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Sorption recovery of platinum(II,IV) in presence of copper(II) and zinc(II) from chloride solutions

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Abstract: The sorption pre-concentration of platinum(II,IV) ions was investigated in presence of accompanying copper(II) and zinc(II) ions from chloride solutions on new previously unexplored ion exchangers (Cybber, Russia). The initial concentrations of platinum and the accompanying ions were 0.25 and 2.0 mmol L⁻¹, respectively, and the acidity of medium was 0.001–4.0 mol L⁻¹ HCl. It was shown that the investigated resins – strong and weak basic anion exchangers as well as chelate ion exchangers – possessed good sorption and kinetic properties. The simultaneous sorption of the investigated ions results in the complete recovery of platinum, while the non-ferrous metal ions were sorbed at less than 20 %. Followed by the selective elution of platinum by a thiourea (80 g L⁻¹) solution in 0.3 M H₂SO₄, the quantitative isolation of platinum was achieved (more than 90 %). Therefore, the studied ion exchangers could be recommended for the recovery and separation of Pt(II,IV), Cu(II) and Zn(II) ions.

Keywords: ion exchange; platinum; copper; zinc; chloride solutions.

INTRODUCTION

With growing global demand for the platinum group metals (PGM), these metals are being recovered not only from natural deposits, but also from non-traditional sources (*e.g.*, metal-bearing high-carbon complexes) and secondary sources,¹ including spent automobile and chemical catalysts, electronic scrap and the so-called tailings (wastes of ore-dressing plants at platinum-containing deposits).^{1–4}

The distinctive feature of both primary and secondary PGM sources is their multicomponent composition. This means that the noble metals are contained in raw materials together with other metals, such as Ni, Zn, Cu, Co, Pb, *etc.* Moreover, the noble metals are micro components, whereas the accompanying metals

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are macro components.^{1,3-5} Therefore, after the breakdown of such raw materials by acids (“*aqua regia*”), chlorination, fusion, *etc.*, the obtained industrial solutions have low concentrations of noble metals.^{2,4-6} These solutions contain PGM complexes, varying in their stability and chemical inertness.^{2,4,7-9} Moreover, it is known^{2,4,7-10} that PGM complexes are affected by aquation and hydrolysis. The sophisticated composition of the solutions makes it essential to use selective methods for the isolation of the noble metals.

As a rule, the PGM are isolated from such solutions by precipitation or electrowinning. However, these methods basically do not provide a high degree of recovery, and the solid products formed in such cases make further processing significantly harder.^{4,6,11,12} These problems could be solved by means of sorption methods, known not only for their selectivity and efficiency, but also for environmental safety and compatibility with a variety of post-determination methods.^{6,11-16}

Among a variety of sorbents, ion exchangers with different functional groups are of special interest because of their high exchange capacity, osmotic and mechanical stability and good kinetic properties.^{2,12,13,15,17} These characteristics allow the recovery of even trace amounts of PGM through their pre-concentration, and also the removal of interfering components. As a result, the obtained noble metals can be of high purification grades.^{2,11,12,17,18}

The selectivity of the ion exchangers is a matter of great importance, given that the ionic state of noble metals in solutions is distinguished by a variety of complex forms with different stabilities and kinetic inertness, and the solutions themselves are multicomponent systems. The selectivity could be improved through the complex-forming properties of ion exchangers.¹⁷

Previously, the recovery of platinum (II,IV) from chloride solutions on Purolite ion exchangers was investigated.¹⁹ Since the recovery of platinum in the presence of accompanying components is a matter of practical interest, the present work is focused on the simultaneous recovery of Pt(II,IV), Cu(II) and Zn(II) because these ions are often contained in real solutions obtained after breakdown of platinum-containing raw materials.²⁻⁶ It should also be noted that these non-ferrous metals are valuable materials and are the subject of industrial recycling.

The sorption recovery of copper(II) and zinc on Purolite ion exchangers were also studied.²⁰ For the present investigation, new, previously unexplored cybber ion exchangers made in Russia were used.

