Buletinul Ştiinţific al Universităţii "Politehnica" din Timisoara, ROMÂNIA
Seria CHIMIE ŞI INGINERIA MEDIULUI
Chem. Bull. "POLITEHNICA" Univ. (Timişoara) *Volume 51(65), 1-2, 2006*

Zinc Recover from Zinc Ash by Extraction with Clorhidric Acid Solutions

Lavinia Lupa, Petru Negrea, Aurel Iovi, Mihaela Ciopec, Giannin Mosoarca

Faculty of Industrial Chemistry and Environmental Engineering, University "Politehnica" of Timişoara, ,
P-ta Victoriei no.2, 300006-Timisoara, email: lavinia.lupa@chim.upt.ro

Abstract: Zinc is the 27th most common element in the earth's crust. More importantly, zinc is fully recyclable. Zinc can be recycled indefinitely, without loss of its physical or chemical properties. In this paper was made studies regarding the recover of zinc from zinc ash resulted during thermal zinc coating by extraction with clorhidric acid solutions in the view of the zinc chloride solution obtaining which can be used at the obtaining of the flux solutions.

Keywords: zinc, extraction, ash, clorhidric acid.

1. Introduction

Zinc is essential to modern society. It is used everywhere: as anti-corrosion coating on steel, for the manufacture of precision components, as a construction material, for the production of brass and rubber, in pharmaceutical and cosmetics products, in fertilizers and food supplements [1]. Galvanizing – the production of steel against corrosion by metallurgical bonding zinc to steel is the most important application of zinc.

At present, approximately 70% of the zinc produced worldwide originates from mined ores and 30% from recycled or secondary zinc [2]. Zinc is recycled at all stages of production and use - for example, from scrap that arises during the production of galvanized steel sheet, from scrap generated during manufacturing and installation process, and from end-of – life products. [3, 4, 5].

In thermal zinc coating industry results zinc ash which contains almost 80 % zinc. This can be recovered under different forms by pyrometallurgical and hydrometallurgical processes [6, 7].

In this paper was made studies regarding the recover of zinc from zinc ash resulted during thermal zinc coating by extraction with clorhidric acid solutions in the view of the zinc chloride solution obtaining which can be used at the obtaining of the flux solutions. Was followed the establishment of the optimum conditions of metals ions extraction to obtain a solution with a concentration of ≈ 200 g/L Zn^{2+}.

2. Experimental

The zinc ash resulted from thermal zinc coating industry, was sorted in 4 fractions (1<0.315 mm, 2= 0.315-1.25, 3=1.25-2, 4=2-6.3), which were analyzed in the view of their composition establish.

To establish the optimum condition of metals ions extraction was followed the dependence of the metals ions extraction concentration by the concentration of the used clorhidric acid solution, ash fraction, ratio Zn^{2+} : HCl, and time of contact between ash and acid solution. Was worked at various concentration of the clorhidric acid (5, 7.5, 10, 12.5, 15 and 20%), at various ratio Zn^{2+} : HCl (1:1, 1:1.05, 1:1.1, 1:1.15, 1:1.2) and at two times of contact that of 15 and 30 minutes.

3. Results and discussion

3.1. The analyze of zinc ash

The zinc ash sorted in those 4 fractions was analyzed in the view of their composition establishment and the experimental data are presented in table 1.

TABLE 1. The composition of the zinc ash

Fraction	Metals ions concentration, %			
	Zn	Fe	Ca	Pb
1	78	0.51	0.07	1.25
2	85.8	0.51	0.08	2.38
3	86.2	0.52	0.1	2.27
4	87.38	0.53	0.13	2.04

From the experimental data we can observe that all for fractions have almost the same composition, it can be observed only a small increasing of the zinc concentration with the increasing of the ash fraction.

3.2. The metals ions extraction concentration at the time of 15 minutes

The experimental data regarding the dependence of the metals ions extraction concentration by the used clorhidric acid solution concentration and by ash fraction at the time of contact between acid and ash of 15 minutes are presented in figure 1- 4.

