

Selective separation of rare earth elements from malic-acid NdFeB magnet leachate by solvent extraction

Supplementary Material

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Figure S1 Speciation diagram of malic acid as a function of pH calculated at 25 °C.

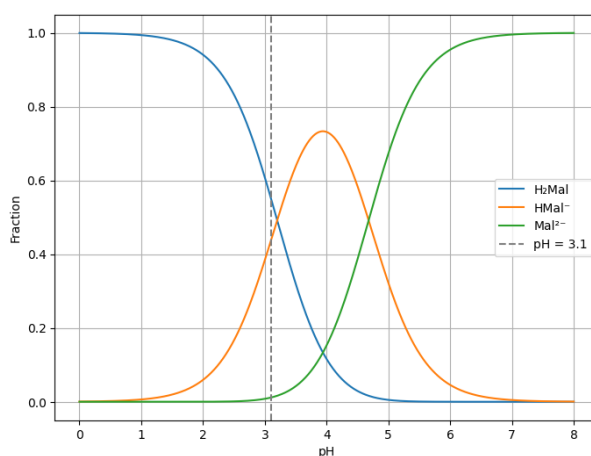


Table S1

Extractant	Diluent	pH	Extraction (%)				Distribution coefficient			
			Nd	Pr	Dy	Fe	Nd	Pr	Dy	Fe
D2EHPA	Isopar-L	2.5	100.0±0.2	100.0±0.1	100.0±0.2	50.6±0.3	139.8	104.9	44.9	1.4
Cyanex 272	Isopar-L	2.9	22.8±0.1	34.8±0.1	61.8±0.2	23.9±0.1	0.3	0.8	1.6	0.3
Aliquat 336	Isopar-L	2.8	0	7.4±0.3	13.3±0.1	33.8±0.1	0.0	0.1	0.2	0.5
TBP	Toluene	2.9	0	2.8±0.1	0.1±0.1	1.3±0.2	0.0	0.0	0.0	0.0

Figure S2 Chemical structures of (a) D2EHPA and (b) Cyanex 272, showing the differences in oxygen content and chain branching that influence the extraction behavior of REEs [58].

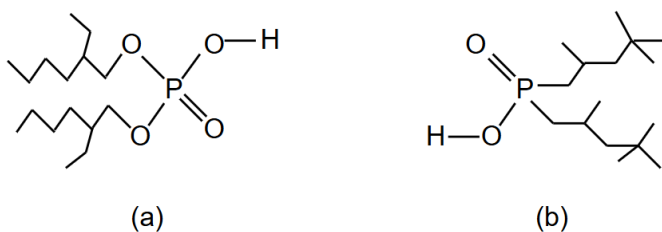


Table S2

Conc (mol·L ⁻¹)		Stripping (%)						
		B	Co	Cu	Dy	Fe	Nd	Pr
HCl	0.1	39.5± 0.3	-	93.8± 0.8	6.2± 0.1	-	24.4± 3.0	32.3± 1.5
	0.3	55.6± 0.1	-	92.3± 0.7	40.0± 0.1	-	54.31± 0.8	59.9± 0.4
	0.5	55.4± 0.1	-	97.7± 1.0	76.4± 0.1	-	73.6± 1.0	79.2± 0.1
	0.7	64.7± 0.2	3.7± 0.4	100± 2.0	72.2± 0.1	0.2± 0.1	100± 0.6	96.5± 0.3
H ₂ SO ₄	0.1	-	-	94.5± 0.8	24.7± 0.5	-	66.7± 0.7	74.5± 2.3
	0.3	-	-	96.8± 1.1	79.3± 3.0	0.1± 0.1	77.6± 2.5	83.2± 3.0
	0.5	-	-	94.2± 1.7	88.7± 0.3	0.1± 0.1	75.8± 2.6	90.74± 0.3
	0.7	-	-	100± 0.6	90.2± 0.9	0.2± 0.1	74.2± 1.0	76.2± 0.5

Table S3 Final composition of the aqueous solution after stripping with 0.7 mol·L⁻¹ HCl (A/O = 1, 20 °C, 10 min)

Element	Concentration (g·L ⁻¹)	Concentration (mol·L ⁻¹)
Nd	3.1 ± 0.2	0.02 ± 0.03
Pr	1.4 ± 0.1	0.01 ± 0.001
Dy	0.1 ± 1.10 ⁻²	6.10 ⁻⁴ ± 8.10 ⁻⁵
B	1.10 ⁻³ ± 1.10 ⁻³	6.10 ⁻⁴ ± 1.10 ⁻⁴
Cu	1.10 ⁻² ± 3.10 ⁻³	2.10 ⁻⁴ ± 1.10 ⁻⁴