EXPERIMENTAL

The Cybber ion exchangers, produced by SYNTEZ_{NVK} Company, St. Petersburg, Russia, were taken for investigation. Their physicochemical characteristics are summarized in Table I. It could be seen from the data that anion exchangers, chelate resins and strong acidic cation exchangers were used to study copper and zinc sorption. Before use, the resins were

prepared according to standard methods and loaded by 2 M HCl, to convert them into the Cl⁻ form (anion exchangers) or H⁺ form (cation exchanger and chelate sorbents).

TABLE I. Physicochemical characteristics of the investigated macroporous ion exchangers Cybber. Resin matrix: styrene (St) – divinylbenzene (DVB); Functionalization: QAB – quaternary ammonia base, TAG – tertiary amino-groups; AMPA – aminomethyl-phosphonic acid; IDAA – iminodiacetic acid; SG – sulfo-groups

| Trade name | Exchanger type | Functional group | Exchange capacity, mmol g ⁻¹ , in the form: | | Swelling grade, % | Moisture % | Working pH range |
|------------|------------------------------|------------------|--|----------------|-------------------|------------|------------------|
| | | | Cl ⁻ | H ⁺ | | | |
| AX 400 | Strong base anion exchanger | QAB | 1.20 | – | 19 | 44 | 0–14 |
| ALX 220 | Weak base anion exchanger | TAG | 1.45 | – | 21 | 50 | 0–8 |
| CRX 300 | Chelating resin | AMPA | – | 1.80 | 23 | 40 | 1–14 |
| CRX 210 | Chelating resin | IDAA | – | 1.10 | 21 | 55 | 1–6 |
| EV 023 | Strong acid cation exchanger | SG | – | 1.80 | 17 | 45 | 0–14 |

The initial platinum stock solution of concentration 9.669 mmol·L⁻¹ was prepared by dissolution of an accurately weighed quantity H₂PtCl₆ in concentrated hydrochloric acid, with the subsequent dilution of the solution to 500 mL with distilled water. The working platinum solutions with concentration 0.25 mmol L⁻¹ and acidity 0.001–4.0 M HCl were prepared from this initial solution. In the present work, only freshly prepared platinum solutions were used.

The solutions of copper(II) and zinc(II) of concentration 2.0 mmol L⁻¹ were prepared from accurately weighed quantities of CuCl₂·2H₂O and ZnCl₂, respectively, which were dissolved in hydrochloric acid solutions of different concentrations (0.001–4.0 mol L⁻¹). All the reagents were of analytical purification grade.

The initial concentrations of the studied ions were selected with the aim of making the experiments similar to the real industrial conditions, *i.e.* to the technical solutions obtained after the processing of secondary materials.^{2,5,18} The acidity range of initial solutions was intentionally wide, to study the sorption properties of the investigated resins.

The concentrations of platinum and non-ferrous metal ions were determined by spectrophotometrical methods, *i.e.*, platinum with SnCl₂·2H₂O,^{7,9} and copper(II) and zinc(II) with PAR (4-(2-pyridylazo)resorcinol)^{21,22} using a Specol 1300 spectrophotometer (Carl Zeiss, Germany).

The sorption of the investigated ions was realized under batch experimental conditions. The equilibrium time determined by special tests was 24 h.

The efficiency of sorption recovery of the ions investigated was estimated by means of the recovery degree, *R* / %, and the distribution coefficient, *D*.

Moreover, the separation coefficients *S* of the recovered metal ions were calculated as follows:

$$S = \frac{K_{Me_1}}{K_{Me_2}} \quad (1)$$

where K_{Me_1} is the distribution coefficient of platinum (or copper) and K_{Me_2} is the distribution coefficient of copper (or zinc).

The sorption isotherms were plotted by varying the molar ratio of resins to the amount of metal ions in the contacting solution.^{23,24} The apparent constants of the ion exchange equilibrium were calculated based on these isotherms according to the law of mass action for the investigated equilibria.^{23,24}

The kinetic behavior of ion exchangers investigated during sorption of the metal ions was studied by the "limited bath" method.^{23,25} After a certain time, the resins and solutions were quickly separated by filtration through a porous glass filter. Then the concentrations of platinum, copper and zinc were determined in the solutions by the spectrophotometrical methods. Using the obtained results, the degree of saturation F was calculated as follows:

$$F = \frac{Q_t}{Q_\infty} \quad (2)$$

where Q_t and Q_∞ , mmol, are the amounts of the metal ion sorbed at time t and at equilibrium, respectively.