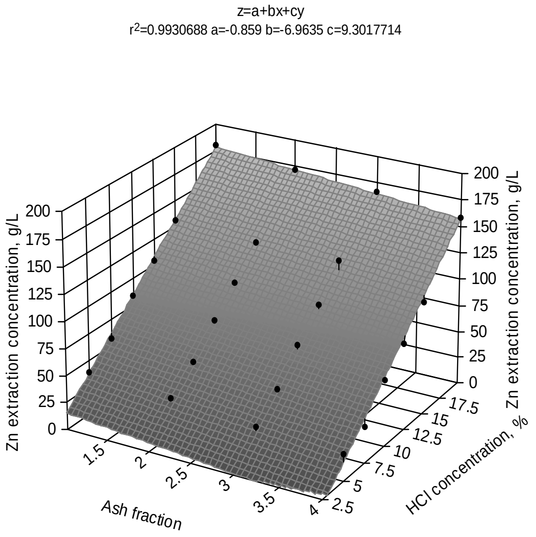

Fig.1. The Zn extraction concentration

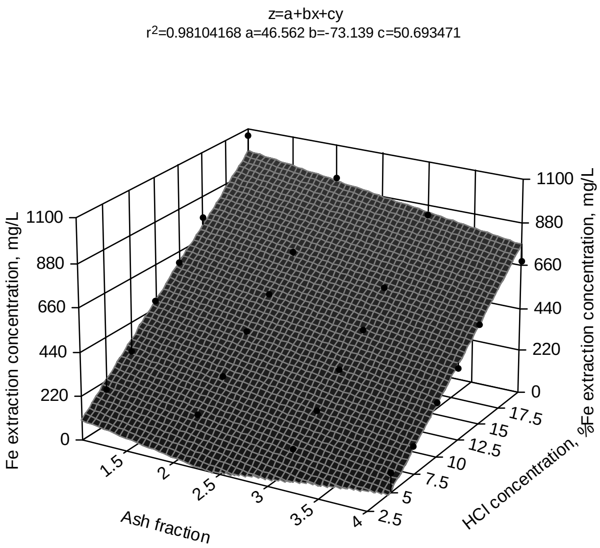

Fig 2. The Fe extraction concentration

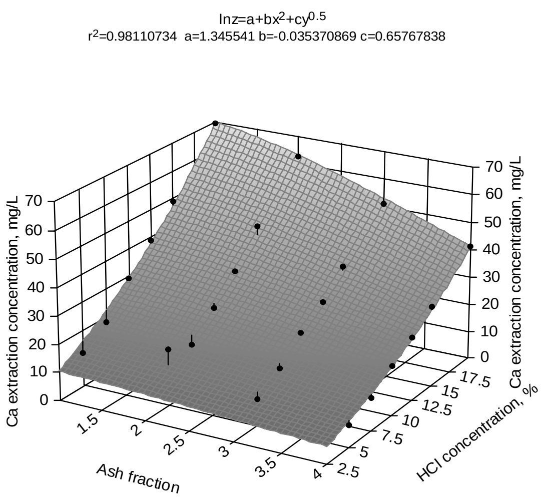

Fig.3. The Ca extraction concentration

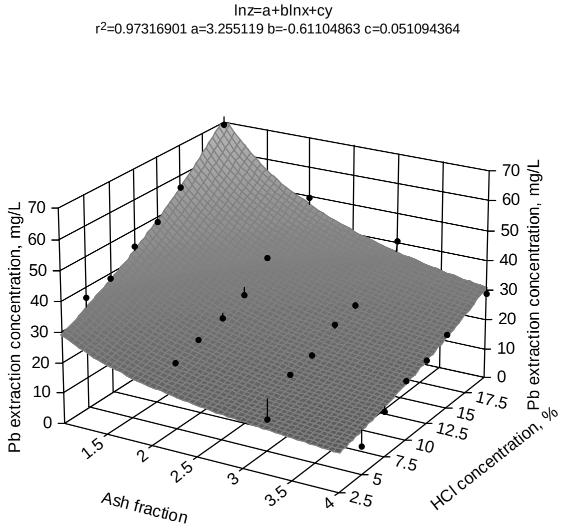

Fig. 4. The Pb extraction concentration

From the experimental data can be observed that the metal ions extraction concentration degrees with the increasing of the fraction and increase with the increasing of the clorhidric acid concentration. Can be observed that at the first ash fraction and at the concentration of 20% of the clorhidric acid is obtained a solution which contain 180 g/L Zn^{2+}.

