An International Journal

Nature and Science

ISSN 1545-0740

Volume 4 - Number 4, December 10, 2006

Nature and Science

ISSN: 1545-0740

Contents

Marsland Company, P.O. Box 21126, East Lansing, Michigan 48909, USA
(517) 980-4106

http://www.sciencepub.org editor@sciencepub.net

LETTER TO EDITOR

The Application of Polyamine Stationary Phases on Hydrometallurgy

Sheau-Long Lee

Department of Chemistry, Chinese Military Academy, Taiwan, R.O.C
Leesheaulong@gmail.com

ABSTRACT: This article presents five polyamine stationary phases with PEDA-AC-CA-phase, PDTA-AC-CA-phase, PTTA-AC-CA-phase, PTPA-AC-CA-phase and PPHA-AC-CA-phase being applied to eight transition metals by the absorbable order of Hg(II) ≥ Cr(II) > Pb(II) > Cu(II) > Cd(II) > Co(II) ≥ Zn(II) > Ni(II) in the treatment of wastewater.

Key words: Polyamine Stationary Phases, Hydrometallurgy.

INTRODUCTION

Heavy metals are serious environmental pollutants. Detection and removal of heavy metals contaminated in the city water should be important in hydrometallurgy. A Kettrup et al. used acid amide bonded starch cellulose to absorb heavy metals [1]. A. Bolto et al. tried to separate the heavy metal in contaminated water [2] or seawater [3] by ion-exchange method. Due to the relatively complex capacity of nitrogen atom, amine group can be used a chelate ligand in the compounds. Most of the studies were focused on the metal ions absorbed by "free amines", such as ethylendiamine for Ag^{+}, Cu^{+2}, Zn^{+2} [4] but Pb^{+2} and Cd^{+2} for different amines [5]. In this article, we designed several packing columns with the concept of combining the advantage of solid stationary phase and the strong absorption capacity of amine group to analyze series of transition metals. Five novel stationary phases by chemical bonded CA-phase [6] to a series of polyamines were applied to the absorption of eight transition metals, Cr(II), Co(II), Ni(II), Cu(II), Zn(II), Cd(II), Hg(II) and Pb(II). The series of polyamines are polymerized from five monomers, ethylendiamine (EDA), triethylenetetramine(TETA), tetra-ethylene-pentamine (TEPA), Penta-ethylenehexamine (PEHA). The synthesized stationary phases were hereafter noted as PEDA-AC-CA-phase, PDTA-AC-CA-phase, PTTA-AC-CA-phase, PTPA-AC-CA-phase and PPHA-AC-CA-phase respectively.

MATERIALS AND METHODS

Being suspension of 100 g CA-phase in 5 g Ethylenediamine, Diethylenetriamine, Tri-ethylenetetramine, Tetra-ethylenepentamine or Pentaethylenehexamine, 0.1 g Benzoyl peroxide was added into a 500ml beaker and the mixture beingheated at 110 ºC in an oil bath for 12 hours. After polymerization, the product was soxhlet-extracted with 500 ml toluene and acetone for 24 hours, followed by washing with 500 ml methanol and dried for 12 hours under vacuum. Finally, about 102 ~ 105 g of PEDA-AC-CA-phase, PDTA-AC-CA-phase, PTTA-AC-CA-phase, PTPA-AC-CA-phase or PPHA-AC-CA-phase were obtained as shown in figure 1. Different masses of stationary phase were added into a heavy metal-containing solution under thermostatically shaken at 25℃ for 24 hours. After reaction, the powder was dried and weighted and concentrations of metals in the solution can be determined by ICP method.

RESULTS

Table 1 shows the absorption of the eight transition metals on five stationary phases in comparison. Figure 2 depicted the bar chart. The absorption ability of polyamines to those stationary phase transition metal ions is as the order of Hg(II) ≥ Cr(II) > Pb(II) > Cu(II) > Cd(II) > Co(II) ≥ Zn(II) > Ni(II). This result is similar with the finding of Liu [6] via resin of strong amide group to adsorb transition metals. The absorption trend of all other ions are identical except for Ni(II) ≥Zn(II). In compare with the data of stabile coefficient from the publication of M.T.OMS [4], the order of absorption ability of Cu(II) 、Ni(II) 、Zn(II) 、Cd(II) 、Co(II) can explain why Cu(II) tend to form Tetrahedral

