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INVESTIGATION OF KINETICS LEACHING AND EXTRACTION OF VANADIUMPENTOXYDE AS A FUNCTION OF TEMPERATURE

RAZISKAVE KINETIKE LUŽENJA IN EKSTRAKCIJE VANADIJEVEGA PENTOKSIDA V ODVISNOSTI OD TEMPERATURE

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In several thermal power plants in operation in the Republic of Macedonia a substantial quantity of ash is produced by oil burning. Ashes are considered as highly hazardous for the environment due to their fine particle size. On the other hand, analyses carried out so far, indicate appreciable contents of vanadium, gallium, beryllium etc. in the ashes.

Key words: oil ashes, V_2O_5, leaching, effect of temperature and solution composition, activation energy of leaching

V Makedoniji obratuje več termoelektrarn, kjer pri zgorevanju olj nastaja pepel, ki je nevaren za okolje zaradi drobnozrnatosti. Po drugi strani pepel vsebuje pomembne količine vanadija, galija, berilija itd.

Ključne besede: oljni pepel, V_2O_5, luženje, vpliv temperature in sestave raztopin, aktivacijska energija luženja

1 INTRODUCTION

Investigations presented in this paper are aimed to examine the possibility of hydrometallurgical treatment of ashes, produced with burning of fuel in power and metallurgical plants. The topics of the present investigations are the recovery of vanadiumpentoxyde as value component and the utilization of dust which is an ecological problem. The investigations of the hydrometallurgical treatment of ashes were aimed to determine the working conditions and process laws of leaching of vanadiumpentoxyde in solution. The purification of V_2O_5 solution and its concentration of V_2O_5 is obtained with liquid-liquid extraction with D2EHPA (DI - 2 etil heksil phosphoric acid).

The effects of temperature (298 - 373 K), phase ratio (S/L : 1/50 - 1/5), concentration of H_2SO_4 in solution (0,5 ; 1 ; 1,5) mol/dm^3, were investigated by constant particle size (-0,074 mm 100 %), velocity of mixing 8000 rev./min and leaching time 3 hours.

Experimental results showing the influence of temperature, concentration of H_2SO_4 and phase ratio on V_2O_5 leaching are showed on **figures 2, 3, 4**.

2 RESULTS AND DISCUSSION

The kinetics shows that by the maximal investigated temperature of T = 373 K and the following conditions S/L 1/50, H_2SO_4 1 mol/dm^3 in the first 30 min of leaching 67,4% V_2O_5 is dissolved. Prolonging the leaching time is without significant influence on volume of V_2O_5 in solution. Changes of concentration of H_2SO_4 (0,5 - 1,5 mol/dm^3), of phase ratio (1/50 - 1/5) affect by constant temperature (343 K) also in the first period the V_2O_5 leaching efficiency.

A leaching activation energy E_a = 24,8 kJ/mole was determined through Arhenius analysis of the kinetics curves in **figure 2**.

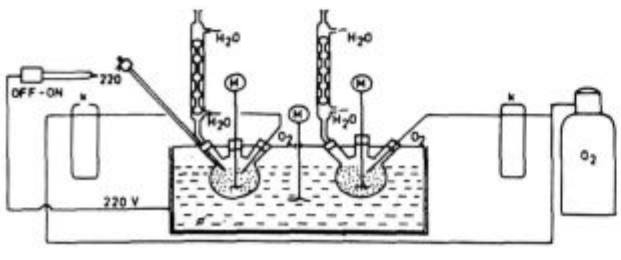

Figure 1: Apparatus for leaching
Slika 1: Naprava za izluževanje

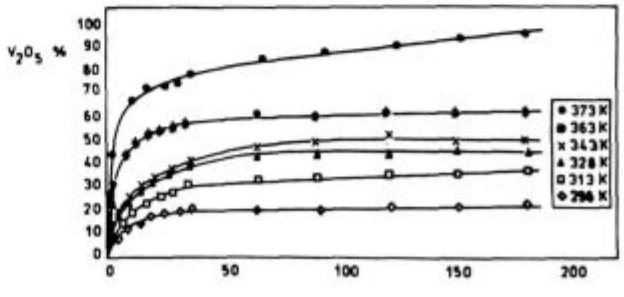

Figure 2: Kinetics of V_2O_5 leaching for different temperatures
Slika 2: Kinetika izluževanja V_2O_5 za različne temperature

