

**ДЕРЖАВНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД  
«УЖГОРОДСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ»  
(м. УЖГОРОД, УКРАЇНА)  
КОШИЦЬКИЙ ТЕХНІЧНИЙ УНІВЕРСИТЕТ  
(м. КОШИЦЕ, СЛОВАЦЬКА РЕСПУБЛІКА)**

**ISSN 2218-5348**

# **МІЖНАРОДНИЙ НАУКОВИЙ ВІСНИК**

***Випуск 1 (12)***

***Матеріали Міжнародної науково-практичної конференції  
«Науковий парк як універсальна регіональна структура інноваційної діяльності»  
(м. Ужгород, Україна – м. Кошице, Словачька Республіка, 3 березня 2016 р.)***

Ужгород – Кошице  
2016

*Вісник містить наукові статті і тези доповідей, проголошених та обговорених на Міжнародній науково-практичній конференції «Науковий парк як універсальна регіональна структура інноваційної діяльності», проведений Ужгородським національним університетом спільно з Кошицьким технічним університетом (Словацька Республіка) 3 березня 2016 року в рамках наукового проекту «Інноваційний університет – інструмент інтеграції в європейський освітній і науковий простір».*

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TECHNICAL UNIVERSITY OF KOŠICE  
(KOŠICE, SLOVAK REPUBLIC)**

**ISSN 2218-5348**

# **INTERNATIONAL SCIENTIFIC HERALD**

***Edition 1 (12)***

***Materials of International scientific and practical conference  
"Science Park as universal regional structure of innovative activity"  
(Uzhhorod, Ukraine – Košice, Slovak Republic, March 3, 2016)***

Uzhhorod – Košice  
2016

*The Herald contains scientific papers and report theses, enunciated and discussed at the International scientific and practical conference "Science Park as universal regional structure of innovative activity", held on March 3, 2016, by Uzhhorod National University together with the Technical University of Košice (Slovak Republic) as part of implementation of the research project "Innovative university – tool of integration to European educational and research area".*

***The publication is issued with the financial support of the International Visegrad Fund.***

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## EAF DUST RECYCLING - PREPARATION OF FINAL PRODUCTS

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*This paper describes basic steps in hydrometallurgical processing EAF (Electric Arc Furnace) dust by using sulphuric acid as a leaching agent in order to achieve maximum zinc extraction. The basic steps of this processing are leaching, solution purification and final processing to either metallic zinc, zinc sulphate or other zinc compounds. It was found that maximum zinc extraction which can be obtained by acidic leaching is almost 90 wt. %. In addition to the leaching, also choosing suitable conditions of solution purification is very important. Impurities can negatively affect economics of the process and the quality of the final product. This work results in a design and description of the technology for processing EAF dust. The technology is based on two stage leaching with metallic zinc or zinc sulphate to be produced as a final product.*

### **Introduction**

Steel production in EAF represented in 2015 almost 26% of worldwide steel production (i.e. 420 million tons) [1]. This production is like any other industrial production source of hazardous waste. Such wastes include fine-grained dust coming from cleaning off-gases generated during production of steel in EAF. In general, EAF dust is material with high content of iron oxides and heavy metals such as Zn, Pb, Cd, Cr and others. Due to the heavy metals content these EAF dusts are classified as hazardous waste [2,3]. According to European legislation [3], this kind of waste is classified as hazardous waste (category 10 02 07 – Solid wastes from gas treatment containing dangerous substances). There are several reasons why it is important to pay attention to processing this kind of waste. Main reasons are:

- Material potential in terms of zinc content. Zinc content in EAF dust is in range of 8 – 35 % [4]. For comparison, zinc content in primary ores is within 5 – 15 % [5]. Current zinc price on London Metal Exchange (LME) is around 1900 US\$/t [6].
- Possibility to obtain Fe-rich concentrate suitable as secondary raw material in pig iron production. Current price of primary Fe ore is around 55 US\$/t [7].
- Reducing amount of hazardous waste or its transformation to non-hazardous waste, what results in reducing or even saving fees for its disposal.

The main reason for processing EAF dust generated in carbon steel production is high content of zinc. The source of zinc is galvanized steel scrap which represents major part of a charge in EAF.