3.3. The metals ions extraction concentration at the time of 30 minutes

The experimental data regarding the dependence of the metals ions extraction concentration by the used clorhidric acid solution concentration and by ash fraction at the time of contact between acid and ash of 30 minutes are presented in figure 5-8.

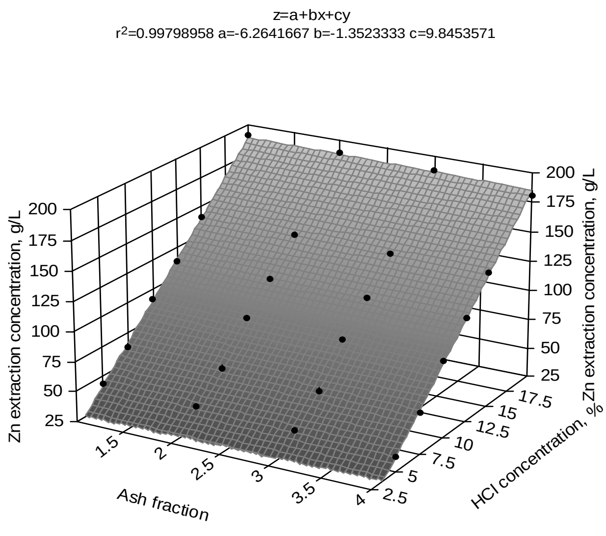

Fig.5. The Zn extraction concentration

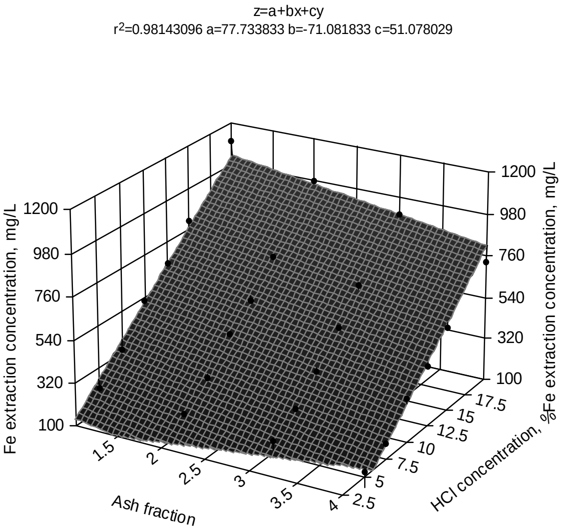

Fig 6. The Fe extraction concentration

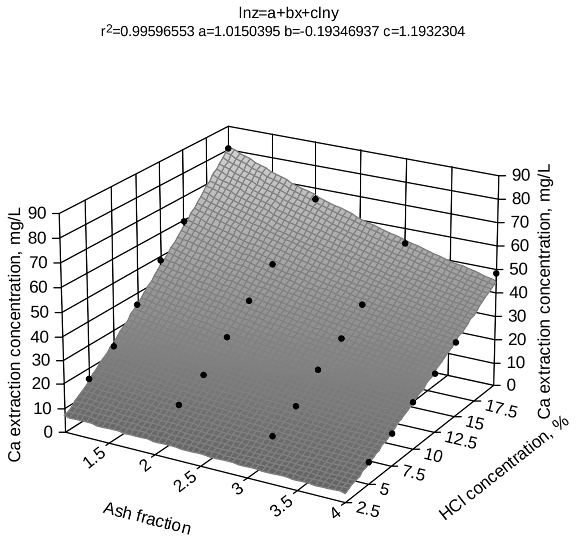

Fig.7. The Ca extraction concentration

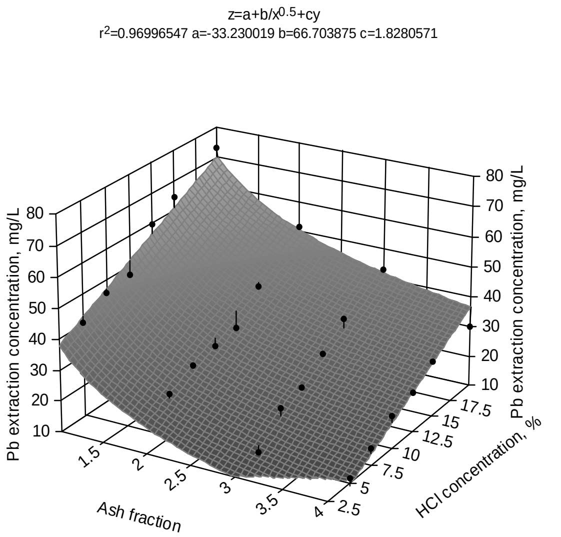

Fig. 8. The Pb extraction concentration

From the experimental data can be observed that in the case of the contact time between ash and acid solution of 30 minutes the metal ions extraction concentration degrees also with the increasing of fraction and increase with the increasing of the acid concentration, but is obtained extractions concentrations higher than in the case of the contact time of 15 minutes.

So it is considered that the work conditions to obtain a solution with a concentration of ≈ 200 g/L Zn is that of using for extraction a solution of clorhidric acid with a concentration of 20% at a contact time of 30 minutes.

3.4. The variation of the metals ions extraction concentration versus the ratio Zn^{2+}: HCl

The experimental data regarding the dependence of the metal ions extraction concentration by the fraction and by the ratio Zn^{2+}:HCl in the case of use for extraction a 20% clorhidric acid solution at a contact time of 30 minutes are presented in figures 9-12.