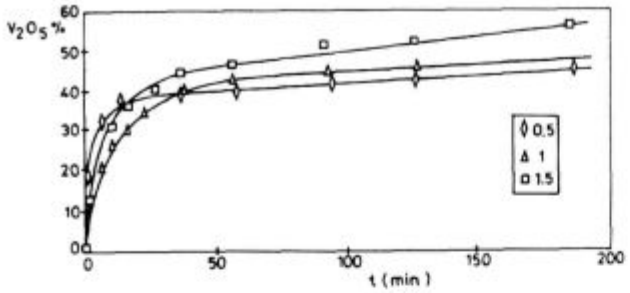

Figure 3: Kinetics of V_2O_5 leaching for different concentrations of H_2SO_4
Slika 3: Kinetika izluževanja V_2O_5 za različne koncentracije H_2SO_4

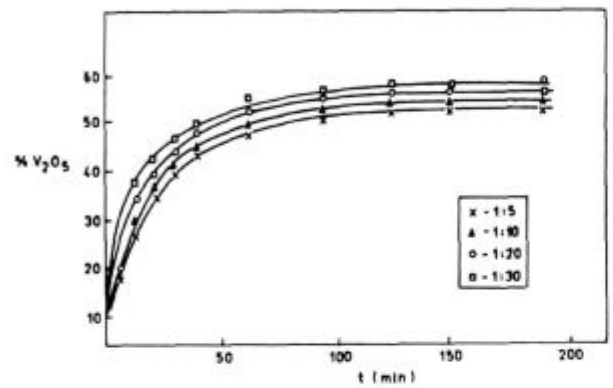

Figure 4: Kinetics of V_2O_5 leaching for different phase ratios
Slika 4: Kinetika izluževanja V_2O_5 za različna razmerja faz

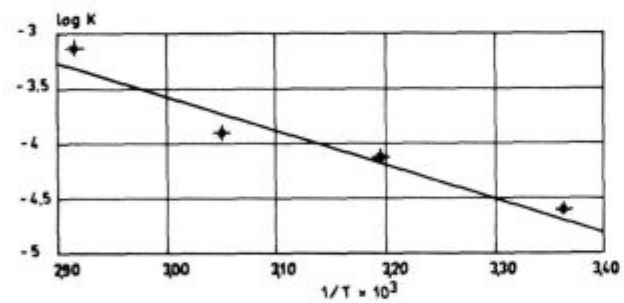

Figure 5: Graph of variables in Arhenius presentation
Slika 5: Odvisnosti v Arhenius predstavitvi

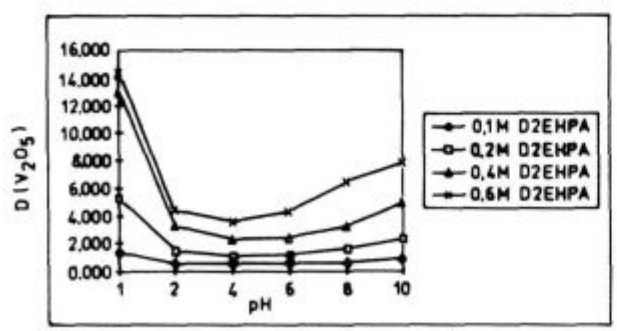

Figure 6: Effect of concentration D2EHPA on coefficient of distribution $D(V_2O_5)$ ($C_{initial}$ = 0,2 mol/dm^3)
Slika 6: Vpliv koncentracije D2EHPA na razdelitveni koeficient $D(V_2O_5)$ ($C_{začetna}$ = 0.2 mol/dm^3)

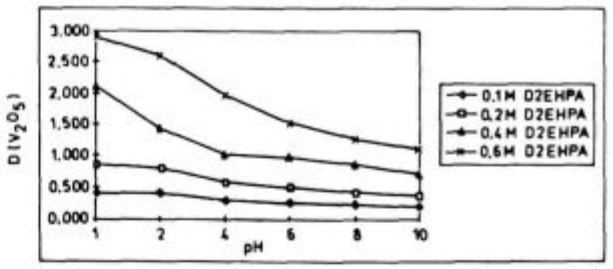

Figure 7: Effect of concentration D2EHPA on coefficient of distribution $D(V_2O_5)$ ($C_{initial}$ = 0,4 mol/dm^3)
Slika 7: Vpliv koncentracije D2EHPA na razdelitveni koeficient $D(V_2O_5)$ ($C_{začetna}$ = 0.4 mol/dm^3)

