

Design of a Hydrometallurgical Treatment System for Aluminium Waste

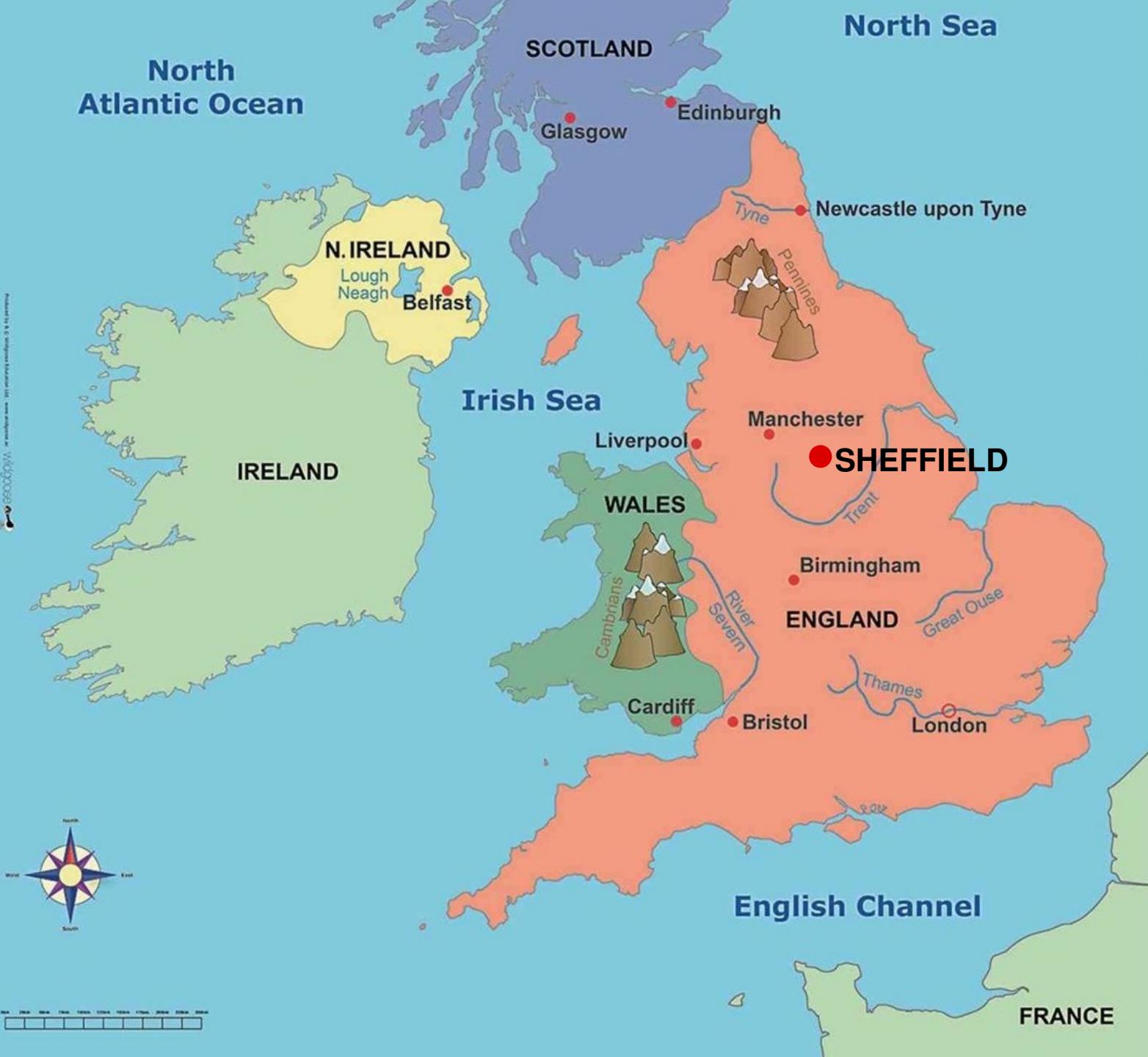
Thomas J. Robshaw, Keith Bonser, Glyn Coxhill, Dr Robert Dawson & Dr Mark D. Ogden



