Process and Technological Flux Cobalt Recovery (Part One)

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Abstract: The purpose of researches was to establish the optimum conditions in the cleaning process of a waste water with Co content and to retrieve the metal (Co) in form of crystalline $CoC_2O_4 \cdot 3H_2O$. It had been studied parameters like: the pH, the optimal dose of reagent precipitant, the cobalt concentration and the temperature. For this study were used analysis methods like chemical, spectral and thermic analysis. Basis on the experimental data we obtained a cobalt recovery degree of 99,3 %.

Keywords: cobalt, recovery, waste waters, concentration, pH, reagent.

1. General remarks

The electronic, electric engineering, mechanical engineering, industries, the organic synthesis, enamel, pigment, aircraft building and ship building industries use high technologies, in which use it is included the cobalt and its combinations, especially: $CoSO_4 \cdot 7H_2O$, $CoCl_2 \cdot 6H_2O$, $[Co(NH_4)](SO_4)_2 \cdot 6H_2O$, CoO, Co_2O_3. [1]

CoO is a basic component of the fundamental enamels or grounding on steel support, being the adherence oxide of the enamel to the support, also basic component of the double oxides, of the pigments, cobalt blue etc. The cobalt is a part of a great deal of catalytic for the oils hydrogenation and desulphurization.

The condensed cobalt waters from the chemical or electrochemical covers represent a valuable source in order to obtain cobalt compounds.

The advance cleaning of these waters and the cobalt recovery salve concomitantly as the economical aspects as the ecological ones for the environmental protection.[2,3]

The researches made have followed the establishing of the best conditions for the cleaning process of the waters with cobalt content and the recovering of the cobalt in form of cobalt oxalate. [4]

2. Method of work

Taking into consideration the cobalt content from the waste waters of the galvanic industry, in the researches made have been used cobalt chloride waters of concentration 0,1M as reactant, it was used an oxalic acid solution 0,5M.

The waters cobalt content has been established complexonometric [5] (titration with C_{III} 0,05M in the presence of ammonium purpurate) and by atomic spectrophotometry absorption. A spectrophotometer AAS-30 Karls Zeiss Jena was used for this. [6]

The cobalt chloride has been treated with oxalic under continuous stirring at a given pH, with a well defined cobalt oxalic acid report, at a temperature and concentration that have been determined.

3. Studies of the cobalt recovering process in the form of cobalt oxalate

The studies are referring to the influence of different factors of the process (reaction mass' pH, oxalic acid dose, cobalt concentration in solution, temperature) on the extraction degree.

A. pH of the reaction mass

The experimental data regarding the influence of the pH of the reaction mass on the cobalt extraction degree are shown in table 1.

TABLE 1. *Extraction degree dependence on the pH of the reaction mass, at 20°C, reaction time 10 minutes, cobalt concentration 0,1M and reactive excess 10 %.*

No. crt.	pH	α,%
1	1	93,00
2	2	93,10
3	2,5	93,10
4	3	93,19
5	3,5	93,19
6	4	93,19
7	4,5	93,19

From these data results that the pH influence to a small extent the extraction degree. The best of the process can be considered the pH ≥ 3.
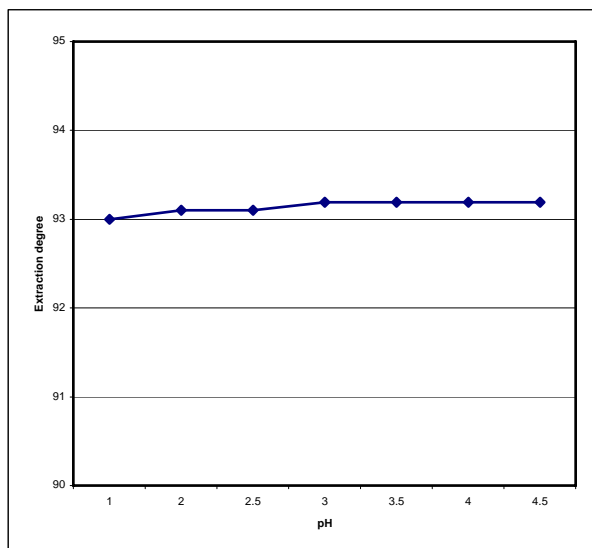
Figure 1. Cobalt extraction degree dependence on the reaction mass pH

B. Oxalic acid dose

The experimental data are shown in table 2 and figure 1.

TABLE 2. Extraction degree dependence on the oxalic acid excess at temperature of 20°C, reaction time 10 minutes, cobalt chloride concentration 0,1M

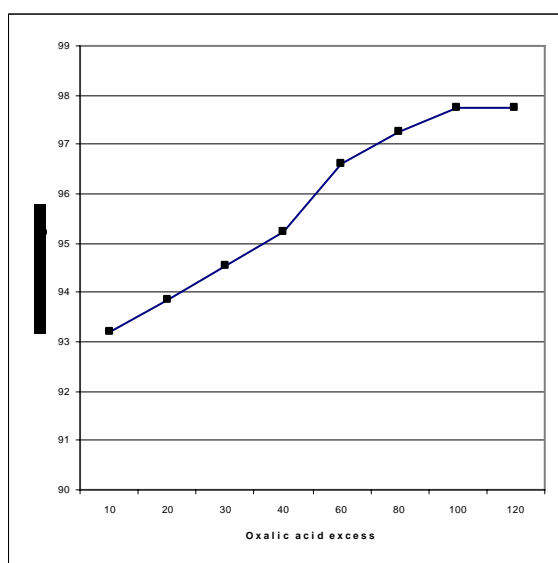| No. crt.	Excess,%	α,%
1	10	93,19
2	20	93,87
3	30	94,55
4	40	95,23
5	60	96,59
6	80	97,27
7	100	97,75
8	120	97,75

Figure 2. Cobalt extraction degree dependence on the oxalic acid excess

From these data results that concurrently with the oxalic acid excess increasing also the cobalt extraction degree increases and tends to a constant value, at an excess value of 100 %.

