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Discussion

Comments on the paper "Removal of aqueous Hg(II) and Cr(VI) using phytic acid doped polyaniline/cellulose acetate composite membrane"

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ABSTRACT

A mistake of using and applying pseudo-first order kinetic expression for adsorption systems has been pointed out. This discussion offered information for citing original idea of pseudo-first order kinetic expression. The original idea of initial adsorption rate calculated from pseudo-second order kinetic model was also presented. It suggested an important idea that author must not only be creative but also be careful while writing in order to publish more valuable and worth of reading papers.

Recently, Li et al. published a paper entitled "Removal of aqueous Hg(II) and Cr(VI) using phytic acid doped polyaniline/cellulose acetate composite membrane" [1]. In Section 3.2.3 "Adsorption kinetics for mercury(II), Cr(VI) and effect of contact time", the authors mentioned that, "The adsorption kinetic data was analyzed using the pseudo-first-order equation and pseudo-second-order equation which are expressed as follows:" without citing appropriate references

$$\frac{1}{q_t} = \frac{k_1}{q_e t} + \frac{1}{q_e} \tag{3}$$

$$\frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{t}{q_e} \tag{4}$$

The pseudo-first-order equation, Eq. (3) is incorrect. Thus results and conclusion in "Removal of aqueous Hg(II) and Cr(VI) using phytic acid doped polyaniline/cellulose acetate composite membrane" might not be appropriate.

In 1898, Lagergren firstly presented the first order rate equation for the adsorption of oxalic acid and malonic acid onto charcoal [2]. In order to distinguish kinetics equation based on concentration of solution and adsorption capacity of solid, Lagergren's first order rate equation has been called pseudo-first order since 1998 [3]. Details of Lagergren rate equation for adsorption reactions were published in 2004 [4]. The most popular form used is:

$$\log(q_e - q_t) = \log(q_e) - \frac{k}{2.303} t$$

q_e and q_t (mg/g) are the adsorption capacities at equilibrium and at time t respectively. k (1/min) is the rate constant of pseudo-first order adsorption. In recent years, the same mistake can be found in *Water Science & Technology* [5], *International Journal of Biological Macromolecules* [6], *Carbohydrate Polymers* [7], *Chemical Engineering Journal* [8,9], *Desalination and Water Treatment* [10], *Separation Science and Technology* [11], and *Applied Clay Science* [12]. However only few related comments were accepted in some journals, such as *Food Chemistry* [13], *Journal of Molecular Liquids* [14], and *Journal of Environmental Sciences-China* [15]. In order to stop the proliferation of the mistake a comment has been made in *Food Chemistry* [13]. This type of error could be avoided if authors have had paid more attentions to details about the model from the original paper.

Furthermore, authors also mentioned pseudo-second order kinetic model, Eq. (4) and "the initial adsorption rate h (mg/(g min)) could be calculated with k_2 and q_e value:"

$$h = k_2 q_e^2 \tag{5}$$

The definition of initial adsorption rate for the adsorption systems of divalent metal ions using sphagnum moss peat has been presented by Ho [16] and this expression was also published in 1998 [3]. In addition, the pseudo-second order kinetic model was used in numbers of adsorption systems in subsequent years [17]. An article entitled "pseudo-second order model for sorption pro-

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cesses" by Ho and McKay [18] has been ranked top one in annual citations in Web of Science category of chemical engineering since 2008 [19].

In order to stop the proliferation of the mistake of the pseudo-first order model a comment has been made [13]. This type of error could be avoided if authors have had paid more attentions to details about the model from the original paper. Citing the original paper not only respects the authors who presented a novel idea in research, but also directs readers to the details of the original work [20]. In my view, Li et al. should have cited the original papers for the initial adsorption rate equation as well as the pseudo-first and pseudo-second order kinetic models, thereby providing greater accuracy and detailed information about the kinetic expression that they employed.

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