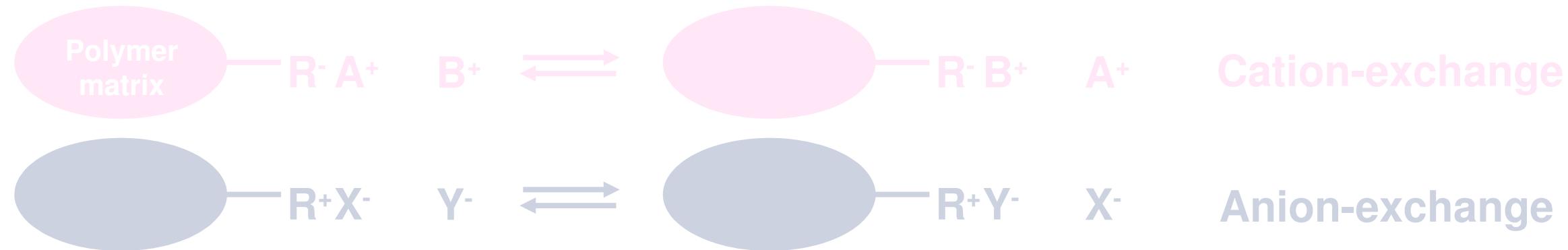
The S



D



Ion-Exchange: What We Do



Metal separation

Sugar decolourisation

Pharmaceutical purification



Juice processing

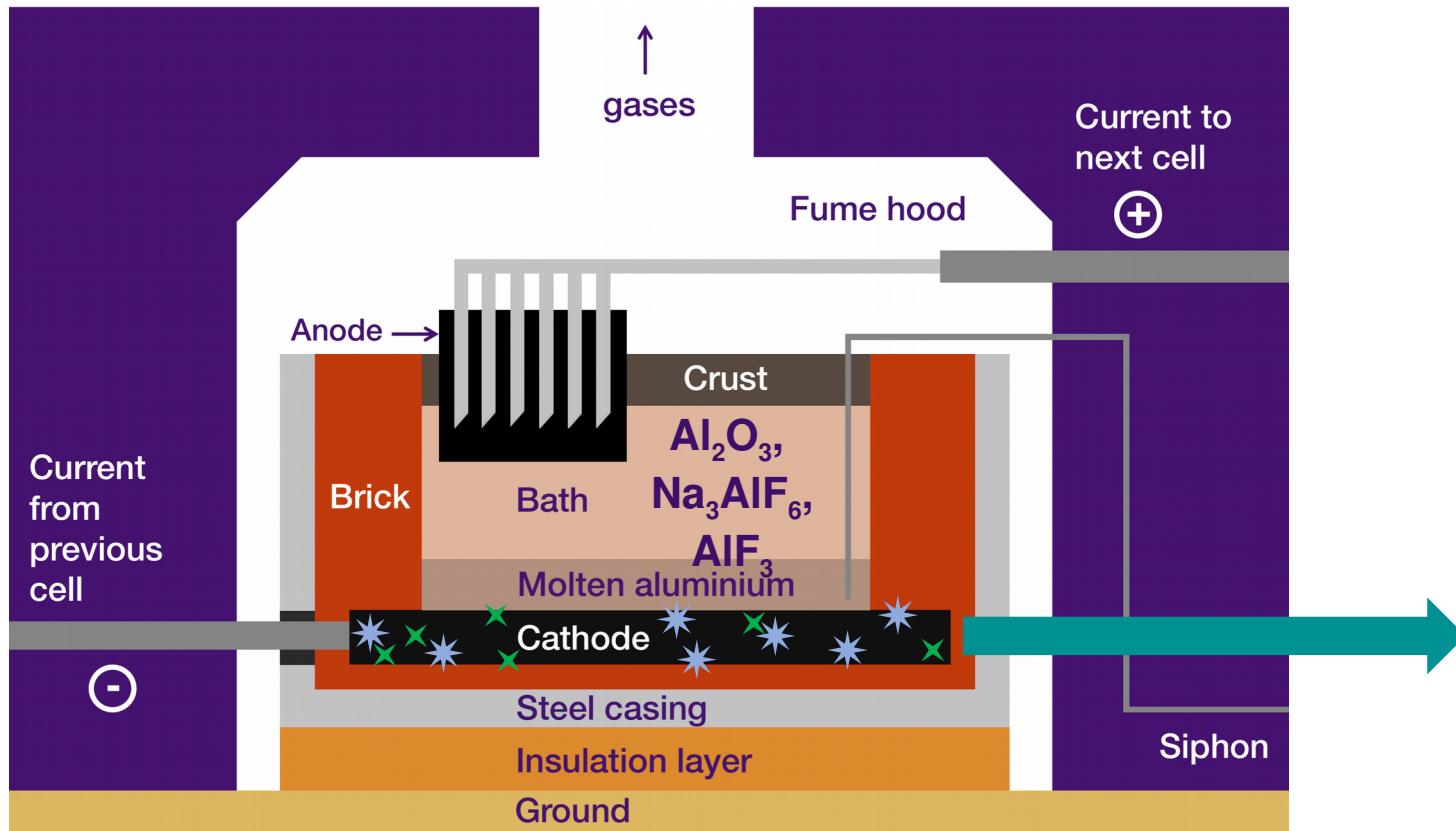
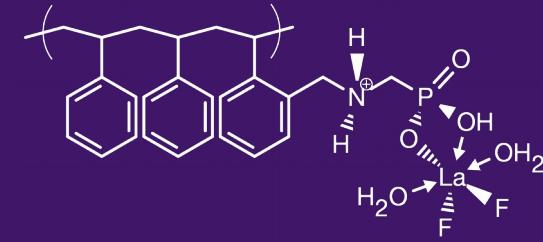


