Application of Heavy Metal Ions Separation from Contaminated Water in Industry

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Abstract: to achieve - study the sorption of silver, copper, nickel ions, the method of changing the volume of solutions of a constant concentration of metal ions is used. The amount of zeolite and constant concentration solution is taken in such an amount that the molar (molecular) parts of the exchanged ions are in a wider range. Some concentrated solutions are taken in flasks in an amount of 20 40 60 80 120 ml and 0.5 g of zeolite are added to them, mixed and a sample is taken periodically for analysis. After 2-2.5 hours, equilibrium occurs. By measuring the density of equilibrium, the amount of sorption of ions is determined.

Key Words: heavy metal ions, natural zeolite, ionites, adsorber, sorption, diffusion, Na-clinoptilolite, kinetic curve, Cu\textsuperscript{2+}, Ni\textsuperscript{2+}

I. INTRODUCTION

At present, pollution of industrial waters with toxic metal ions is the most important problem for the environment. The aim of this article is separating heavy metal ions from industrially polluted water. Thus, the effects of factors on internal kinetic processes play an important role, and the learning of these processes is of practical importance [1-3]. Consequently, it may be concluded that when modified Na-clinoptilolite conditions are favorable, the modified natural zeolite can be successfully used in heavy metal ions to purify industrial waste.

Experimental part

It is known that access to pure water is a key factor for the health of society. At present, pollution of industrial waters with toxic metal ions Cu (II), Ni (II), Ag (II), Co (II) is the most important problem for the environment. Wastes that incorporate non-ferrous metals, such as mercury, silver, cadmium and nickel, occur during metallurgy industry development, are processing, electrolysis and galvanic production. This wastewater treatment requires a lot of efficient processing methods, from which adsorption, sedimentation, ion exchange, and flotation are in the focus of attention.

Given the above, the following objective is to be addressed: The most pressing problem is the purification of industrial wastewater from heavy metal ions by the adsorption method, as wastes of petrochemical and oil refineries cause environmental pollution. Let's look at some experimental and theoretical foundations of that process[4-8].

To achieve this goal, the method of changing the volume of the solution by constant concentration of the metal ions was used to study the sorption of silver, copper, nickel ions [1] . The amount of zeolite and constant concentrated solution is that the large range of molten

![Fig 1. Equilibrium curves of Ni\textsuperscript{2+} ion exchange in Na-formed clinoptilolite: 1-25\(^{\circ}\)C; 2-50\(^{\circ}\)C; 3-75\(^{\circ}\)C; Co - 7,14 \times 10\(^{-3}\) mg•ekv /ml](Image)

![Fig 2. Equilibrium curves of the Cu\textsuperscript{2+} ion exchange in Na-clinoptilolide:](Image)
1-25°C; 2-50°C; 3-75°C; C₀ = 6.24 • 10⁻³ mg • ekv / ml

Fig 3 shows the kinetic curves of the Ni²⁺ ion exchange in Na-clinoptilolite a temperature of 25 °C and a solution velocity of 2.76 to 30.12 cm / min. The solubility of the Ni²⁺ ions was initially coincident with the thickness of Co=1.10 • 10⁻³ mg • ekv / ml, zeolitic layer x = 9.3cm, diameter 1.2cm. The fractional dimensions of the grass are in the range of 0.63-1.00 mm, the average radius of the grain is R = 0.041 cm. The amount of sorbent is g = 10q, the porosity of the nucleation m’ = 0.40 [2].

Reduced to ten times. The mathematical model of adsorption dynamics, taking into account the diffusion of external and internal diffusions, as well as the balloon grains, is based on the following equations and boundary conditions:

\[
\frac{\partial C}{\partial t} + \frac{\partial a}{\partial r} + \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial C}{\partial r} \right) = D_c \frac{\partial^2 C}{\partial x^2};
\]

\[
\frac{\partial a}{\partial r} + \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial a}{\partial r} \right) = D_a \frac{\partial^2 a}{\partial r^2};
\]

\[
a(x,r,t) = a(x,r,t) = \frac{a_C g(x,r,t)}{C_C} \frac{dC_C}{dx} (x,r,t),
\]

Where: Cg (x, r, t), ag

Based on the criterion, a random search method is used. C⁰, C° - report and experimental prices according to the concentrations of metal ions in the wax; c-any accuracy given. Selecting a few starting points (D₀,o) of the effective coefficient of diffusion will be performed in C report. Then add the step h to the D₀, Repeat the C° again. D₀ value, which provides the condition C = / C°. C° / ≤ ε , is considered optimal. Where: Cg (x, r, t), ag (x, r, t) - a small amount of average value local concentration in the nucleus in the non-invasive phases of adsorption.; ε =r₀⁴/D₀, A=4π r₀⁴ N, D₀, D_c - diffusion coefficients; G-Henri coefficient; N-unit number of grains Lef's look at the calculation of model parameters. Definition of Dc - diffusion coefficient

\[
F = / C°. C° / ≤ ε
\]

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\[
D_a 10^{17}, \text{sm}²/\text{min}.
\]

Fig 4. Exit curves of Ni²⁺ ions exchange at different velocities of Na-clinoptilolite:

1-V = 2.82 cm / min; 2-V=14.52 cm / min; 3-V=28.44 cm / min; T = 25 ° C

As it turns out, the increase in the flow rate of the solution flow increases by 2.5 times the Ni²⁺ output at the output of Na-clinoptilolite, but the duration of the leak is

Fig 5. Diffusion coefficient: 1- Ni²⁺; 2- [Ni (NH₃)₆]²⁺; 3- Cu²⁺; 4- [Cu (NH₃)₆]²⁺; In the crystal interior space of the 5-Ag⁺ Na-clinoptilolite (T = 20 ° C, in smaller prices of V)
III. CONCLUSIONS

If we compare the data for nickel and copper, we will see that the price of diffusion in them is the same. However, for the copper, the equivalent price reaches a value of 2 times the price of the micronutrient ion exchange rate relative to nickel. The initial density of the exchanged ions affects the density in micrometers, but they do not affect the diffusion process.

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