CHROMIUM(III) MEDIATED TRANSPORT IN THE BULK LIQUID MEMBRANE SYSTEMS

Katarzyna ROTUSKA

Chemical Metallurgy Division, Department of Chemistry, Wrocław University of Technology, Wybrzeże Wyspiańskiego 23, 50-370 Wrocław

ABSTRACT

Tanning processes consumes only 70% of chromium of the tanning bath, residual chromium is released into wastewaters. The possibility of recover and recycle the residual metal is a main purpose at technological improvements.

A good affinity of DNNSA towards chromium(III) ions is documented in literature and is the best among all other carriers tested for Cr(III) mediated transport in liquid membrane systems [1-5].

The studies of chromium(III) removal from the model tanning solutions were performed in the bulk liquid membrane system. Effects of concentration dinonylnaphtalenesulphonic acid as a carrier of Cr(III) in a membrane phase, as well as chloride and sulphate ions concentration in feed phase on effectiveness of chromium(III) permeation were studied.

EXPERIMENTAL

The initial feed phase was chromium(III) chloride solution with Cr(III) concentration of 0.058 mol/dm^3 and pH 4. The pH was adjusted with 0.1M NaOH. In a following experiments the composition of feed solution was changed by addition of potassium chloride or sodium sulphate. 4M H_2SO_4 solution was as a receiving phase.

The bulk liquid membrane was composed from a mixture of kerosene and *o*-xylene and dinonylnaphtalenesulphonic acid as a carrier of Cr(III) ions.

All experiments were done in a two compartment vessel with a barrier. Feed and stripping phases were mixed at 50 r.p.m., liquid membrane wasn't mixed. All experiments were performed at 25ºC. Different experimental conditions were studied to establish their effect on transport rate of Cr(III). The concentration of DNNSA in a membrane was equal to 20, 25, 30 and 50% (v/v) respectively.

The concentration of chromium ions was determined in feed and stripping phase spectrophotometrically with Spekol-205 at wavelength 595 nm. The concentration of Cr(III) in membrane was calculated from the mass balance:

$$c_M = c_p - (c_Z + c_O)$$

where c_M denotes Cr(III) concentration in membrane phase while c_p, c_z and c_0 stand for initial and actual concentration of Cr(III) in the feed and stripping solution, respectively.

RESULTS AND DISCUSSION

The obtained results showed that the composition of organic phase is significant for the transport rate of Cr(III). It should be noticed that the higher carrier concentration in membrane phase results in the faster transport of Cr(III). But there is an optimal concentration of DNNSA above which the effectiveness of Cr(III) transport decreases considerably (Fig.1).

This is probably due to the formation of DNNSA-Cr(III) complexes which increase the viscosity of the membrane. For further studies the concentration 25 %(v/v) of DNNSA in the membrane was chosen as optimal.

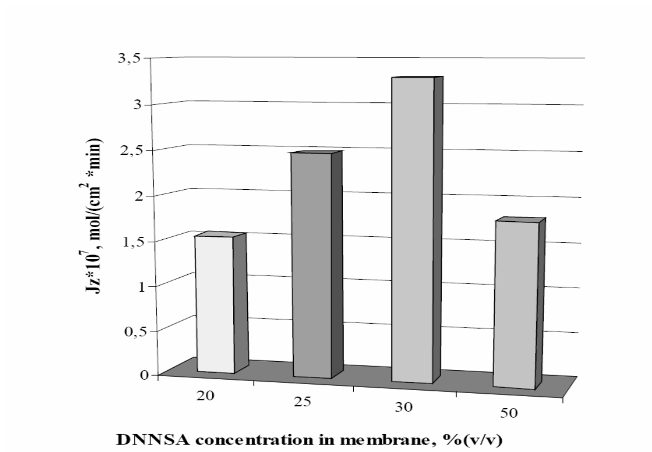

Fig.1. Chromium(III) flux vs. DNNSA concentration in membrane phase

The effect of chloride ions concentration (0.28 and 0.42 mol/dm^3, respectively) and sulphate ions concentration (0.10 and 0.21 mol/dm^3, respectively) on chromium(III) permeation was also studied.

The obtained results (Fig.2) prove that the increasing concentration of chloride and sulphate ions decrease the yield of extraction and reextraction, respectively.

However, the negative effect of sulphate ions on Cr(III) permeation is lower than that observed for chloride ions. Probably this is affected by a different stability of corresponding Cr(III) complexes formed in the feed solution.

Moreover, the rate of reaction was slow down, when the feed solution contained both chloride and sulphate ions, but the observed trend was similar to that established for sulphate ions only.

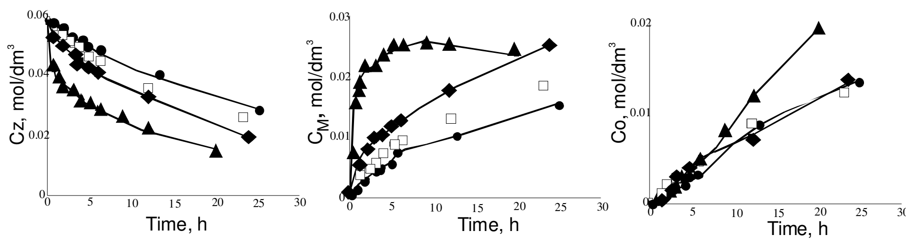

Fig.2. Cr(III) concentration changes vs. time. Initial concentration of Cr(III) in feed phase - 0.058 M, pH = 4; ▲ - in the absence of salts; ◆- 0.42M KCl, ■- 0.21M Na_2SO_4; ●- 0.42 M KCl + 0.21 M Na_2SO_4. Indexes z, m and o refer to donor, membrane and receive phases, respectively

CONCLUSIONS

1. An increase of carrier concentration to a certain value in membrane phase increases the permeation of Cr(III), but after exceeding this concentration the decrease of process effectiveness is observed. It is due to the increase of membrane viscosity and low diffusion ability of its components.
2. An increase of chloride and sulphate ions concentrations in feed phase decrease the yield of Cr(III) extraction and reextraction. The negative effect of sulphate ions on Cr(III) permeation is lower than that of chloride ions.

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