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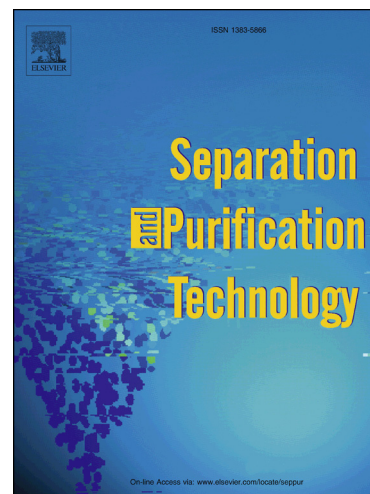
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Highly selective extraction of metal ions from dilute solutions by hybrid electrodialysis technology

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Abstract:

This study examines the feasibility of coupling electrodialysis (ED) to an in-situ complexation reaction (CR) step (named as ED-CR process), to selectively recover and concentrate various metallic cations with different or similar valences hardly separable by conventional ED.

In a first stage, the complexing behavior of different chemical agents towards four metal ions (Ag, Zn, Cu and Cd) have been studied and modeled from ionic forms distribution calculations. EDTA was found to be the best agent which combines advantageous characteristics: the formation of thermodynamically stable negative charged complexes in a large range of metal ion concentration, a discriminant complexation ability, and the possibility of ligand displacement for the ultimate recovery of the released metal ion (and the complexing agent as well).

In a second stage, electro-extraction performances have been investigated under various operating conditions: pH of the feed to be treated, solution flow rates and concentrations, electric voltage applied, concentration of electrolyte solutions used, continuous or batch mode applied.

The results showed high electro-separation performances both for the Ag/Zn and Cu/Cd systems. Some limitations of the process have been identified and well-delimited operating conditions could be proposed to achieve both optimal extraction and selectivity. This original hybrid technology would extend the potentialities of ED for the treatment of added-value metal ion containing wastewaters.

Keywords: hybrid electrodialysis; complexation; selective separation; metal ions recovery; water reuse.

Abbreviations / Acronyms:

AAS	atomic absorption spectroscopy
AEM	anion exchange membrane
A400	special grade of anion exchange membrane for large organic ion transport
AFNOR	association française de normalisation
CEM	cation exchange membrane
CR	complexation reaction
DC	direct current
EC	energy consumption
ED	electrodialysis
EE	electro-extraction efficiency
EDBM	electrodialysis with bipolar membranes
EDTA	ethylene diamine tetra acetic acid
HEDP	1-hydroxyethane-1,1-diphosphonic acid
IEM	ion exchange membrane
NF	nanofiltration
UF	ultrafiltration

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