In general, there are three basic ways of processing EAF dust: pyrometallurgical, hydrometallurgical and a combined method. Recently, pyrometallurgical processing is mostly used in practice. However, pyrometallurgical processing is economically effective only when more than 100 000 t of dust is processed annually, what is impossible to reach in Slovakia.

On the other side, hydrometallurgical processing is characterized by higher flexibility, lower energy consumption and by possibility to reach economical profit also when lower amount of dust is processed (around 10 000 t/annually).

In conditions of Slovakia, hydrometallurgical processing seems to be the best choice for using material potential of EAF dust. Therefore, this work is focused on hydrometallurgical processing of EAF dust with using sulphuric acid as leaching agent. The scheme of processing EAF dust by acidic leaching is shown in Fig.1.

As it results from Fig.1, hydrometallurgical processing EAF dust with using sulphuric acid consists of three basic steps: passing zinc into a solution, solution purification and preparation of a final product. This work describes basic steps of acidic leaching of EAF dust and based on the results it offers a desing processing procedure.

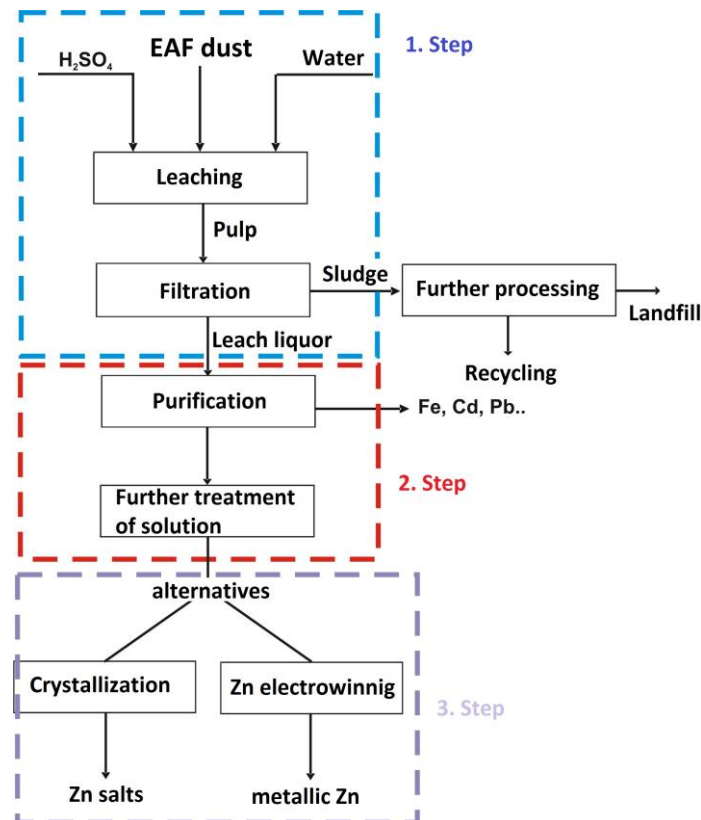


Fig. 1. The scheme of complex processing EAF dust

## Experimental

### Material

Material used in this experimental part was supplied by the company Železiarne Podbrezová, a.s. The results of chemical analysis of studied sample is stated in Table I.

TABLE I. CHEMICAL ANALYSIS OF EAF DUST SAMPLE

Element	Zn	Fe	Ca	Pb	Cd	Mn	Cr	Si	LOI*
Content [wt.%]	17.1	27.2	4.4	1.3	0.1	1	0.8	3.2	7.08

Mineralogical composition of the sample was investigated by XRD phase analysis, results of which are shown in Fig. 2.

