# On innovations in the Processing of Zinc cakes in the Conditions of JSC «Almalyk MMC»

**Kholikulov Doniyor Bakhtiyorovich, Yakubova Dildar Makhmudjonovna, Yakubov Nodirbek Makhmudjonovich**

Deputy Director for Research and Innovation of Almalyk branch of the Tashkent state technical university, PhD, associate professor, Almalyk, Uzbekistan;
Associate Professor, Department of Corporate Governance, Tashkent state technical university;
Research researcher

**ABSTRACT:** The article studied the oxidation reaction of zinc cake and established it occurs in the kinetic region.A program for modeling technology and hardware for the processing of zinc cake was developed.

**KEY WORDS:**zinc cake, dissolution reaction, process, mode, kinetics, diffusion, program, temperature.

## I.INTRODUCTION

Thermal steam treatment of zinc production cake at an optimal temperature regime in time leads to a decrease in the mass of the product and an increase in the content of zinc and other metals in the cinder. Based on the results obtained and for economic reasons, it can be argued that the optimal temperature of heat treatment is $850^0$C, and the time of heat treatment is 1 hour.The chemical composition of the product of heat treatment of cake zinc production,%:, %: Zn-23,8; Cu-5,58; Cd-0,31; Fe-15,3; $S_s$-0,2; Pb-5,98; $SiO_2$-10,5; $Al_2O_3$-1,6[1, 2].

## II. SIGNIFICANCE OF THE SYSTEM

The introduction of new information technologies in the development process automated systems contributes to the further development of mathematical modeling. The variety of models used is increasing, and mathematical methods for solving computational problems are of independent importance. The modeling process is also being improved with using not only large computers, but also personal equipment integrated into information and computing systems. There are newpromising areas in the theory of mathematical modeling, focused on the analysis and synthesis of complex systems. Mathematical modeling has become a means of solving the problems of building complex systems and process control without capital expenditures.

## III. EXPERIMENTALRESULTS

The kinetics of the interaction corresponds to the behavior of sulfides of other heavy metals. To describe the diffusion regime of topochemical reactions, we used the most correctly described Erofeev – Kolmogorov equation $\lg[-\lg(1-\alpha)]=$ $=\lg k + n\lg\tau + \lg\lg e$.

According to the calculation results, we build diagrams of a graphical interpretation of these equations and judge the nature of the process (Fig. 1).The rate constants of the reactions occurring during the thermal treatment of zinc cake and the Arrhenius dependence calculated according to various equations have in all cases one kink and are represented by a straight line in the temperature range 800-950$^0$C.
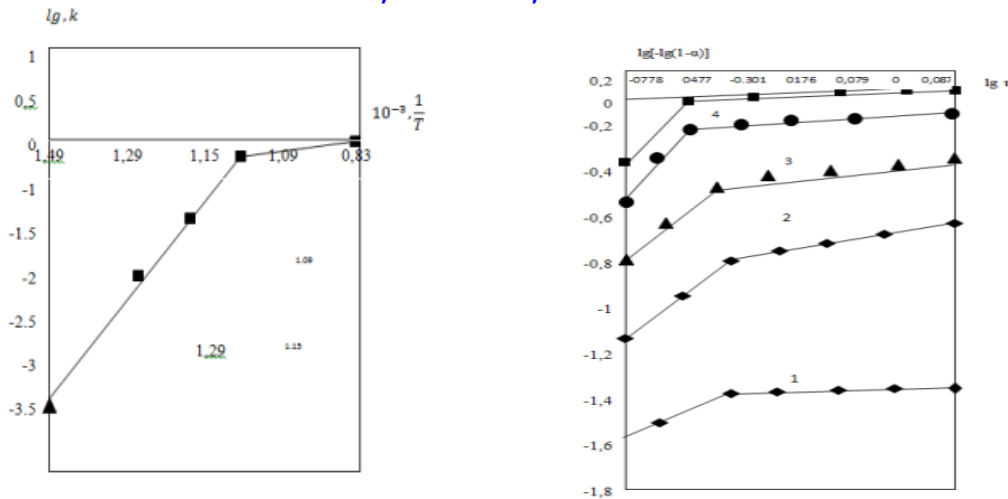
Fig.1. A graphical interpretation of the applicability of the Erofeev-Kolmogorov equation to the process of heat treatment of zinc cake with steam

$1-800^0C$; $2-850^0C$; $3-900^0C$; $4-950^0C$; dependence of lg on the inverse temperature of the oxidation reaction of heat treatment.

The dependence of lgk on 1/T satisfies the Arrhenisovian conditions of straightness. Since $n^31$ we can say that the oxidation reaction of zinc cake occurs in the diffusion region. Change in the phase composition of the cinder depending on the processing time at $900^0C$. In the first 5-7 minutes, evaporation of moisture mainly occurs. In the next 30 minutes, sulfides are oxidized to the formation of oxides in accordance with the reactions given in table. 1.

To calculate and construct a graphical interpretation of the equations, we used a program that simplifies calculations. Based on the results obtained, we construct diagrams of a graphical interpretation of these equations and judge the nature of the process (Table 2).