Gold refining

Water softening



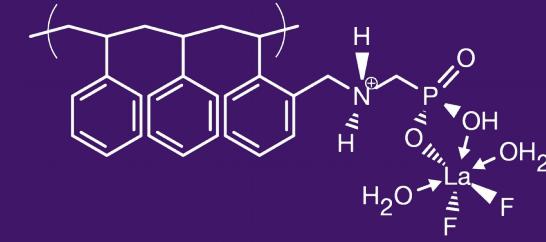
Spent Potlining (SPL)



Hall-Héroult electrolytic cell
For aluminium production



Characteristics of



1st-cut
Graphite-based

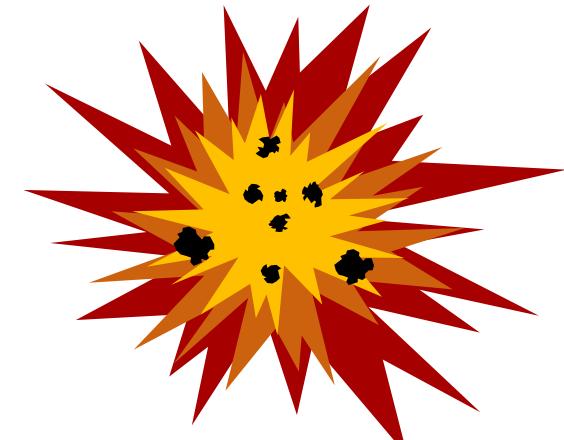


TOXIC



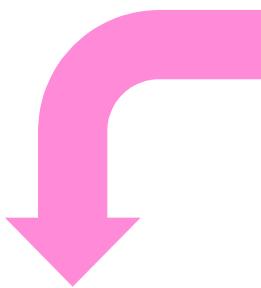
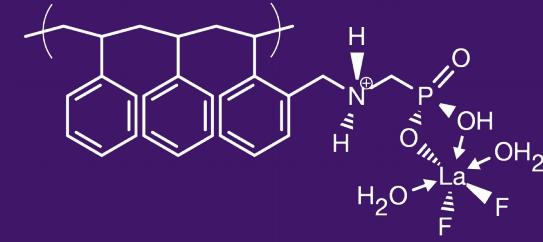
~50% carbon
≤10% fluoride
≤1% cyanide