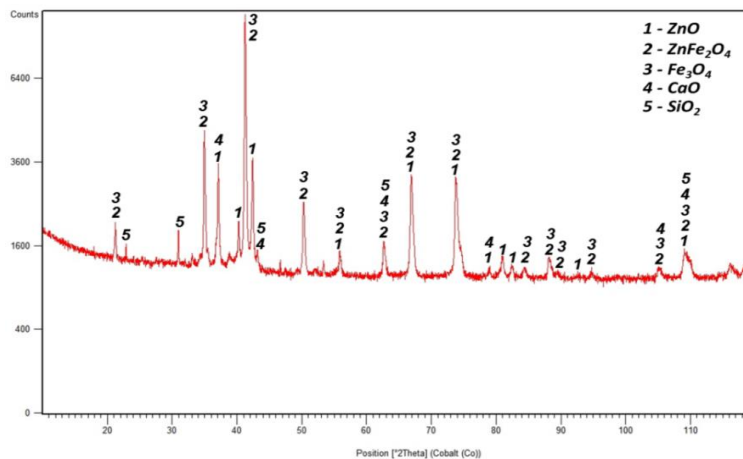


Fig. 2. The XRD pattern of EAF dust sample

### Leaching of EAF dust in sulphuric acid solutions

Leaching experiments were carried out in the standard laboratory apparatus. The aim of the leaching was to achieve the highest extraction of Zn into a sulphuric acid solution. In addition to zinc extraction also iron extraction was observed. The main parameters affecting zinc extraction being studied in this work were: sulphuric acid concentration (0.05 – 1M), temperature (20 – 95°C), L:S ratio (10 – 50).

Maximal zinc extraction was 87 wt.% and was achieved at following conditions: 1 M H<sub>2</sub>SO<sub>4</sub>, 80°C, L:S = 50. Kinetic curves of leaching Zn and Fe at these conditions are illustrated in Fig. 3.

It results from Fig. 3, that passing zinc into the solution is a very fast process and already in first minutes maximal zinc extraction can be achieved. Passing iron into the solution is, comparing to zinc, significantly slower process what is given by different leaching mechanism. Selective leaching of zinc without iron passing into the solution would be an ideal case, which can be

reached by using less concentrated acid solutions, lower temperature and by reducing the leaching time. However, disadvantage of such conditions is lower zinc extraction. As practice require the highest possible zinc extractions it is impossible to avoid passing iron into the solution. From this reason, iron must be removed from the solution prior to the next processing step.

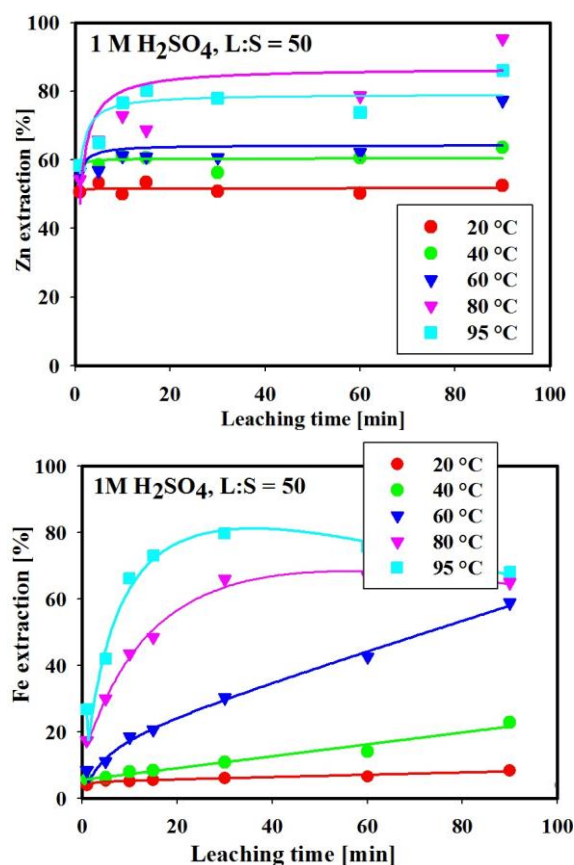


Fig. 3. Kinetic curves of Zn and Fe extraction at 20 – 95 °C in 1 M  $H_2SO_4$  and L:S = 50

### ***Precipitation of iron from the solution***

The limit concentration for iron in electrolyte in zinc production is 20 – 30  $\mu\text{g/ml}$  [8]. Higher concentrations of iron in the solution can reduce hydrogen overpotential and reduce overall efficiency of zinc electrowinning.

Experiments of iron removal were carried out with leach-liquor coming from leaching experiments described in section B. Chemical composition of the leach-liquor is listed in Table II.