The rate constants of reactions that occur during the thermal treatment of the molybdenum product and the Arrhenius dependence calculated according to various equations have in all cases one kink and are represented by a straight line in the temperature range $400-800^0C$.

In fig. 1 g shows that the dependence of lgk on 1/T satisfies the Arrhenisovian straightness conditions. Since $n \geq 1$, it can be said that the oxidation reaction of zinc cake occurs in the kinetic region.

Processing kinetic data on various equations of topochemical kinetics allowed us to obtain the values of the reaction rate constant and activation energy .Calculations have shown that the process of thermal steam treatment of zinc cake in the temperature range under consideration $(400-800^0C)$ occurs in the kinetic region.

Table2

The value of the apparent activation energy of the oxidation of zinc cake by water vapor, calculated according to various kinetic equations.

| Equations | E, kJ/mol | E, kJ/mol |
|---|---|---|
| $lg[-lg(1 - \alpha)] = lg\kappa + nlg\tau + lglge$ | 162,55 | 38,83 |

A program has been developed for modeling technology and instrumentation for the processing of zinc cinder, as well as software "the principle of operation of the process of rolling of zinc cakes"[3, 4].

The program for modeling technology and hardware design for the processing of zinc cinder: is intended for workers of the metallurgical and chemical-technological areas, in the demo mode of the control of the processing of zinc cinder and hardware design of the process used for its processing.

The program consists of 9 "buttons", which are designed to view various technological processes associated with the processing of zinc cinder.

In addition, the program can be applied in the process of teaching students of higher and secondary special education in the metallurgical and chemical-technological fields.

Functionality of the program:

- visually you can trace the process of processing zinc cinder;
- switch using the "button" to various processes related to technology;
- manage in random order individual technological processes.
- get acquainted with various text documents, the basics of zinc cinder processing, prepared using Notepad and Word.

Software "principle of the process of Weltzincz of zinc cakes."The most common type of zinc cake processing by the pyrometallurgical method is the Waelz process.In this case, the mixture, consisting of a mixture of cake and a fine solid carbonaceous reducing agent (usually coke in the amount of 35-50 % by weight of cake), is heated in a tubular rotary kiln to a temperature of 1100-1300$^0$C. In the charge layer, the atmosphere is reducing, and in the gas phaseon the surface of the charge, the atmosphere is oxidizing.Moisture is removed from the charge at the upper end of the furnace and gradually heats up.At temperatures of 900-1000$^0$C and more, zinc oxide and its other compounds are reduced with the formation of vaporous zinc and CO.Vaporous zinc above the charge surface is oxidized to ZnO, and CO burns up with the formation of $CO_2$.The same thing happens with lead and cadmium compounds.The resulting very small particles of zinc, lead and cadmium oxides are carried away by the gas stream from the furnace in the form of sublimates.Gases leave the furnace with a temperature of 600-800$^0$C.They are cooled, and sublimates are captured. Fine purification of gases is usually carried out in bag filters (sometimes electrostatic precipitators).The extraction in Waelz sublimates from cake is characterized by the following data,%: zinc 92-96;lead 90-94;cadmium 94-96.The composition of the Waelzsublimates ,%: Zn 55-70;Pb 5-15;Cd 0,6-1.1, so they can be successfully processed by the hydrometallurgical method.

The second product of the Waelz process, discharged at the lower end of the furnace, is clinker. It usually contains less than 1% zinc, 15-22% carbon, almost all copper, noble metals, iron and waste contained in the original charge.

The purpose of the electronic educational-methodical program: It was intended for the employees of Almalyksy GMK JSC and for students in the Metallurgy direction at the Heavy Metallurgy course, getting an accurate idea of the automation of zinc production processes.

Functionality of the programs: The program is used at the zinc plant of Almalyksky MMC JSC and for training students in the Metallurgy direction at the Heavy Metallurgy course.

## IV. CONCLUSION AND FUTURE WORK

The studies allow us to draw the following conclusions on the problem of hydrometallurgical processing of zinc cake:

1. The oxidation reaction of zinc cake occurs in the kinetic region.

2. Based on the research, a program was developed for modeling technology and hardware design of the zinc cinder processing process and software "the principle of operation of the process of rolling of zinc cakes.

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**AUTHOR'S BIOGRAPHY**

| № | Full name place of work, position, academic degree and rank | Photo |
|---|---|---|
| 1 | **Kholikulov Doniyor Bakhtiyorovich**, Deputy Director for Research and Innovation Almalyk branch of the Tashkent state technical university, PhD, associate professor. Uzbekistan, Tashkent region, Almalyk. 110100, Region of KichikNokhiya 5/2., MirzoUlugbek Street house 88 apartment 19. | |
| 2 | **Yakubova Dildar Makhmudjonovna**, Associate Professor, Department of Corporate Governance, Tashkent state technical university. Uzbekistan, Tashkent, Olmozorrayon, 2-Guruch ariq, 20. | |
| 3 | **Yakubov Nodirbek Makhmudjonovich,** research researcher. Uzbekistan, Tashkent, 100174, Mirzo-Ulugbek rayon, Gazalkent, 86/ | |