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Discussion

Comments on "Equilibrium and kinetic studies for the biosorption system of copper(II) ion from aqueous solution using *Tectona grandis* L.f. leaves powder"

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Abstract

This letter reports the way to solve the Redlich–Peterson isotherm. In addition the importance of constraints for the Redlich–Peterson isotherm exponent was discussed in detail.
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Keywords: Isotherm; Redlich–Peterson; Langmuir; Theory; Limitations

Recently Kumar et al. [1] had published a paper entitled above. In the section biosorption equilibrium (Section 4), a three parameter Redlich–Peterson isotherm was used to explain the experimental equilibrium data. Based on the predicted Redlich–Peterson isotherms, a negative value of constant 'g' (-0.3488) was reported.

The Redlich–Peterson [2] isotherm was proposed by considering the limitations of Freundlich and Langmuir isotherm. The Redlich–Peterson isotherm as reported in the original article is given by [2]

$$q_e = \frac{AC_e}{1 + BC_e^g} \tag{1}$$

where A is the Redlich–Peterson isotherm constant (L/g), B the Redlich–Peterson isotherm constant (L/mg$^{1-(1/A)}$) and g is the exponent, which lies between 0 and 1. It has two limiting cases, which can be explained as follows:

When the exponent $g = 1$, the Langmuir equation results, given by

$$q_e = \frac{AC_e}{1 + BC_e} \tag{2}$$

When $g = 0$, Redlich–Peterson isotherm equation transforms to Henry's law equation:

$$q_e = \frac{AC_e}{1 + B} \tag{3}$$

The features of Redlich–Peterson isotherm following the Langmuir isotherm when the constant g equals unity was recently verified for the sorption of basic dyes onto activated carbon [3–6]. In addition the Redlich–Peterson isotherm following the Freundlich isotherm for the constant A and $B \gg 1$ and $g = 1$ was verified for the sorption of auramine O onto activated carbon [7]. Thus anything g value out of the range from 0 to 1 will violate the theory behind the Redlich–Peterson isotherm. In addition this will also lead to a difficulty in explaining where the isotherm (Freundlich or Henry or Langmuir) represents. Though search for the best fit isotherm using regression methods are acceptable, care should be taken such that the regression methods should not affect the theory of the isotherms. The negative value of the Redlich–Peterson exponent [1] which is <1 suggest that the Redlich–Peterson exponent g was not subjected to the theoretical constraints while applying linear regression technique. Irrespective of the regression method, either linear or non-linear method, the Redlich–Peterson isotherm should be subjected under the constraints $0 < g < 1$. In addition, in Section 2.4 of the referred paper [1], it was reported that a minimization procedure was adopted to maximize the coefficient of deter-

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mination, between the theoretical data for q_e predicted from the linearized form of Redlich–Peterson isotherm equation and the experimental data. However from the isotherm parameters reported with negative g values and also the very lower r^2 value of 0.1117 for Redlich–Peterson isotherm suggest that iteration techniques are to be used to minimize the error distribution between the experimental equilibrium data and the isotherms under the constraints $0 < g < 1$. It is to be noted that the negative g value will fail to explain the linear or the Freundlich type exponential or the Langmuir's saturation zone at equilibrium conditions. In addition the g value falling in the range from 0 to 1 will be helpful to get a more clear idea about the actual mechanism of the sorption process. In addition from Table 1 of Ref. [1], it can be seen that both the Freundlich and Langmuir isotherm well represents the experimental equilibrium data with higher r^2 values. In this situation the g value will be helpful in explaining where the isotherm represents, either in the Freundlich or the Langmuir. Thus it would be more informative if the authors predict the Redlich–Peterson isotherm by considering the theoretical constraints of this isotherm.

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