TABLE II. **CHEMICAL COMPOSITION OF THE SOLUTION**

Element	Fe	Zn	Ca	Mn	Pb
	[ $\mu\text{g/ml}$ ]				
	3391	4170	614	147	4



From economical and technological point of view, goethite and jarosite process can be considered as the most suitable for removing iron from a solution. In experimental part of this work both of these processes were used in order to remove iron from leach liquor coming from leaching EAF dust in sulphuric acid solutions. The experimental conditions of iron removal were following: temperature 80-95 °C; time 120 min; neutralization agents - 1M NaOH, CaCO<sub>3</sub>, lime milk; 300 rpm; pH = 3-4 for goethite precipitation; pH = 2.5-3.5 for jarosite precipitation. Ammonium sulfate was used as additive for jarosite creation.

Fig. 4 shows the results of iron precipitation from the leach-liquor. These curves show trends in amount of iron being removed from the solution depending on the change in pH and temperature.

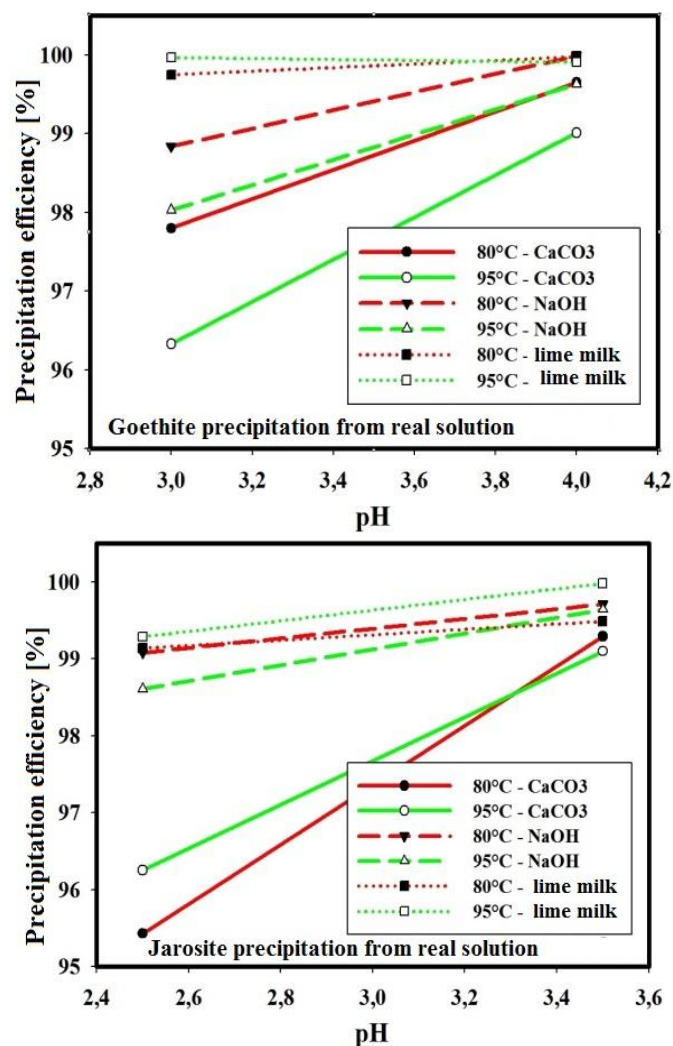


Fig. 4. Effect of temperature and pH on amount of iron removed from the solution

Based on the results achieved in this step it was found that the highest amount of iron can be removed at following conditions: temperature > 80°C and

pH  $\geq 3,5$  when lime milk is used as a neutralizing agent. At these conditions, it is possible to reduce iron concentration in the solution below 1  $\mu\text{g/ml}$ .