Then the kinetic curves were plotted as dependences $F = f(t)$ and the half-exchange times, $t_{1/2}$ / s, were determined from these curves at $F = 0.5$. Subsequently, the diffusion coefficients of metal ions in a resin grain, \bar{D}_S / cm² s⁻¹, were calculated from the following equation:

$$\bar{D}_S = \frac{r^2}{4\pi^2 t_{1/2}} \quad (3)$$

where r / cm is the radius of the resin grain.

Moreover, the process rate, ν / mmol g⁻¹ s⁻¹, was calculated using the formula:

$$\nu = \frac{a_i}{t_i} \quad (4)$$

where a_i / mmol g⁻¹ is the quantity of metal ion sorbed by the resin at time t_i / s.

All the results were subjected to statistical processing according to conventional procedures.^{26,27} The average experimental error for 3–4 parallel runs was less than 6 %.

The details regarding the batch and kinetic experiments, as well as the sorption pre-concentration and recovery data, are given in the Supplementary material to this paper.

RESULTS AND DISCUSSION

The ionic state of platinum in chloride solutions was investigated in detail.^{2,4,7–10} The electron absorption spectrum of a freshly prepared platinum (II,IV) solution in 2 M HCl, which had two absorption maxims at 218 and 251 nm, was recorded. This spectrum is in full compliance with literary data and corresponds to the presence of complexes $[\text{PtCl}_4]^{2-}$ (218 nm) and $[\text{PtCl}_6]^{2-}$ (251 nm).^{2,9,10}

The ionic states of copper(II) and zinc(II) in chloride solutions were previously investigated in detail^{21,22} and are described in a previous work.²⁰ There-

fore, the initial investigated solution contained different chloride complexes of the studied ions, and their subsequent sorption on the ion exchangers depended on the form of their complex compounds.

Since the Cybber ion exchangers were investigated for the first time, the sorption recovery of platinum (II,IV), copper(II) and zinc ions were initially studied from their individual solutions of different acidities.

These studies revealed that the studied anion exchangers and chelate sorbents exhibited high affinity for platinum (II,IV) ions, with no dependence on the acidity of medium. As for copper (II) and zinc (II) recovery under the same conditions, the results correlated with their ionic state in the solutions. Thus, the anion exchangers and chelate resins recovered copper(II) ions only from the strong acidic solutions, indicating the sorption of copper anionic chloride complexes. Copper was only recovered from the 0.001–0.1 mol L⁻¹ HCl solutions by the strong acidic cation exchanger EV 023, meaning that cationic copper complexes are present in these solutions. It should be noted that the ion exchangers in a strong acidic medium exhibited high affinities for copper(II) ions.

Moreover, only the chelate ion exchanger Cybber CRX 300 recovered zinc ions over the whole range of investigated HCl concentrations. The other resins did not sorb Zn(II) from strong acidic solutions, although it is known from the literary data that negatively charged complexes [ZnCl₄]²⁻ are present in such solutions. This was also supported by the fact that the cation exchanger EV 023 did not recover zinc ions from 2–4 M HCl solutions. This phenomenon is of academic interest and will be the subject of further investigations. However, the fact that copper(II) and zinc(II) ions could be recovered in different ways and from different media provides the opportunity to separate these ions by varying the HCl concentration in the contacting solution.

Based on this, the simultaneous recovery of copper and zinc from strong and weak acidic media was further investigated. The results are presented in Table II. It can be seen from these data that the presence of zinc did not affect copper(II) sorption, which means that copper is not recovered from weakly acidic solutions by the investigated resins. As for the sorption of zinc in presence of Cu(II), in this case they were recovered from strong acidic solutions, and at a quite satisfactory level (86–89 %). No doubt, it could be considered the effect of synergy, *i.e.*, the increase in sorption ability of ion exchanger to an ion that was not sorbed (or poorly sorbed) from individual solutions in the presence of another ion.^{28–30} Therefore, the simultaneous action of both components has an effect on the sorption ability of the ion exchangers. The data in Table II also show that the studied sorbents were more selective towards copper(II) ions than to zinc ions.

