Comments on the paper ‘Synthesis and application of ion-imprinted resin based on modified melamine-thiourea for selective removal of Hg(II)’

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Recently, Monier et al. published the paper entitled ‘Synthesis and application of ion-imprinted resin based on modified melamine-thiourea for selective removal of Hg(II)’.

In the section Adsorption kinetics, the authors noted: ‘For better evaluation of the extraction mechanism and investigation of the rate-limiting step, the obtained kinetic results were treated by using both pseudo-first-order and pseudo-second-order kinetic models, which can be mathematically expressed as follows:

\[ \frac{1}{q_t} = \frac{k_1}{q_e} + \frac{1}{q_e} t \] (9)

\[ \frac{t}{q_t} = \frac{1}{k_2q_e} + \frac{1}{q_e} t \] (10)

where \( k_1 \) and \( k_2 \) are the pseudo-first-order rate constant (min\(^{-1}\)) and pseudo-second-order rate constant of adsorption (g mg\(^{-1}\) min\(^{-1}\)) for adsorption, respectively, and \( q_e \) and \( q_t \) (mg g\(^{-1}\)) are the amounts of metal ion adsorbed at equilibrium and at time \( t \) (min), respectively.

In fact, Eqs (9) and (10) are the same. From Eqs (9) and (10), \( k_1 \) can be obtained as

\[ k_1 = \frac{1}{k_2q_e} \]

In addition, the pseudo-first-order model, Eqn (9), is not correct. The units of the parameters in Eqn (9) also cannot agree with each other. Thus means that ‘Synthesis and application of ion-imprinted resin based on modified melamine-thiourea for selective removal of Hg(II)’ might not be correct. The same mistake has been mass duplicated by Monier et al. in Carbohydrate Polymers, the Chemical Engineering Journal, Colloids and Surfaces B – Biointerfaces, the International Journal of Biological Macromolecules, Journal of Applied Polymer Science, Journal of Colloid and Interface Science, Journal of Hazardous Materials, Journal of Molecular Recognition, Polymer International and Reactive and Functional Polymers.

In 1898, Lagergren first presented the first-order rate equation for the adsorption of oxalic acid and malonic acid onto charcoal. Details of the Lagergren rate equation for adsorption reactions were published in 2004. 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\(^{-1}\)) are the adsorption capacities at equilibrium and at time \( t \) respectively. \( k \) (min\(^{-1}\)) is the rate constant of pseudo-first-order adsorption. In recent years, the same mistake has been pointed out in Food Chemistry, Journal of Molecular Liquids and Journal of Environmental Sciences – China.

The pseudo-second-order kinetic expression for the adsorption systems of divalent metal ions using sphagnum moss peat was presented by Ho in 1995 and this expression was also published in 1996. A modified equation was presented in 1998 to correct a mistake in the previous paper that was published in 1996. The pseudo-second-order kinetic model has a non-linear form

\[ q_t = \frac{q_e^2kt}{q_e + q_k kt} \]

and four linear forms:

\[ \frac{t}{q_t} = \frac{1}{kq_e} + \frac{1}{q_e} t \]

\[ \frac{1}{q_t} = \left( \frac{1}{kq_e} \right) \frac{1}{t} + \frac{1}{q_e} \]

\[ q_t = q_e - \left( \frac{1}{kq_e} \right) \frac{q_t}{t} \]

\[ \frac{q_t}{t} = kq_e^2 - kq_e q_t \]

The model has been used in numbers of adsorption systems in subsequent years. Furthermore an article entitled...
'Pseudo-second-order model for sorption processes' by Ho and McKay\textsuperscript{33} has been ranked top in annual citations in the Web of Science category of chemical engineering since 2008.\textsuperscript{34} A review of second-order models for adsorption systems gave more details.\textsuperscript{35} In order to stop the proliferation of the mistake of the pseudo-first-order model a comment has been made.\textsuperscript{24–26} Citing the original paper not only respects the work of the authors who presented a novel research idea but also discussed this idea in detail in the body of their paper.\textsuperscript{26} In my view, Monier et al. should have cited the original paper for the pseudo-first-order and pseudo-second-order kinetic models and thereby provided greater accuracy and information details about the kinetic expression they employed.

REFERENCES