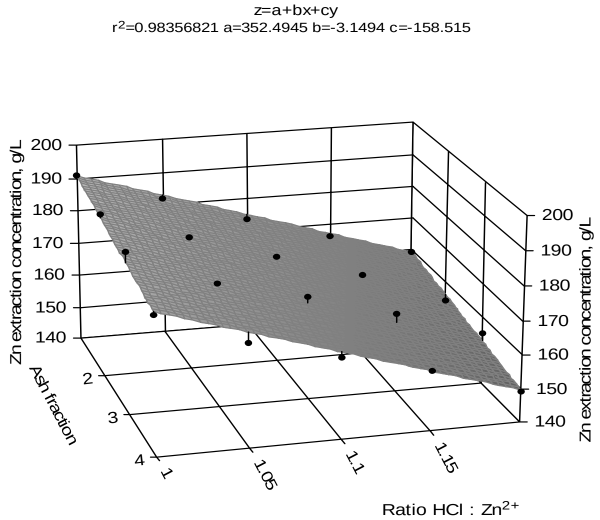

Fig.9. The Zn extraction concentration

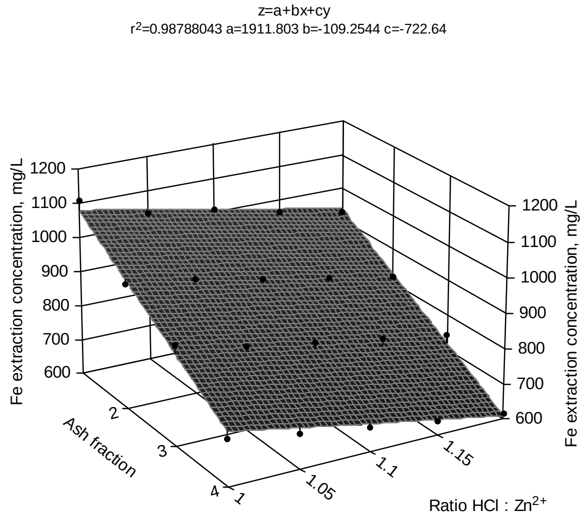

Fig 10. The Fe extraction concentration

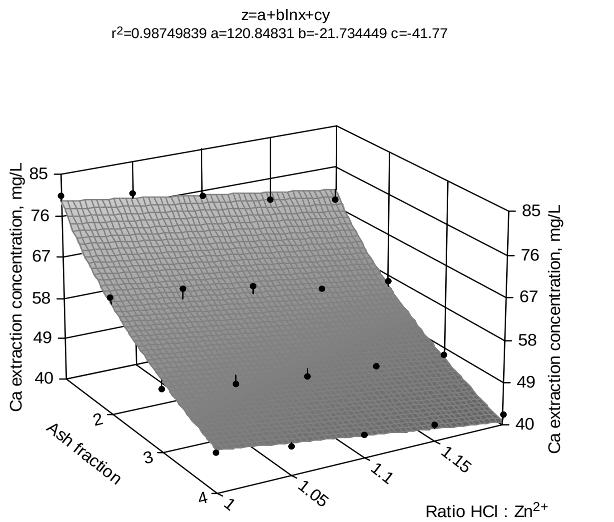

Fig.11. The Ca extraction concentration

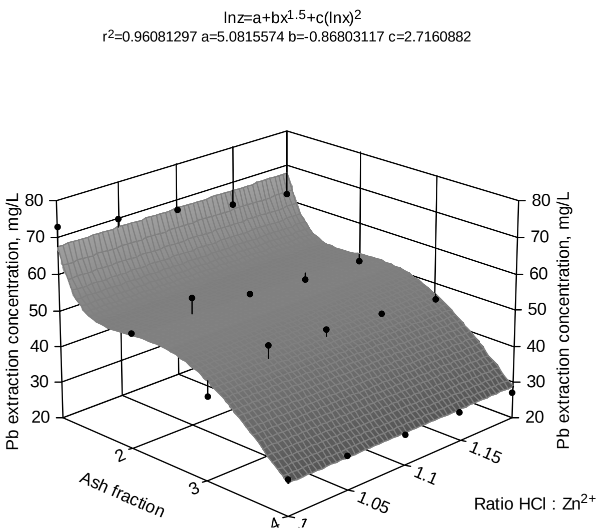

Fig. 12. The Pb extraction concentration

From the experimental data can be observed that the metals ions extraction concentration degrees with the ash fraction increasing and with the increasing of the ratio Zn^{2+}: HCl. So to obtain a solution with a higher concentration of Zn is not necessary to use the clorhidric acid in excess. It is considered the optimum work conditions the ratio Zn^{2+} : HCl = 1:1.

4. Conclusions

In this paper was followed the establishment of the optimum work condition of metals ions extraction from zinc ash resulted from thermal zinc coating industry to obtain a solution with a concentration of 200 g/L Zn^{2+}.

From the experimental data can be observed that the metals ions extraction concentration is influenced by the studied parameters, these decrease with the increasing of ash fraction, and of the ratio Zn^{2+}:HCl, and increase with the increasing of the clorhidric acid concentration and with the increasing of contact time. The optimum work conditions are considered to be:

- the ash fraction that is < 0.315 mm;
- the clorhidric acid solution concentration = 20%,
- time of contact 30 min;
- the ratio Zn^{2+}: HCl = 1:1.

In this way is reduce the quantity of wastes resulted from thermal zinc coating industry and the zinc ions are recovered and put in good use by obtaining of zinc chloride solution which can be use to the obtaining of the flux solution and so the zinc ions which were a wastes are reintroduce in the technological flux.

References

1. F. Porter, Zinc Handbook, **1991**.
2. M. Martin, R. Wildt, An Introduction to Recycling Zinc Coated Steel, IZA, **2001**.
3. K. Mager et al., Recovery of Zinc Oxide from Secondary Rpw Materials, Fourth International Symposium on Recycling of Metals and Engineered Materials, **2000**, p. 329-344.
4. M. A. Rabah, A.S. El-Sayed, Recovery of zinc and some of its valuable salts from secondary resources and wastes, Hydrometallurgy 37, **1995**, p. 23-32.
5. European Zinc Institute, Zinc Recycling , EZI Publ. Brussels, **1990**.
6. Gustavo Rossini, Andreea MOura Bernades, Galvanic sludge metals recovery by pyrometallurgical and hydrometallurgical treatment, Journal of Hazardous Materials, 131(1-3), **2006**, pag. 210-216.
7. P. Dvorak, J. Jandova, Hydrometallurgical recover of zinc from hot dib galvanizing ash, Hidrometallurgy, 77(1-2), **2005**, pag. 29-33.