The separation coefficients of non-ferrous metal ions during their recovery from 2 M HCl solution are shown in Table III. It can be seen that all the values exceed 1 and, therefore, copper and zinc could be completely separated.

TABLE II. Simultaneous recovery of copper(II) and zinc(II) from chloride solutions of different acidity on the investigated ion exchangers ($c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$)

| Trade name | Parameter | Recovery of: | | | |
|------------|-----------|--|------|--|-----------------|
| | | Cu(II) in presence of Zn(II) at $c_0(\text{HCl}) / \text{mol L}^{-1}$ | | Zn(II) in presence of Cu(II) at $c_0(\text{HCl}) / \text{mol L}^{-1}$ | |
| | | 2.0 | 0.01 | 2.0 | 0.01 |
| AX 400 | $R / \%$ | ≈ 100 | – | 86 ± 4 | 89 ± 5 |
| | $\log D$ | 5.08 ± 0.31 | – | 3.78 ± 0.23 | 3.89 ± 0.23 |
| ALX 220 | $R / \%$ | ≈ 100 | – | 86 ± 4 | 89 ± 5 |
| | $\log D$ | 4.79 ± 0.29 | – | 3.79 ± 0.23 | 3.91 ± 0.23 |
| CRX 300 | $R / \%$ | ≈ 100 | – | 88 ± 4 | 88 ± 5 |
| | $\log D$ | 5.11 ± 0.31 | – | 3.85 ± 0.23 | 3.86 ± 0.23 |
| CRX 210 | $R / \%$ | ≈ 100 | – | 87 ± 4 | 87 ± 4 |
| | $\log D$ | 4.99 ± 0.29 | – | 3.82 ± 0.23 | 3.81 ± 0.22 |

TABLE III. Separation coefficients of Cu and Zn during their sorption from strong acidic chloride solutions ($c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$; $c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$)

| Trade name | Separation coefficient | Trade name | Separation coefficient |
|------------|------------------------|------------|------------------------|
| AX 400 | 20 | CRX 300 | 18 |
| ALX 220 | 10 | CRX 210 | 13 |

Furthermore, the sorption pre-concentration of platinum (II,IV) in the presence of copper(II) and zinc(II) was studied from strong acidic chloride solutions, given that under industrial conditions, the noble metals are mostly present in strong acidic media after the breakdown. The results are summarized in Table IV, from which it could be seen that the presence of copper and zinc ions in the system had no effect on the sorption pre-concentration of platinum, and hence, it could be completely recovered from the solution by the investigated sorbents. Simultaneously, the copper ions and, especially, the zinc ions were sorbed at low levels (not more than 20 % for Cu and 16 % for Zn). These data clearly illustrate the distinct selectivity of ion exchangers towards noble metal complexes. On the one hand, this could be explained by the fact that complexes with greater stability are “preferable” for the resins during sorption from multicomponent solutions.³¹ As the stability of platinum chloride complexes is much higher than those of copper and zinc,⁸ the sorption centers of the resin are preoccupied by platinum complexes.

However, on the other hand, it is known^{17,32,33} that complex-forming sorbents that contain nitrogen or sulfur atoms in their functional groups show especially high selectivity towards noble metal ions. From the investigated range of sorbents, the weak basic anion exchanger ALX 220 and chelate resin CRX 210 belong to this group. It is important that CRX 210 contains iminodiacetic acid as functional groups, *i.e.* two carboxylic groups. The Lewis theory of acids and bases states that platinum ions are “soft” acids, and possess lower affinity to oxy-

gen donor atoms,^{8,34} which explains the lower degree of recovery of platinum on the chelate resin CRX 210 in comparison with that on ALX 220. The strong basic anion exchanger AX 400 with quaternary ammonia bases as functional groups has a high selectivity to platinum ions, due to the strong electrostatic interaction between these large-sized and practically not hydrated groups and the aquatic complex ions of the noble metal.³¹