Coordination with two EDA and other four kinds of ions tend to form six coordination with three EDA. Thus, Cu(II) has higher adsorption ability than the other four ions and the order of stability constant β of Ni(II)、Zn(II)、Cd(II)、Co(II) after being formed six Coordination are Ni(II)＞Co(II)＞Zn(II)＞Cd(II). Therefore, the order of forming six coordination with three EDA can be Ni(II)＞Co(II)＞Zn(II)＞Cd(II). The reason for Ni(II) having the lowest absorption ability is because of the highest consumption of EDA functional group. Less Ni(II) can be chelated by EDA in a unit area than Co(II), Zn(II) and Cd(II). This result is consistent with PEDA-AC-CA-phase absorption and the research of E. Jacobsen [5] that Pb(II) tends to form fourth coordination compound with triethylenetetramine (TETA), tetraethylenepentamine (TEPA). Since Cd(II) tends to form six coordination compounds, the amino group in unit area can absorb more Pb(II) than Cd(II). Nevertheless, polyamine stationary phases can have good absorption ability for Hg(II), Cr(II), Pb(II) and Cu(II). We can use them for Hydrometallurgy of transition metal ions and for specific transition metal ions adsorption in wastewater。

REFERENCES

[1]. Zhang B. W., Fischer K., Bieneik D. and Kettrup.A., 〝Synthesisof amidoxime containing modified starch and application for the removal of heavy metals〞 Reactive Polymers 20:207 (1993)

[2]. Bolto B. A. and Pawlowski L. (1987) Waste water treatment by Ion Exchange, Chapman and Hall, New York.

[3]. Li, Shanji. Jiaying University, Meizhou, Guangdong, Peop. Rep. China. Fenxi Ceshi Xuebao (2006), 25(5), 96-98. Publisher: Fenxi Ceshi Xuebao Bianjibu,

[4]. Oms M. T., Forteza, R., Cerda V. and Borrul F., 〝Thermometric Study of Metal Nitrogenated Ligand Complexes, I Ethylenediamine Complexes with Ag(I),Cu(II),Zn(II),Ni(II), Mn(II),Cd(II)and Co(II)〞 (1989) Thermochimica Acta 138:1(1989)

[5]. Jacobsen,E.and Schroder,K., 〝Polarography of Lead and Cadmium Complexes with Tetraethylenepentamine and Pentaethylenehexamine〞 Acta Chemica Scandinavica, 16,1393 (1961).

[6]. Liu,C.Y., Chang,H.T.and Hu,C.C., 〝Complexation Reactions in a Heterogeneous System〞,Inorganica Chimica Acta.,172,151 (1990).

Table 1

The absorbed amount (mg) of metals by stationary phases

Phase		Cr(II)	Co(II)	Ni(II)	Cu(II)	Zn(II)	Cd(II)	Hg(II)	Pb(II)
PEDA-AC-CA-phase	A	4.53	23.19	23.68	14.13	22.97	22.38	10.21	8.98
	B	10.22	0.90	0.66	5.43	1.02	1.31	7.39	8.01
PDTA-AC-CA-phase	A	4.92	23.21	23.82	21.93	22.47	22.47	4.63	9.05
	B	10.04	0.9	0.59	1.54	1.26	1.27	10.18	7.98
PTTA-AC-CA-phase	A	12.31	21.73	22.95	5.56	21.71	21.75	3.60	11.47
	B	6.34	1.64	1.02	9.72	1.64	1.62	10.70	6.77
PTPA-AC-CA-phase	A	9.09	22.31	22.15	13.40	22.15	21.95	9.73	9.37
	B	7.96	1.34	1.43	5.80	1.42	1.53	7.64	7.81
PPHA-AC-CA-phase	A	9.55	21.64	20.84	13.17	21.01	22.10	8.39	10.51
	B	7.72	1.68	2.08	5.91	1.54	1.45	8.01	7.24

A: residual metal ion concentration in solution (ppm)
B: metal ion absorption weight on each gram powder phase(mg/g)

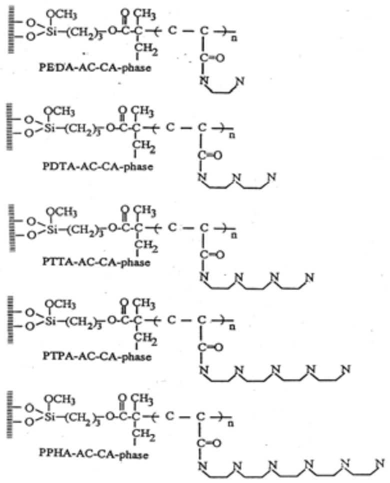

Figure 1
The structure of five Polyamine Stationary Phases

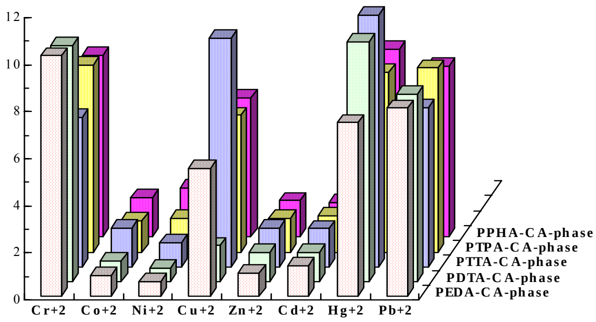

Figure 2
The absorption result of the eight transition metal on five stationary phases

Nature and Science

Call for Papers

The international academic journal, ***"Nature and Science"*** (ISSN: 1545-0740)**,** is registered in the United States, and invites you to publish your papers.

