Reply to comments on "Low-cost chitosan-calcite adsorbent development for potential phosphate removal and recovery from wastewater effluent" by Pap et al. [Water research 173 (2020) 115573]

Reply to Comments on "Low-cost chitosan-calcite adsorbent development for potential phosphate removal and recovery from wastewater effluent" by Pap et al. [Water research 173 (2020) 115573]

Sabolc Pap[a,b,*], Caroline Kirk[c], Barbara Bremner[a], Maja Turk Sekulic[b], Lisa Shearer[a], Stuart W. Gibb[a], Mark A. Taggart[a]

[a] *Environmental Research Institute, North Highland College, University of the Highlands and Islands, Thurso, Caithness, Scotland, KW14 7JD, UK*

[b] *University of Novi Sad, Faculty of Technical Sciences, Department of Environmental Engineering and Occupational Safety and Health, Trg Dositeja Obradovića 6, 21 000 Novi Sad, Serbia*

[c] *School of Chemistry, University of Edinburgh, David Brewster Rd, Edinburgh, EH9 3FJ, UK*

[*] Corresponding author at:
Environmental Research Institute, North Highland College, University of the Highlands and Islands, Scotland, KW14 7JD, UK
E-mail: szabolcs.pap@uhi.ac.uk; sabolcpap@uns.ac.rs

ORCID: 0000-0001-7395-1913;

Notes: The authors declare no competing financial interests

Abstract

This letter is in response to the comments of Dr Hu and Dr Zhang on "*Low-cost chitosan-calcite adsorbent development for potential phosphate removal and recovery from wastewater effluent*". We thank Dr Hu and Dr Zhang for their interest and comments, and having reflected, we wish to provide some clarification.

Keywords: Adsorption; Kinetics; Isotherm; Bohart-Adams model; Curve characteristics

1. Correction of curve fitting results

We agree that the model parameters obtained using Origin software and the Levenberg–Marquardt method are slightly different from those we reported. We used Excel, which clearly produced some insignificant divergence in the calculated data (Pap et al., 2020). However, we feel that there is limited difference in the key constants and error values generated, and moreover, the thermodynamic data (e.g., ΔH was 88.66 and is now 63.71 kJ/mol) remain similar. Therefore, no changes are considered necessary to our concluding remarks (also see Supplementary Information which compares previous and updated data).

2. Bohart–Adams model

The authors thank Dr Hu and Dr Zhang for their insightful comments regarding the different versions of the Bohart-Adams model (exponential vs logistic given by Eqs. (1) and (2) in their Comment). Indeed, we were not familiar with the logistic version at the time the article was prepared, and as such, we used the exponential version, which is able to track breakthrough data up to about $C < 0.3C_0$ breakthrough (Ang et al., 2020; Chu, 2020). One of our main goals was to design a column adsorption system to remove P from wastewater at low concentrations. Therefore, the model may (in practice), be largely

irrelevant when we have a breakthrough of >20-30%, as the adsorbent bed would need replacing (Ang et al., 2020).

3. Use of Clark model

The authors agree that to use the Clark model, the adsorption system should ideally follow Freundlich. However, since the Freundlich equation was approximately valid, the Clark model was considered suitable for the approximation of a packed bed column system (Han et al., 2009; Rout et al., 2017; Wan Ngah et al., 2012). However, we agree that in future it would be better to correlate the experimental data with the Clark model as a three-parameter empirical model. See Supplementary Information for the refitted data (Figure S1c-e).

4. Partial and complete data

We would agree that using model fitting on a partial breakthrough curve can affect model parameters, however, this approach is common (Han et al., 2008; Lim and Aris, 2014; Zheng et al., 2019). It should be noted that the model parameters were not used for further calculations, or, to draw significant key conclusions. The authors will consider this constructive criticism in future studies.

5. Conclusions

We thank the authors of "*Comment on "Low-cost chitosan-calcite adsorbent development for potential phosphate removal and recovery from wastewater effluent" by Pap et al. [Water research 173 (2020) 115573]*" for drawing out the above points for clarification. We believe such contributions avoid the propagation of errors within the literature and help improve the robustness of papers published in the field of adsorption.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Ang, T.N., Young, B.R., Taylor, M., Burrell, R., Aroua, M.K., Baroutian, S., 2020. Authors' response to comments on Ang et al. "Breakthrough analysis of continuous fixed-bed adsorption of sevoflurane using activated carbons." Chemosphere 126389. https://doi.org/10.1016/j.chemosphere.2020.126389

Chu, K.H., 2020. Breakthrough curve analysis by simplistic models of fixed bed adsorption: In defense of the century-old Bohart-Adams model. Chem. Eng. J. 380, 122513. https://doi.org/10.1016/j.cej.2019.122513

Han, R., Ding, D., Xu, Y., Zou, W., Wang, Y., Li, Y., Zou, L., 2008. Use of rice husk for the adsorption of congo red from aqueous solution in column mode. Bioresour. Technol. 99, 2938–2946. https://doi.org/10.1016/j.biortech.2007.06.027

Han, R., Wang, Yu, Zhao, X., Wang, Yuanfeng, Xie, F., Cheng, J., Tang, M., 2009. Adsorption of methylene blue by phoenix tree leaf powder in a fixed-bed column: experiments and prediction of breakthrough curves. Desalination 245, 284–297. https://doi.org/10.1016/j.desal.2008.07.013

Lim, A.P., Aris, A.Z., 2014. Continuous fixed-bed column study and adsorption modeling: Removal of cadmium (II) and lead (II) ions in aqueous solution by dead calcareous skeletons. Biochem. Eng. J. 87, 50–61. https://doi.org/10.1016/j.bej.2014.03.019

Pap, S., Kirk, C., Bremner, B., Sekulic, M.T., Shearer, L., Gibb, S.W., Taggart, M.A., 2020. Low-cost chitosan-calcite adsorbent development for potential phosphate removal and recovery from wastewater effluent. Water Res. 173, 115573. https://doi.org/10.1016/j.watres.2020.115573

Rout, P.R., Bhunia, P., Dash, R.R., 2017. Evaluation of kinetic and statistical models for predicting breakthrough curves of phosphate removal using dolochar-packed columns. J. Water Process Eng. 17, 168–180. https://doi.org/10.1016/j.jwpe.2017.04.003

Wan Ngah, W.S., Teong, L.C., Toh, R.H., Hanafiah, M.A.K.M., 2012. Utilization of chitosan-zeolite composite in the removal of Cu(II) from aqueous solution: Adsorption, desorption and fixed bed column studies. Chem. Eng. J. 209, 46–53. https://doi.org/10.1016/j.cej.2012.07.116

Zheng, Y., Wang, B., Wester, A.E., Chen, J., He, F., Chen, H., Gao, B., 2019. Reclaiming phosphorus from secondary treated municipal wastewater with engineered biochar. Chem. Eng. J. 362, 460–468. https://doi.org/10.1016/j.cej.2019.01.036