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Letter to the Editor

Comment on "Removal of copper from aqueous solution by aminated and protonated mesoporous aluminas: kinetics and equilibrium," by S. Rengaraj, Y. Kim, C.K. Joo, and J. Yi

Yuh-Shan Ho *

School of Public Health, Taipei Medical University, 250 Wu-Hsing Street, Taipei 11014, Taiwan

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Abstract

This study presents a literature review concerning the precision of over 80 publications which originally cited Ho's pseudo-second-order kinetic expression for solute sorption on various sorbents. This model applies to a range of solid–liquid systems such as metal ions, dyestuffs, herbicides, oil, and organic substances in aqueous systems onto various sorbents. A reference section in a paper plays a key role to researchers who are interested in the paper's statement and following study or finding useful information from the paper. This section is as important as the core of a paper; however, it is easily ignored by the author. This comment offers information citing the original presentation of a pseudo-second-order kinetic expression. It is also suggested that an author not only must be creative but also must be careful while writing in order to publish more valuable and papers more worthy of reading.

Keywords: Adsorption; Kinetics; Pseudo-second order; Citation

Recently, Rengaraj et al. published the paper "Removal of Copper from Aqueous Solution by Aminated and Protonated Mesoporous Aluminas: Kinetics and Equilibrium" [1]. In Section 3.3.2, "Pseudo-First-Order Kinetic Model," the authors mentioned that "The sorption kinetics may be described by a pseudo-first-order model" using Eqs. (6) to (8) in the paper and cited three previous Rengaraj et al. papers as secondary references. In the first reference, there is a mistake in citing the pseudo-first-order model [2]. In the other two references, the authors did not mention any pseudo-first-order model [3,4]. A citation review of the Lagergren rate equation for adsorption reactions has been presented [5]. The correct reference citing the original Lagergren paper was first presented by Ho et al. in 1998: "S. Lagergren, Zur theorie der sogenannten adsorption gelöster stoffe, *Kungliga Svenska Vetenskapsakademiens. Handlingar*, Band 24, No. 4, (1898), 1–39." Its English translation is "S. Lagergren, About the theory of so-called adsorption of soluble substances, *Kungliga Svenska Vetenskapsakademiens. Handlingar*, Band 24, No. 4, (1898), 1–39" and the abbreviation style is "S. Lagergren, Zur theorie der sogenannten adsorption gelöster stoffe, *K. Sven. Vetenskapsakad. Handl.*, Band 24, No. 4, (1898), 1–39." In order to distinguish a kinetic equation based on the adsorption capacity of a solid from one based on the concentration of a solution, Lagergren's first-order rate equation has been called pseudo-first-order [6–9].

In Section 3.3.3, "Pseudo-second-order kinetic model," the authors cited Rengaraj et al. [2] and Kim et al. [10] for a pseudo-second-order model to describe the kinetic of sorption of copper onto aminated and protonated mesoporous alumina using Eqs. (9) to (16) in the paper. In fact, in the first reference [2], the authors did not mention a pseudo-second-order model in the paper. In the other reference [10], the authors cited Ho's pseudo-second-order model from Quek et al. [11] as a secondary reference. The expression for the pseudo-second-order model Kim et al. used, Eqs. (9) and (10) in the reference paper, are from Ho's previous publications [6–9,12–28], but not the same as Quek et al. [11].

The second-order kinetic expression for the adsorption systems of divalent metal ions using sphagnum peat moss has been reported by Ho [29]. In order to distinguish a ki-

* Fax: 886-2-2738-4831.
E-mail address: ysho@tmu.edu.tw.

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Table 1
Pseudo-second-order kinetic models of various related systems from the literature