### ***Cementation of impurities from solution***

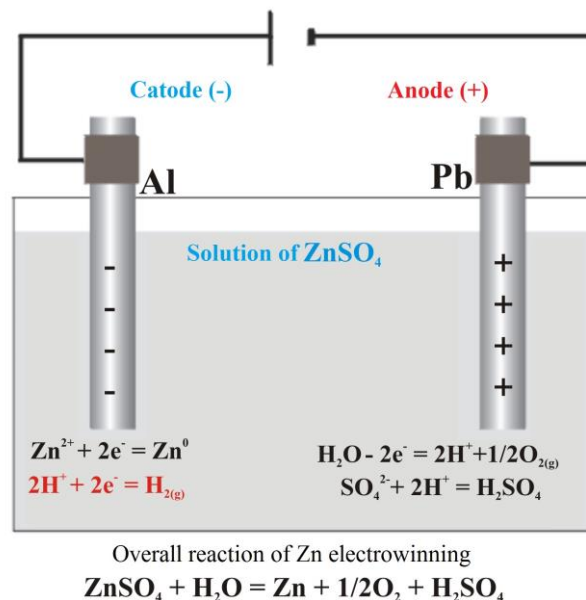
Cementation by zinc powder serves to purification of a solution from impurities, which are more electropositive than zinc (e.g. Fe, Cd, Pb, Cu). This purification step is carried out mostly before final processing by Zn electrowinning to metallic zinc or in production other salable products.

In case of purification of a solution coming from leaching EAF dust it is very important to remove Cd and Pb from the solution. Otherwise, these impurities can precipitate on a cathode together with metallic zinc what could reduce final value of the metallic zinc. Experimental conditions of cementation Cd and Pb from the solution were as follows: temperature 20, 50 and 80  $^{\circ}\text{C}$ ; time 60 min; pH = 4, 5, 6; 300 rpm; amount of Zn powder 0.5 g/250 ml of solution.

Experimental results showed a possibility to remove 100 wt.% of Cd and almost 90 wt.% of Pb from solution coming from leaching EAF dust in sulphuric acid solutions. Concentration of iron, remained in the solution after iron precipitation step, was also reduced in the cementation step.

### ***Electrolytic deposition of zinc from the solution***

Zinc electrowinning process, together with reactions taking place during this process, is described schematically in Fig. 5.















*Fig. 5. Zinc electrowinning process*

The highest current efficiencies (over 90 %) were achieved at current densities up to 833  $\text{A/m}^2$  and temperatures 20 and 40 $^{\circ}\text{C}$ , Table III. The highest current efficiency, 99%, was achieved at temperature 40 $^{\circ}\text{C}$  and current density 333  $\text{A/m}^2$ . Table III shows that at conditions with the highest current

efficiencies, zinc was obtained in the form of compact plate with minimum amount of dendrites.

TABLE III. FORM OF ZINC DEPOSITED ON THE CATODE DURING ELECTROWINNING PROCESS

t [°C]	Current density [A/m <sup>2</sup> ]			
	333	500	833	1000
20°C	 95,98 %	 95,90 %	 97,95 %	 83,62 %
40°C	 98,98 %	 95,90 %	 91,80 %	 84,02 %
60°C	 83,67 %	 71,23 %	 86,10 %	 70,31 %

### *Crystallization of zinc sulphate from the solution*

In general, production of zinc sulphate from a solution is a relatively simple procedure. Input solution was represented by the same solution as it was used for electrowinning experiments. The solution was heated up in order to evaporate water to the point of crystallization of zinc sulphate. Crystallized zinc sulphate was separated from the solution by filtration and was dried for 24 hours at 80°C. Final zinc sulphate is illustrated in Fig. 6.



Fig. 6. Crystallized zinc sulphate

### *Desing of hydrometallurgical processing EAF dust*

Based on the results of experiments, process for complex processing of EAF dust was proposed, Fig. 7.