Cement-based
2nd-cut



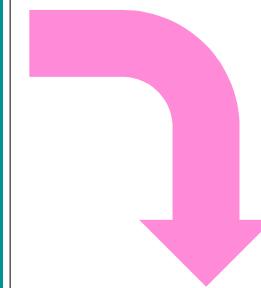
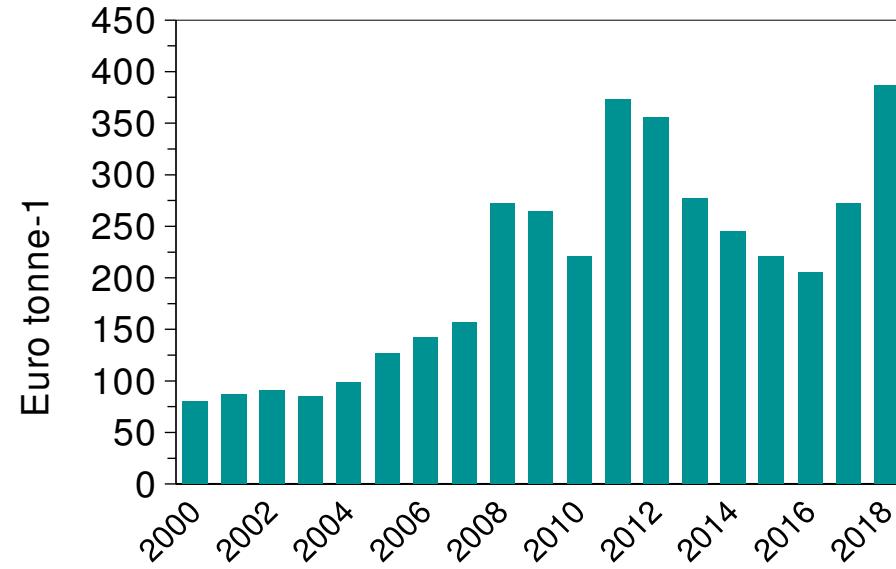
EXPLOSIVE

Graphite and



Fluorspar (CaF_2)

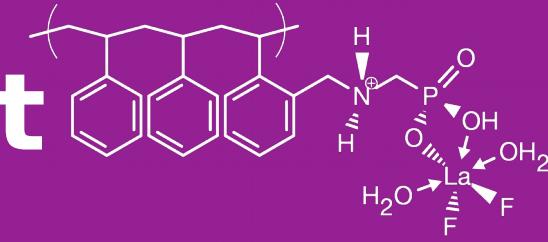
Global reserves: 310 MT
“CRITICAL MINERAL”