Sorbent	Sorbate	References
2-Mercaptobenzimidazole–clay	Hg(II)	[31]
Activated carbon	Hg(II)	[32]
Activated carbon	Pb(II), Hg(II), Cd(II), Co(II)	[33]
Activated carbon	Cd(II)	[34]
Activated carbon	Pb(II)	[35]
Activated carbon	Methylene blue	[36]
Activated carbon	Cd(II)	[37]
Activated carbon	Phenol	[38]
Activated carbon	Cd(II), Ni(II)	[39]
Activated carbon	2,4-Dichlorophenoxy-acetic acid (2,4-D)	[40]
Activated clay	Basic red 18, Acid blue 9	[41]
Aspergillus niger	Pb(II), Cd(II), Cu(II), Ni(II)	[42]
Aspergillus niger	Basic blue 9	[43]
Aspergillus niger	Acid blue 29	[44]
Aspergillus niger	Congo red	[45]
Baker's yeast	Cd(II)	[46]
Banana stalk (*Musa paradisiaca*)	Hg(II)	[47]
Base-treated juniper fiber	Cd(II)	[48]
Beech leaves	Cd(II)	[13]
Bi_2O_3	Cr(VI)	[13]
Blast furnace slag, dust, sludge, carbon slurry	Phenols	[49]
Bottom ash	Cu(II), Pb(II)	[13]
Calcined alunite	Phosphorus	[50]
Calcined Mg–Al–CO_3 hydrotalcite	Cr(VI)	[51]
Chinese reed (*Miscanthus Sinensis*)	Cr(III)	[52]
Chitin, Chitosan, *Rhizopus arrhizus*	Cr(VI), Cu(II)	[53]
Coir	Cu(II), Pb(II)	[54]
Coir pith carbon	Congo red	[55]
Cypress leaves	Pb(II)	[13]
Date pits	Methylene blue	[56]
Diatomaceous earth	Methylene blue	[57]
Fly ash	Omega chrome red ME, *o*-cresol, *p*-nitrophenol	[21]
Fly ash	Victoria blue, OCL, PNP, OCRME	[13]
Grafted silica	Pb(II), Cu(II)	[58]
Hazelnut shells	Co(II)	[59]
Iron oxide-coated sand	As(V), As(III)	[60]
Juniper fiber	Cd(II)	[48]
Microcystis	Ni(II), Cr(VI)	[61]
Microporous titanosilicate ETS-10	Pb(II)	[62]
Mixed clay/carbon	Acid blue 9	[63]
Mucor rouxii	Pb(II), Cd(II), Ni(II), Zn(II)	[64]
Myriophyllum spicatum	Pb(II), Zn(II), Cd(II)	[65]
Na–bentonite	Oil	[66]
Peat	Basic blue 69, Acid blue 25	[8]
Peat	Cu(II)	[67]
Peat	Cu(II)	[68]
Peat	Cu(II)	[13]
Peat-resin particle	Basic magenta, Basic brilliant green	[69]
Perlite	Cd(II)	[70]
Phosphate	Aluminum-impregnated mesoporous	[71]
Pith	Basic red 22, Acid red 114	[22]
Reed leaves	Cd(II)	[13]
Rhizopus oligosporus	Cu(II)	[72]
Rice hull	Cr(VI), Cu(II)	[73]
Sago	Cu(II), Pb(II)	[11]
Sawdust	Cd(II), Pb(II)	[74]
Sawdust	Phenol	[75]
Schizomeris leibleinii	Pb(II)	[76]
Spent grain	Pb(II), Cd(II)	[77]
Sphagnum peat moss	Cu(II), Ni(II)	[30]
Sphagnum peat moss	Chrysoidine (BO2), Astrazon blue (BB3), Astrazone blue (BB69)	[9]

(*continued on next page*)

Table 1 (*Continued from previous page*)

Sorbent	Sorbate	References
Sphagnum peat moss	Cu(II), Ni(II), Pb(II)	[78]
Sugar beet pulp	Pb(II), Cu(II), Zn(II), Cd(II), Ni(II)	[79]
Sugar beet pulp	Pb(II)	[80]
TNSAC	Phosphate	[13]
Tree fern	Cd(II)	[20]
Tree fern	Cu(II)	[17]
Tree fern	Pb(II)	[81]
Vermiculite	Cd(II)	[82]
Waste tyres, Sawdust	Cr(VI)	[83]
Wollastonite	Ni(II)	[13]
Wood	Basic blue 69, Acid blue 25	[7]
Zeolite	As(V)	[84]

netic equation based on the adsorption capacity of a solid from one based on the concentration of a solution, Ho's second-order rate equation has been called pseudo-second-order [6–9,12–28]. The earlier application of the pseudo-second-order equation to the kinetic studies of competitive heavy metal adsorption by sphagnum peat moss was undertaken by Ho et al. [30]. The modified model was also reported in subsequent years [6–9,12–28]. The most frequently cited papers were published in *Environmental Technology* [30], *Process Safety and Environmental Protection* [6,7], *Journal of Environmental Science and Health Part A—Toxic/Hazardous Substances & Environmental Engineering* [21], *Chemical Engineering Journal* [8], *Resources, Conservation and Recycling* [22], *Process Biochemistry* [13], and *Water Research* [14]. In addition, similar comments have also been published in *Adsorption Science & Technology* [23], *Journal of Colloid and Interface Science* [24,25], *Journal of Chemical Technology and Biotechnology* [26], *Biochemical Engineering Journal* [27], and *Bioresource Technology* [28].

The pseudo-second-order rate expression of Ho has been widely applied to the sorption of metal ions, dyes, herbicides, oil, and organic substances from aqueous solutions (References [31–84], see Table 1). Moreover, discussion of the reaction order has been reported, such as the comparison of chemisorption kinetic models [6] and a pseudo-second-order model [13]. Furthermore, Ho's kinetic expression has also been applied to a multistage batch adsorption design [18,19] and pseudo-isotherm studies [20].

Research papers conventionally include an introduction, a description of the objectives and procedures of the study, an account of the results, and a discussion of the results and their implications. However, a paper's contribution exists not only in its originality and creativity, but also in its continuity and development toward the following researches. The reference section can play a key role for researchers who were interested in the paper's statement and would like to follow the study or find useful information from the paper [5].

Bias in reviewing papers is more difficult to resolve, since it may derive from conflict of interest, or even personal hostility [85]. Calne and Calne [85] suggested that authors should cite relevant work of others, as well as their own. Authors could merely be instructed to include key citations in their introduction and to verify, in writing, that they have fully reviewed published work. I suggest that Rengaraj et al. cite Ho's original pseudo-second-order kinetic expression paper and Lagergren's pseudo-first-order kinetic model paper, or relevant works.

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