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Letter to the Editor

Comments on “Removal of Congo red from aqueous solution by anilinepropylsilica xerogel” by Pavan FA, Dias SLP, Lima EC, Benvenutti EV. Dyes and Pigments 2008;76:64–9

This letter discusses the importance and advantages of the constraints in the Redlich–Peterson isotherm exponent.

The paper by Pavan et al. [1] is very useful and informative to researchers working in this particular area. However we offer comments on the adsorption isotherm aspects of this particular paper [1]. In the adsorption isotherm section (section 2.7 and 3.2 of Ref. [1]), a three parameter Redlich–Peterson isotherm was used to explain the experimental equilibrium data. The Redlich–Peterson isotherm was reported for three solution temperatures and a value of the constant ‘g’ greater than unity ($g > 1$) was reported.

In 1959, the Redlich–Peterson [2] isotherm was proposed by considering the limitations of both the Freundlich and Langmuir isotherms. The Redlich–Peterson isotherm as reported in the original article is given by Ref. [2]:

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

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

(a) when the exponent $g = 1$, the Langmuir equation is given by:

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

(b) when $g = 0$, the Redlich–Peterson isotherm equation transforms to Henry’s law

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

The form of the Redlich–Peterson isotherm follows that of the Langmuir isotherm when the constant g equals unity, as was recently verified for the sorption of basic dyes onto activated carbon [3–6]. In addition, the Redlich–Peterson isotherm follows the Freundlich isotherm when the constants A and $B \gg 1$ and $g = 1$, as verified for the sorption of Auramine O onto activated carbon [7]. It has been reported that the Redlich–Peterson isotherm follows Henry’s law in the case of the sorption of sodium ions onto tree fern [8]. Thus, any value of g out of the range 0–1 will fail to explain the theory behind the Redlich–Peterson isotherm. Although the search for a best fit isotherm using regression methods is acceptable, care should be taken insofar as the regression methods should not interfere with the theory underlying the isotherm. In the paper under consideration [1], the value of the Redlich–Peterson exponent being greater than unity (Table 3 of Ref. [1]) suggests that no constraint was fixed to the Redlich–Peterson exponent ‘g’ when using regression techniques. Irrespective of whether linear or non-linear regression methods were employed, the Redlich–Peterson isotherm should be used under the constraints $0 < g < 1$. In addition the value of g lying in the range 0–1 will provide a clearer idea about the actual mechanism of the sorption process. Also, from Table 3 of Ref. [1], it can be seen that both the Freundlich and Langmuir isotherms represent well the experimental equilibrium data with higher r^2 values; in this situation, the value of g will describe which isotherm, either the Freundlich or the Langmuir, represents the data.

Thus, we suggest that the authors might wish to re-evaluate the Redlich–Peterson isotherm considering the theoretical constraints of this particular model.

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