bed columns. In summary, results of this study contribute to the understanding and application of intensified adsorption processes for facing water pollution problems caused by heavy metals and other priority pollutants.

Keywords: Stratified packed bed columns, Antagonistic adsorption, Heavy metals, Bone char, Water treatment, Artificial neural network model

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