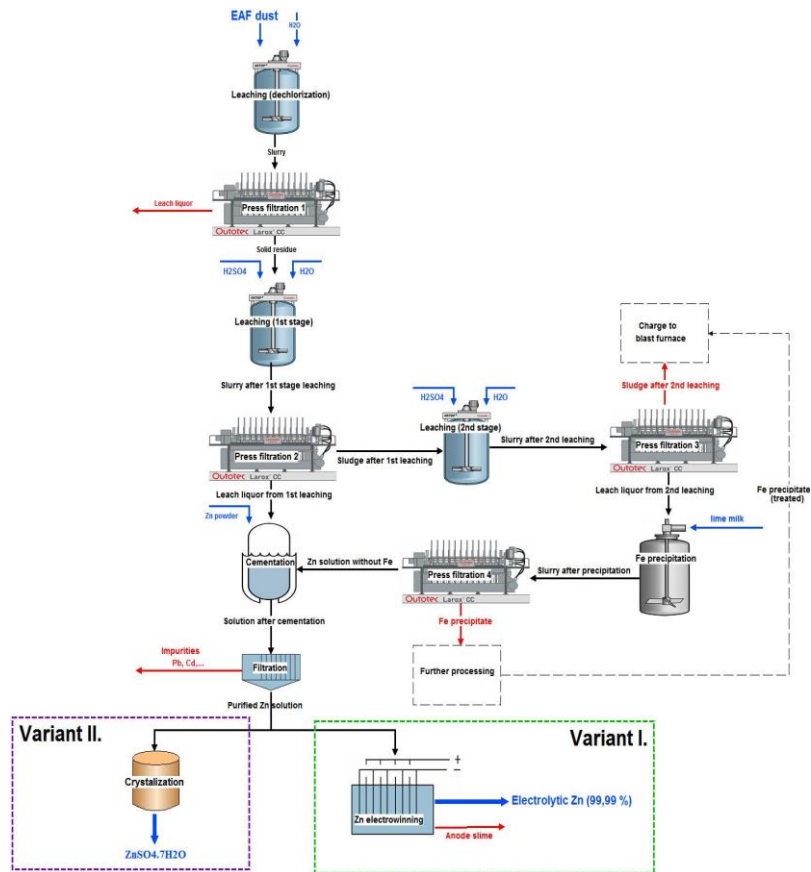


Fig. 7. Scheme of hydrometallurgical processing EAF dust

The process is based on two-stage leaching in sulphuric acid solutions at different concentrations with aim to obtain zinc either as metal or salt –  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ .

First step of proposed process is washing EAF dust with water in order to remove chlorine, which could be released as a gas during electrowinning process. After washing and subsequent filtration EAF dust is subjected to the first leaching step in 0.25 M  $\text{H}_2\text{SO}_4$  at 60 °C for 10 minutes. It results from experimental results that this way it is possible to leach out ~ 50 wt.% of zinc present in the sample, while iron remained in the solid residue. Solid residue after first leaching stage is subjected to the second leaching stage in 1M  $\text{H}_2\text{SO}_4$  at 60°C for 60 minutes. The aim of this second leaching stage is to leach out zinc which was not leached out in first stage. As leach liquor after second leaching stage contains beside zinc also high amount of iron it is necessary to carry out iron precipitation step. This step is performed at temperature 95°C with using lime milk as neutralizing agent. The pH value was kept in range of 3.5 – 4.5. After subsequent filtration of iron precipitate, solutions from first and second leaching stage are put together. This solution is treated by cementation by zinc powder in order to remove impurities like Pb, Cd, Cu, etc. Purified solution is used as an electrolyte for zinc electrowinning process or as starting solution for crystallization of zinc sulphate.

## **Conclusion**

Hydrometallurgical processing of EAF dust, with respect to the amount of dust being generated in the Slovak Republic, seems to be the most suitable way of processing. As, according to the European legislation, EAF dust is classified as hazardous waste, its processing would lead not only to economical profit in the form of recovering valuable compounds (Zn and Fe concentrate) but also it would reduce fees paid for disposal of this hazardous waste. Laboratory research in the field of hydrometallurgical processing realized in the frame of LSPO (Laboratory of Processing Industrial Waste) demonstrated the potential of using sulphuric acid as leaching agent. By choosing suitable conditions it is possible to achieve high extraction of zinc into the solution and by following purification (iron precipitation and cementation) it is possible to obtain solution suitable either for zinc electrowinning or zinc sulphate crystallization. The possibility to produce these two products within one technology is a big advantage of this processing.

## ***Acknowledgment***

This publication is the result of the Project implementation: University Science Park TECHNICOM for Innovation Applications Supported by Knowledge Technology, ITMS: 26220220182, supported by the Research & Development Operational Programme funded by the ERDF. We support research activities in Slovakia. This project is being co-financed by the European Union. This work was supported by the Slovak Research and Development Agency under the contract No. APVV-14-0591. This work was supported by Ministry of Education of the Slovak republic under Grant MŠ SR VEGA 1/0293/14.