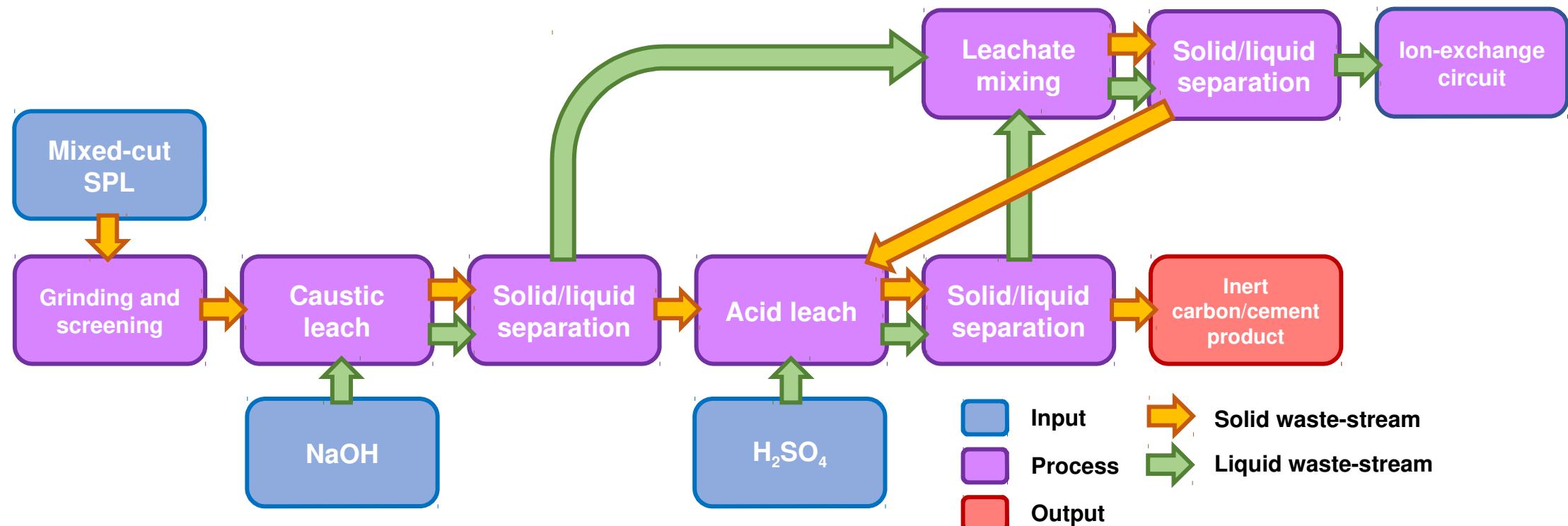
Graphite

Global reserves: 800 MT⁶

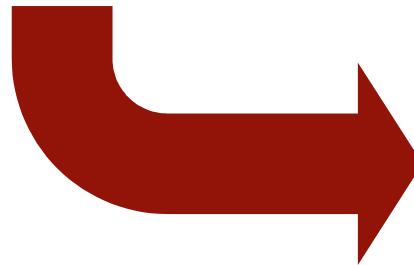
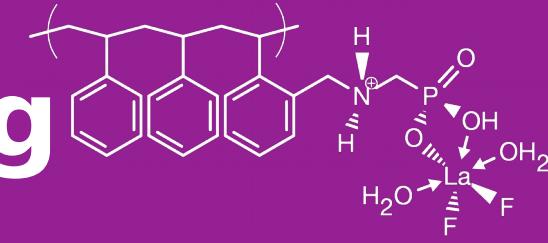
Hydrometallurgical SPL Treatment



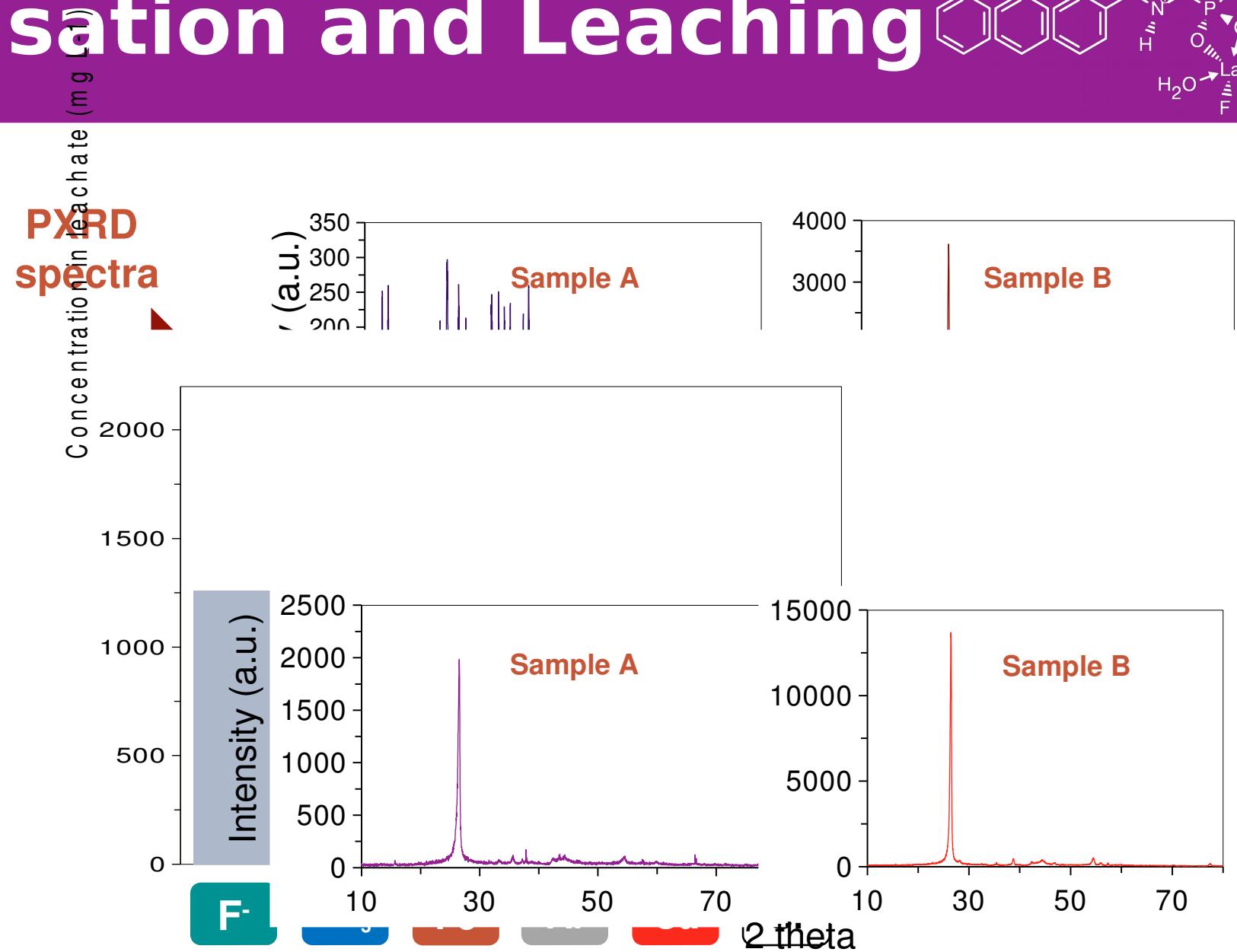
Proposed new system for maximum fluoride recovery



