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DISTRIBUTION COEFFICIENT OF Cr (VI) AND Ni (II) IONS REMOVAL FROM AQUEOUS SOLUTION BY THE ANODE DUST

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ABSTRACT
Anode dust is generated during the aluminium by electrolytic process and recognized as metallurgical waste. The subject of this work was the determination of distribution coefficient of removing Cr (VI) and Ni (II) ions from aqueous solution. Distribution coefficient value is indicator of the removing efficiency of Cr (VI) and Ni (II) ions. The influence of the initial concentration of examined ions and temperature on distribution coefficient value is shown.
Keywords: anode dust, Cr (VI) and Ni (II) ions, distribution coefficient

1. INTRODUCTION
Chromium and nickel are a toxic heavy metals that are widely used in metallurgical, chemical and storage battery industries [1]. The chronic toxicity of chromium and nickel to humans and the environment has been well documented. Of its two oxidation states, Cr (III) and Cr (VI), the hexavalent form is considered to be a group "A" human carcinogen because of its mutagenic and carcinogenic properties. High concentration of nickel (II) causes cancer of lungs, nose and bone [2]. It is essential to remove Cr (VI) and Ni (II) from industrial wastewater before being discharged. For this reason, it is generally the advanced treatment processes such as chemical reduction, ion exchange, reverse osmosis, electro dialysis, and adsorption used. Since the cost of these processes is rather expensive, the use of agricultural residues or industrial by-product have been received with considerable attention [1].
The anode dust (CAD) originates from the baking and transport of carbon electrodes - anodes in aluminium production industry and it is not recycled [3]. This is non-toxic metallurgical waste material that has to be disposed of on the specially arranged landfil. This process is rarely applied; it is expensive and requires a lot of area. Therefore, it is necessary to find its use as a secondary raw material.
In this study, the determination of distribution coefficient of Cr (VI) and Ni (II) ions removing was investigated.

2. MATERIALS AND METHODS

2.1. Preparation and characterization of anode dust
For analysis, a representative sample of anode dust was obtained using a quartering technique. The sample was dried at 105°C for 4 hours and sieved to particle size 0.125 - 0.2 mm. The chemical composition of the sample was determined by atomic absorption spectroscopy (the AAS method). It was found that the anode dust was dominated by C (94.49 *wt* %), followed by Si (1.73 *wt* %), Al (1.69 *wt* %), S (1.50 *wt* %), and Fe (0.34 *wt* %).

2.2. Experimental procedure

A stock solution of Cr (VI) and Ni (II) ions was prepared by dissolving $K_2Cr_2O_7$ and $NiCl_2 \cdot 6H_2O$ in 1000 ml deionized water. This solution was diluted as required to obtain the standard solutions. The initial concentrations of the solutions contained 50-500 mg/l of Cr (VI) and Ni (II) ions. The batch experiments were carried out in 100 ml conical flasks by agitating 0.375 mg anode dust with 25 ml of the Cr (VI) and Ni (II) ions solution for a period of 30 (for Ni (II)) and 60 (for Cr (VI)) minutes at 20, 40 and 60 °C on a mechanical shaker.
The concentration of Cr (VI) and Ni (II) ions before and after the adsorption was determined spectrophotometrically with standard method [4].

Distribution coefficient of Cr (VI) and Ni (II) ions, K_D was calculated according to equation (1):

$$K_D = \frac{c_0 - c_e}{c_e} \cdot \frac{V}{m} \qquad (1)$$

where,
c_0 – initial concentration of metal ions, mg/l,
c_e –equilibrium concentration of metal ions, mg/l,
V - volume of solution, l,
m - adsorbent mass, g.

3. RESULTS AND DISCUSSION

Figures 1 and Figure 2 show the distribution coefficients of Cr (VI) and Ni (II) ions as a function of initial concentration of metal ions and temperature. This graph shows the distribution coefficients of Cr (VI) and Ni (II) ions decrease with increasing the initial concentration metal ions. At the same time, increasing temperature increases the distribution coefficient.

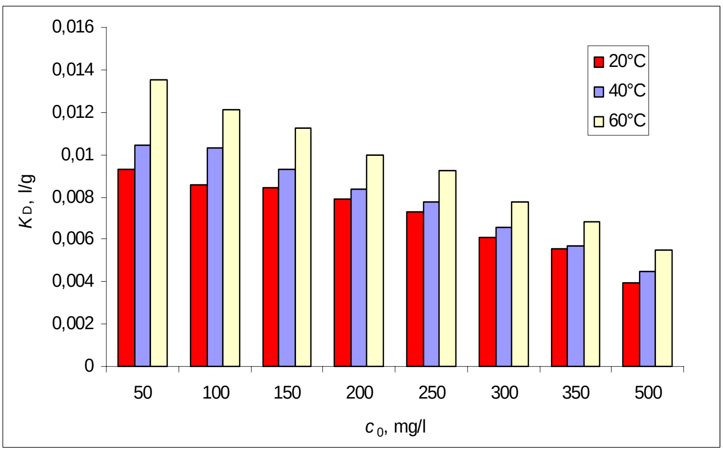

Figure 1. Distribution coefficient for Cr (VI) at different temperatures

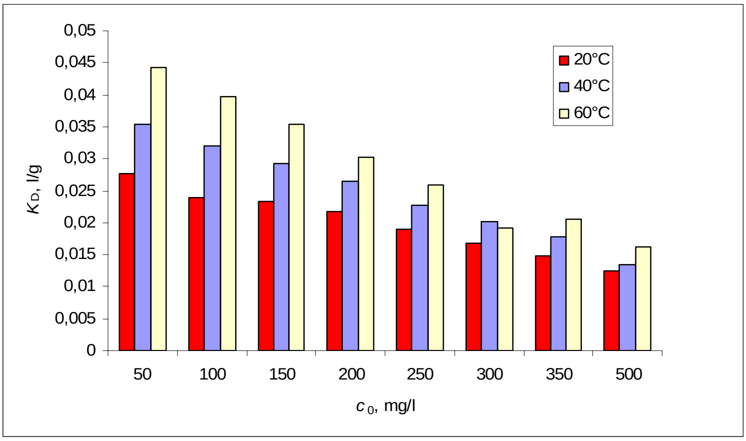

Figure 2. Distribution coefficient for Ni (II) at different temperatures

Distribution coefficients are connected with the energy of adsorption [5]. The value for the distribution coefficients indicates the endothermic nature of adsorption process. The results obtained are consistent with earlier researches conducted on similar system [6, 7].

4. CONCLUSION

- The distribution coefficients of Cr (VI) and Ni (II) ions decrease to the initial concentration of metal ions.
- Increasing temperature increases the distribution coefficient.
- Test results for the coefficient distributions indicate endothermic nature of adsorption reaction.

5. REFERENCES

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