## ***REFERENCES***

- [1] World Steel Association, Steel Statistical Yearbook 2015, Worldsteel Association 2015, [cited 19.04.2016]; Available on internet: <http://www.worldsteel.org/dms/internetDocumentList/bookshop/2015/Steel-Statistical-Yearbook-2015/document/Steel%20Statistical%20Yearbook%202015.pdf> ok-archive.html.
- [2] Environmental Protection Agency, Land Disposal Restrictions for Electric Arc Furnace Dust (K061), 1991, [cited 10.04.2013]; Available on internet: <http://www.epa.gov/wastes/laws-regs/state/revision/frs/fr95.pdf>.
- [3] National Waste Collection Permit Office, European Waste Catalogue and Hazardous Waste List — Environmental Protection Agency, Valid from 1 January 2002. [cited 24.06.2015]; Available on Internet: [http://www.nwcpo.ie/forms/EWC\\_code\\_book.pdf](http://www.nwcpo.ie/forms/EWC_code_book.pdf).
- [4] Kukurugya F: Hydrometallurgical processing of EAF dust, PhD thesis, HF-TUKE, Košice, 2014, p 128.

- [5] International Zinc Association, Zinc – Natural occurrence, [cited 07.02.2015]; Available on internet: [http://www.zinc.org/basics/zinc\\_natural\\_occurrence](http://www.zinc.org/basics/zinc_natural_occurrence).
- [6] London Metals Exchange, Zinc price charts, [cited 19.04.2016]; Available on internet: <http://www.lme.com/zinc.asp>.
- [7] Iron Ore – Monthly Price – Commodity Prices – Price Charts, [cited 19.04.2016]; Available on internet: <http://www.indexmundi.com/commodities/?commodity=iron-ore>
- [8] Graf G.: Zinc, in Ullmann's Encyclopedia of Industrial Chemistry, 2005, Wiley-VCH Verlag GmbH & Co.

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*Наукове видання*

***МІЖНАРОДНИЙ НАУКОВИЙ ВІСНИК  
INTERNATIONAL SCIENTIFIC HERALD***

***Випуск 1 (12)***

*Свідоцтво про державну реєстрацію друкованого засобу масової інформації  
КВ №20546-10346Пр, видане Міністерством юстиції України 15.01.2014 р.*

Відповідальний за випуск І.В. Артёмов  
Упорядник А.І. Гусь  
Коректура: Т.М. Алексеєва, Л.І. Серєда  
Технічне редагування: М.І. Іванова, О.І. Гурчумелія  
Комп'ютерна верстка та дизайн обкладинки А.І. Бродич

Підписано до друку 30.03.2016 р.  
Ум.друк.арк. 29,2  
Гарнітура Times New Roman  
Формат 60x84/8 Зам.№28  
Тираж 300 прим.

Оригінал-макет виготовлено  
в редакційно-видавничому відділі ДВНЗ «УжНУ»  
88015, м. Ужгород, вул. Заньковецької, 89,  
E-mail: dep-editors@uzhnu.edu.ua

Віддруковано ПП А.А. «Демидов»  
88000 м. Ужгород, вул. Митрака, 25

M-72

Міжнародний науковий вісник: збірник наукових статей за матеріалами Міжнародної науково-практичної конференції «Науковий парк як універсальна регіональна структура інноваційної діяльності», Ужгород-Кошице, 3 березня 2016 року /ред. кол. В.І.Смоланка (голова), І.В.Артюмов та ін. – Ужгород: ДВНЗ «УжНУ», 2016. – Вип. 1(12). – 254 с.

**ISSN 2218-5348**

УДК 001:378

International Scientific Herald: collection of scientific papers on materials of International scientific and practical conference "Science Park as universal regional structure of innovative activity", Uzhhorod-Kosice, March 3, 2016 / ed. count. V. Smolanka (Chairman), I. Artjomov and others. – Uzhhorod: SU "UzhNU", 2016 – Ed. 1 (12). – 254 p.