

**Critical metals recovery from the spent lithium-ion batteries'
leaching solution using electrodialysis technologies: strategies and
challenges**

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Table S1. The performance data of several separation methods in the recovery of leaching solution from spent lithium-ion batteries

Method	Target metals	Solution composition	Solvent liquid	pH	
Electrodialysis	Li, Ni, Co, Mn	$C_{Li}=1.00 \times 10^{-2} \text{ M}$, $C_{Ni}=C_{Co}=C_{Mn}=3.33 \times 10^{-3} \text{ M}$	EDTA	2	St
				3	St
			–	1.5	St
Solvent extraction	Li, Ni, Co	$C_{Li}=2.8 \text{ g L}^{-1}$, $C_{Ni}=0.5 \text{ g L}^{-1}$, $C_{Co}=14.4 \text{ g L}^{-1}$	Cyanex 272+TOA	~7	The The
Solvent extraction	Li, Co, Mn	$C_{Li}=C_{Co}=C_{Mn}=4 \times 10^{-3} \text{ M}$	Cyanex272+PC-88A	4.95	The order
Solvent extraction	Li, Ni, Co	$C_{Fe}=3.6 \text{ g L}^{-1}$, $C_{Cu}=1.8 \text{ g L}^{-1}$, $C_{Mn}=1.8 \text{ g L}^{-1}$, $C_{Ni}=0.5 \text{ g L}^{-1}$, $C_{Co}=20.6 \text{ g L}^{-1}$, $C_{Li}=2.5 \text{ g L}^{-1}$.	P507	3.5	Reco Recc
Precipitation	Li, Ni, Co, Mn	100% of Li, Ni, Co, and Al in NCA material are leached out.	For Co: NaClO	3	The 100% still
			For Ni: NaOH	11	
Precipitation	Li, Ni, Co, Mn	LCO, LMO, and LCNM were mixed and leached according to the weight ratio of 1:1:1.	For Mn: KMnO_4	2	The Mn, 97.4%
			For Ni: dimethylglyoxime	9	
			For Co: NaOH	11	
			For Li: saturated Na_2CO_3	–	

Table S2. Advantages and disadvantages of the treatment of leaching solutions methods

Method	Advantage	Disadvantage
Electrodialysis	<ul style="list-style-type: none"> • Selective ion removal • Low consumption of chemicals • Scalable • Environmentally friendly 	<ul style="list-style-type: none"> • Dependence on electric energy • Membrane fouling • High initial cost
Precipitation	<ul style="list-style-type: none"> • Low cost • Low energy consumption 	<ul style="list-style-type: none"> • Complicated process • High reagent consumption • Hard to precipitate only one ion • Generation of solid waste
Solvent extraction	<ul style="list-style-type: none"> • High selectivity and recovery • Low energy consumption • Scalable 	<ul style="list-style-type: none"> • High price of solvent • Consumption of organic solvents • Generation of toxic waste liquid