TABLE IV. Sorption pre-concentration of platinum(II,IV) from strong acidic chloride solutions in the presence of copper(II) and zinc(II) on the investigated ion exchangers ($c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$; $c_0(\text{Pt}) = 0.25 \text{ mmol L}^{-1}$; $c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$)

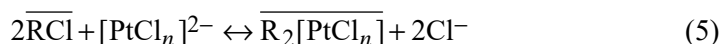
| Trade name | Parameter | Recovery of: | | |
|------------|-----------|--|--|--|
| | | Pt(II,IV) in the presence of Cu(II) and Zn(II) | Cu(II) in the presence of Pt(II,IV) and Zn(II) | Zn(II) in presence of Pt(II,IV) and Cu(II) |
| AX 400 | $R / \%$ | 95±5 | 14±1 | 10±1 |
| | $\log D$ | 4.43±0.27 | 2.30±0.14 | 2.01±0.12 |
| ALX 220 | $R / \%$ | 95±5 | 20±2 | 16±2 |
| | $\log D$ | 4.45±0.27 | 2.48±0.15 | 2.32±0.14 |
| CRX 210 | $R / \%$ | 77±4 | 12±1 | 7±1 |
| | $\log D$ | 3.53±0.21 | 2.04±0.12 | 1.97±0.12 |

The separation coefficients of platinum and the accompanying metals were calculated and the results are given in Table V. The values were much greater than 1, indicating the possibility of isolation of platinum from the non-ferrous metal ions.

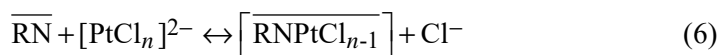
TABLE V. Separation coefficients of Pt and non-ferrous metal ions during their sorption from strong acidic chloride solutions ($c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$; $c_0(\text{Pt}) = 0.25 \text{ mmol L}^{-1}$; $c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$)

| Trade name | Separation coefficients of Pt(II,IV) towards: | |
|------------|---|---------|
| | Cu (II) | Zn (II) |
| AX 400 | 137 | 273 |
| ALX 220 | 91 | 137 |
| CRX 210 | 34 | 34 |

Thus, the obtained data led to the conclusion that the sorption pre-concentration of platinum(II,IV) proceeded on the strong basic anion exchanger according to the anion exchange mechanism:



The weak basic anion exchanger sorbed platinum ions not only through anion exchange, but also through additional complexation between the metal ions and the nitrogen atoms of the functional groups:



where $n = 4$ or 6 .

The chelate ion exchanger CRX 210 recovered platinum(II,IV) ions according to the complex-formation mechanism:



where $n = 4$ or 6 ; m is the number of functional groups of the resin RL with the charge z ; S is the dissolvent.

The sorption isotherms of platinum in presence of accompanying copper and zinc ions are shown in Fig. 1 for the strong and weak basic anion exchangers. It can be seen that the curves are convex, *i.e.*, the anion exchangers are selective towards Pt(II,IV) ions.^{23,24} Based on the isotherms, the apparent constants of the ion exchange equilibrium were 3.0 and 2.4 for ALX 220 and AX 400, respectively. These values correlate with the selectivity of the sorbents.