C. Cobalt concentration

The experimental data concerning the dependence of the cobalt extraction degree on its concentration in solution are given in table 3 and figure 2.

TABLE 3. Extraction degree dependence on the cobalt concentration at 20°C, reaction time 10 minutes, pH = 3, oxalic excess 100 %.

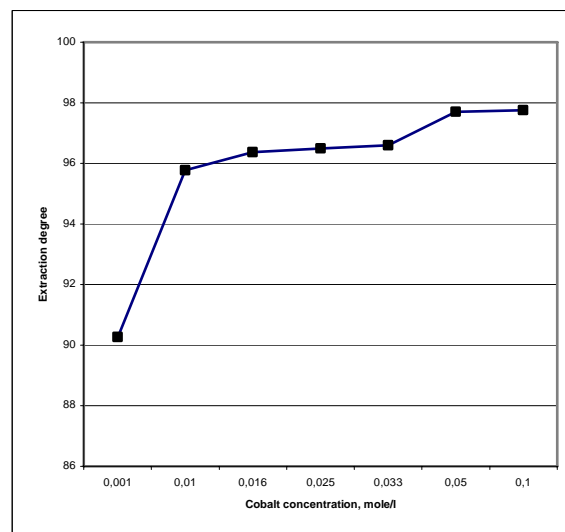| No. crt.	C[M]	α,%
1	0,001	90,26
2	0,01	95,77
3	0,016	96,37
4	0,025	96,50
5	0,033	96,59
6	0,05	97,70
7	0,1	97,75

Figure 3. Extraction degree on the cobalt concentration in solution

From the data above present it results that the extraction degree of the cobalt diminishes at lower concentrations than 0,02M.

Therefore, for the waste waters with content of 6 - 7g Co/dm^3, the method of the cobalt separation in form of oxalate is very efficient.

D. Temperature

The data obtained regarding the influence of temperature on the extraction degree are shown in table 3 and 4, figures 2-4.

TABLE 4. Cobalt extraction degree dependence on the cobalt concentration in solution at 70ºC, pH = 3, reaction time 10 minutes, oxalic acid excess 100 %

No. crt.	C[M]	α,%
1	0,001	95,00
2	0,01	97,04
3	0,016	98,38
4	0,025	98,42
5	0,037	98,72
6	0,05	98,88
7	0,1	99,29
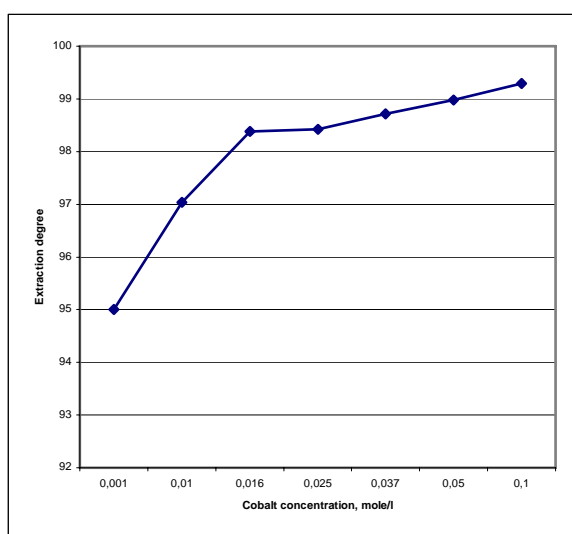
Figure 4. Extraction degree dependence on the cobalt concentration (at 70ºC)

Figure 5. Extraction degree dependence on the cobalt concentration in solution

4. Conclusions

The optimum conditions of the process, experimentally established, are pH = 3, 100% oxalic acid excess, cobalt solution concentration ≥ 0,02M, temperature 70ºC. In these conditions it is accomplished an optimum separation degree of the cobalt (≈ 99%).

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From these data result that the rate of cures at different temperatures is the same. At a constant concentration of the cobalt in solution, the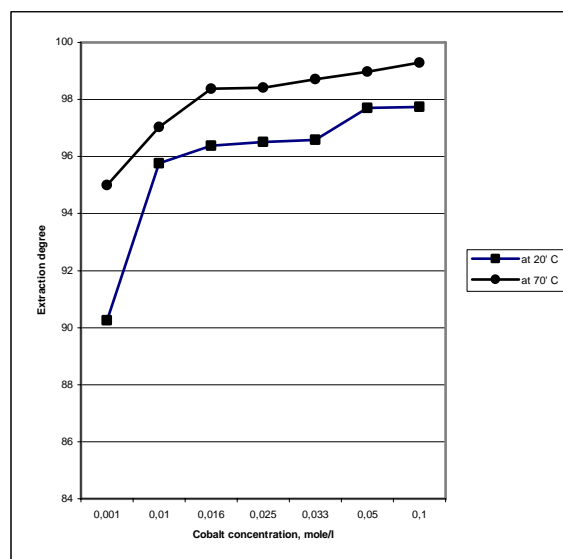 extraction degree is bigger as the temperature is higher.