Any valuable papers that describe natural phenomena and existence and reports that convey scientific research and pursuit are welcome, including both natural and social sciences. Papers submitted could be reviews, objective descriptions, research reports, opinions/debates, news, letters, and other types of writings that are nature and science related.

Here is a new avenue to publish your outstanding reports and ideas. Please also help spread this to your colleagues and friends and invite them to contribute papers to the journal. Let's make efforts to disseminate our research results and our opinions in the worldwide for the benefit of the whole human community.

Papers in all fields are welcome.

Please send your manuscript to editor@sciencepub.net; naturesciencej@gmail.co m

For more information, please visit: http://www.sciencepub .org

Marsland Company
P.O. Box 21126
Lansing, Michigan 48909
The United States
Telephone: (517) 303-3990
Email: editor@sciencepub.net; naturesciencej@gmail.com
Website: http://www.sciencepub.org

Nature and Science

ISSN 1545-0740

The ***Nature and Science*** is an international journal with a purpose to enhance our natural and scientific knowledge dissemination in the world under the free publication principle. Any valuable papers that describe natural phenomena and existence or any reports that convey scientific research and pursuit are welcome, including both natural and social sciences. Papers submitted could be reviews, objective descriptions, research reports, opinions/debates, news, letters, and other types of writings that are nature and science related.

1. General Information

(1) Goals: As an international journal published both in print and on internet, *Nature and Science* is dedicated to the dissemination of fundamental knowledge in all areas of nature and science. The main purpose of *Nature and Science* is to enhance our knowledge spreading in the world under the free publication principle. It publishes full-length papers (original contributions), reviews, rapid communications, and any debates and opinions in all the fields of nature and science.

(2) What to Do: *Nature and Science* provides a place for discussion of scientific news, research, theory, philosophy, profession and technology - that will drive scientific progress. Research reports and regular manuscripts that contain new and significant information of general interest are welcome.

(3) Who: All people are welcome to submit manuscripts in any fields of nature and science.

(4) Distributions: Web version of the journal is freely opened to the world, without any payment or registration. The journal will be distributed to the selected libraries and institutions for free. For the subscription of other readers please contact with: editor@americanscience.org or americansciencej@gmail.com or editor@sciencepub.net.

(5) Advertisements: The price will be calculated as US$400/page, i.e. US$200/a half page, US$100/a quarter page, etc. Any size of the advertisement is welcome.

2. Manuscripts Submission

(1) Submission Methods: Electronic submission through email is encouraged and hard copies plus an IBM formatted computer diskette would also be accepted.

(2) Software: The Microsoft Word file will be preferred.

(3) Font: Normal, Times New Roman, 10 pt, single space.

(5) Manuscript: Don't use "Footnote" or "Header and Footer".

(6) Cover Page: Put detail information of authors and a short title in the cover page.

(7) Title: Use Title Case in the title and subtitles, e.g. "**Debt and Agency Costs".**

(8) Figures and Tables: Use full word of figure and table, e.g. **"Figure 1.** Annul Income of Different Groups**", Table 1. Annual Increase of Investment".**

(9) References: Cite references by "last name, year", e.g. "(Smith, 2003)". References should include all the authors' last names and initials, title, journal, year, volume, issue, and pages etc.

Reference Examples:

Journal Article: Hacker J, Hentschel U, Dobrindt U. Prokaryotic chromosomes and disease. Science 2003;301(34):790-3.

Book: Berkowitz BA, Katzung BG. Basic and clinical evaluation of new drugs. In: Katzung BG, ed. Basic and clinical pharmacology. Appleton & Lance Publisher. Norwalk, Connecticut, USA. 1995:60-9.

(10) Submission Address: editor@sciencepub.net, Marsland Company, P.O. Box 21126, Lansing, Michigan 48909, The United States.

(11) Reviewers: Authors are encouraged to suggest 2-8 competent reviewers with their name and email.

2. Manuscript Preparation

Each manuscript is suggested to include the following components but authors can do their own ways:

(1) Title page: including the complete article title; each author's full name; institution(s) with which each author is affiliated, with city, state/province, zip code, and country; and the name, complete mailing address, telephone number, facsimile number (if available), and e-mail address for all correspondence.

(2) Abstract: including Background, Materials and Methods, Results, and Discussions.

(3) Keywords.

(4) Introduction.

(5) Materials and Methods.

(6) Results.

(7) Discussions.

(8) Acknowledgments.

(9) References.

Journal Address:

Marsland Company
P.O. Box 21126
Lansing, Michigan 48909
The United States
Telephone:(517) 303-3990
E-mail: editor@sciencepub.net;
naturesciencej@gmail.com
Websites: http://www.sciencepub.org

ISSN 1545-0740

9 771545 074108

Nature and Science

Nature and Science: Volume 4, Number 4, 2006