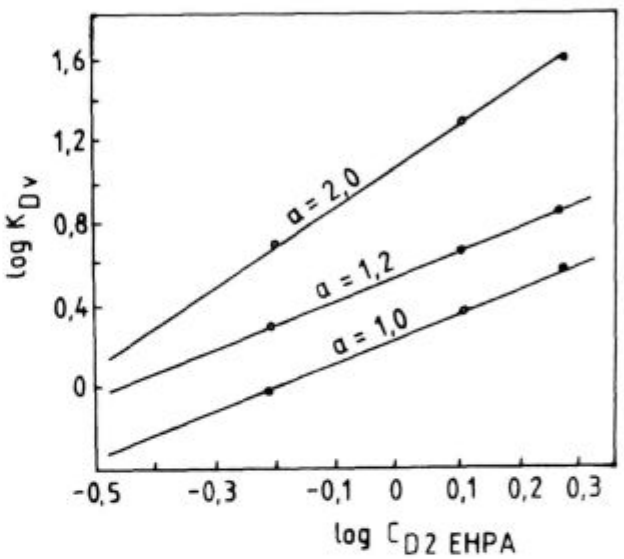

Figure 8: Log-log dependence of $D(V_2O_5)$ and (D2EHPA) for different concentrations of HCl ($C_{initial}$ = 0,2 mol/dm^3)
Slika 8: Log-log odvisnost med $D(V_2O_5)$ and (D2EHPA) za različne koncentracije HCl ($C_{začetna}$ = 0.2 mol/dm^3)

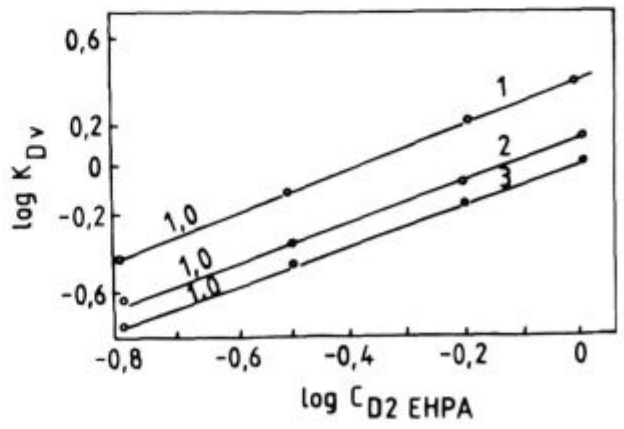

Figure 9: Log-log dependence of $D(V_2O_5)$ and (D2EHPA) for different concentrations of HCl ($C_{initial}$ = 0,4 mol/dm^3)
Slika 9: Log-log odvisnost med $D(V_2O_5)$ in (D2EHPA) za različne koncentracije HCl ($C_{začetna}$ = 0,4 mol/dm^3)

The experimental investigation of liquid-liquid extraction using D2EHPA was carried out with initial concentrations of V_2O_5 of 0,2 mol/dm^3 and of 0,4 mol/dm^3. In the tests sulfate solutions were used and the liquid-liquid extraction investigated as function of the following parameters:

a) pH of solution: 1 ; 2 ; 4 ; 6 ; 8 ; 10 mol/dm^3
b) Concentration of D2EHPA: 0,1 ; 0,2 ; 0,4 ; 0,6 mol/dm^3

3 RESULTS AND DISCUSSION

The experimental results showing the coefficient of distribution $D(V_2O_5)$ and the level of extraction $E(V_2O_5)$ as a function of parameters a) and b) are given in **table 1** and **2** and **figure 6** and **7**.

The analyses of the experimental data show by determined changes of the coefficient of distribution and level of extraction V_2O_5 as a function of pH an intial period of decreasing grade of extraction while by increasing of pH, the extraction efficiency of V_2O_5 is increased.

In logarithmic presentation the functions are straight lines which slopes represent the solvent coefficients. In **figure 8 and figure 9** the line slope have a tangents value of 2. It is concluded that vanadium will be recovered with a phase ratio $C_{D2EHPA}/L_{phase} = 2$. With increasing the pH solutions until 10 mol HCl the slope is tangent decreased to 1, 2 and in this case extraction will be realized with a ratio phase $D2EHPA/L_{phase} = 1 : 1$.

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