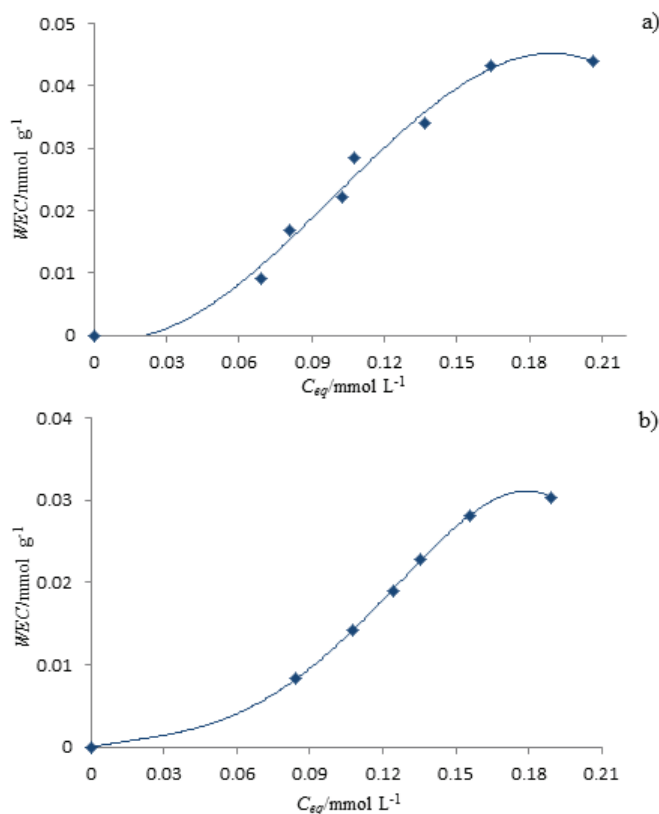


Fig. 1. Isotherms of platinum sorption in presence of copper(II) and zinc(II) from strong acidic solutions onto: a) ALX 220 and b) AX 400; $c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$.

Furthermore, the kinetic properties of ion exchangers during the recovery of platinum(II,IV) ions in presence of copper(II) and zinc(II) were investigated. The dependences of the process rate on time are presented in Fig. 2. It could be seen that the process rate increased sharply at the beginning of ion exchange and then decreased gradually before reaching equilibrium.

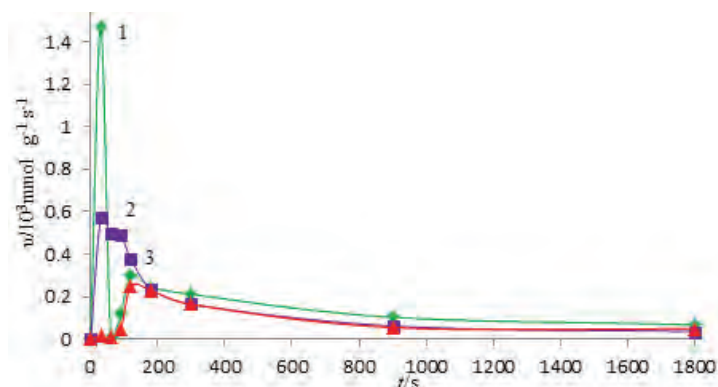


Fig. 2. Dependences of process rate on time during sorption pre-concentration of platinum(II,IV) in presence of copper(II) and zinc(II) on the investigated ion exchangers; $c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$; $c_0(\text{Pt}) = 0.25 \text{ mmol L}^{-1}$; $c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$; \blacklozenge (1) – ALX 220; \blacksquare (2) – AX 400; \blacktriangle (3) – CRX 210.

The calculated main kinetic parameters for sorption pre-concentration of Pt(II,IV) in the presence of the accompanying ions are summarized in Table VI. According to the data, it proceeds coherently, with high process rate. The other kinetic parameters – half-exchange time and diffusion coefficients – correlate with the previously discussed data on selectivity.

TABLE VI. Kinetic parameters during sorption pre-concentration of platinum(II,IV) in the presence of copper(II) and zinc(II) from strong acidic chloride solutions on the investigated ion exchangers ($c_0(\text{HCl}) = 2.0 \text{ mol L}^{-1}$; $c_0(\text{Pt}) = 0.25 \text{ mmol L}^{-1}$; $c_0(\text{Cu}) = c_0(\text{Zn}) = 2.0 \text{ mmol L}^{-1}$); \bar{v} is the average process rate

| Trade name | Kinetic parameter | | |
|------------|----------------------|--|---|
| | $t_{1/2} / \text{s}$ | $D_S \times 10^7 / \text{cm}^2 \text{ s}^{-1}$ | $\bar{v} \times 10^5 / \text{mmol g}^{-1} \text{ s}^{-1}$ |
| AX 400 | 7200 | 1.1 | 1.8 |
| ALX 220 | 1800 | 4.6 | 1.9 |
| CRX 210 | 2700 | 2.3 | 0.7 |

Finally, the desorption of platinum from the ion exchangers was investigated. As the amount of accompanying non-ferrous metal ions was no higher than 20 % (Table IV), after the sorption pre-concentration of platinum, it was enough to wash the ion exchangers with 0.5 M HNO_3 once for their complete removal. Then, the elution of platinum by thiourea solution (80 g L^{-1}) in 0.3 M

H₂SO₄ was performed, given that acidic thiourea solutions are conventional desorption agents for noble metals.^{2,9} As a result, 93 % of the platinum was eluted from the resin AX 400, and 90 % of the platinum – from ALX 220. Therefore, the anion exchangers CYBBER AX 400 and ALX 220 could be recommended for the recovery of platinum(II,IV) ions and their quantitative separation from accompanying copper(II) and zinc ions.

CONCLUSIONS

Sorption recovery of platinum(II,IV) in the presence of copper(II) and zinc(II) ions from chloride solutions on new CYBBER ion exchangers produced in Russia was investigated. Since these resins were studied for the first time, their sorption properties were investigated during recovery of each component from its individual solutions over a wide range of HCl concentrations (0.001–4.0 mol L⁻¹). High affinities of the ion exchangers for platinum(II,IV) complexes were revealed. However, copper(II) ions were sorbed only from strong acidic solutions, while zinc ions, only from weak acidic media.

An investigation of the simultaneous recovery of Cu(II) and Zn(II) from weak and strong acidic chloride solutions showed that zinc ions were sorbed at a high level in the presence of copper(II) from both weak and strong acidic media. This phenomenon was the result of synergy.

A study of sorption pre-concentration of platinum(II,IV) in the presence of copper(II) and zinc(II) has revealed the high selectivity of the investigated ion exchangers towards the noble metal ions, whereas the non-ferrous metal ions were recovered to no more than 20 %.

The investigation of kinetic properties of the resins revealed high rate of ion exchange process during Pt(II,IV) recovery in the presence of the accompanying ions. The main kinetic parameters, *i.e.*, half-exchange time and diffusion coefficients in the resin grain, correlated with the previously found selectivity of the sorbents.

The elution of the investigated components from the resins after sorption was realized using 0.5 M HNO₃ (for copper and zinc) and thiourea solution (80 g L⁻¹) in 0.3 M H₂SO₄ (for platinum). As a result, the quantitative isolation and separation of the ions was achieved.

The obtained results allowed the recommendation of the anion exchangers CYBBER AX 400 and ALX 220 for sorption pre-concentration of platinum(II,IV) in presence of accompanying Cu(II) and Zn(II) ions from strong acidic chloride solutions and for the subsequent isolation of the noble metal by selective elution.

SUPPLEMENTARY MATERIAL

Details of the batch and kinetic experiments, considerations about the ionic states of the metal in chloride solutions and sorption pre-concentration and recovery data, Tables S-I–S-III,

are available electronically from <http://www.shd.org.rs/JSCS/>, or from the corresponding author on request.

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ИЗВОД

СОРПЦИОНО ИЗДВАЈАЊЕ ПЛАТИНЕ(II,IV) У ПРИСУСТВУ БАКРА (II) И ЦИНКА (II) ИЗ ХЛОРИДНИХ РАСТВОРА

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Концентровање јона платине (II,IV) сорпцијом је испитивано у присуству пратећих јона бакра (II) и цинка (II) из хлоридних раствора на новим јоно-измњивачима Cybber (Русија), који до сада нису испитивани. Почетна концентрација платине и пратећих јона је била 0,25 и 2,0 mmol L⁻¹, редом, а киселост средине је била 0,001–4,0 mol L⁻¹ HCl. Показано је да испитиване смоле – јаки и слаби базни анијонски измењивачи као и измењивачи хелатних јона – имају добре сорпционе и кинетичке особине. Истовременом сорпцијом испитиваних јона платина је потпуно издвојена, док су јони бакра и цинка сорбовани мање од 20 %. Након тога, селективним издвајањем платине раствором тиоурее (80 g L⁻¹) у 0,3 M H₂SO₄, постигнута је квантитативна изолација платине (више од 90 %). На основу добијених резултата може се закључити да се испитивани јоно-измењивачи могу користити за одвајање јона Pt(II,IV), Cu(II) и Zn(II).

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