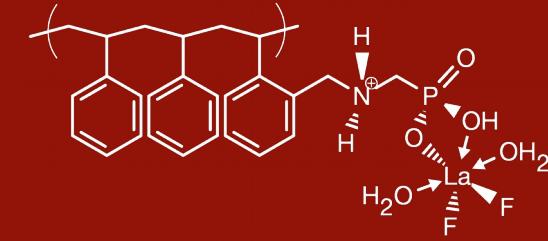
SPL Characterisation and Leaching



NaOH (1M) / H_2O_2 (3%), 3 hrs
 H_2SO_4 (0.5M), 2 hrs
Combine leachates



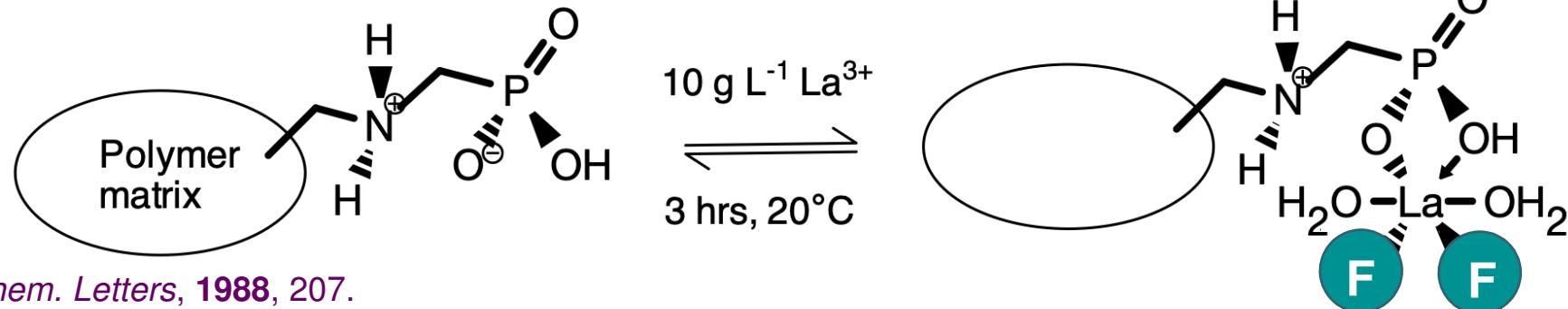
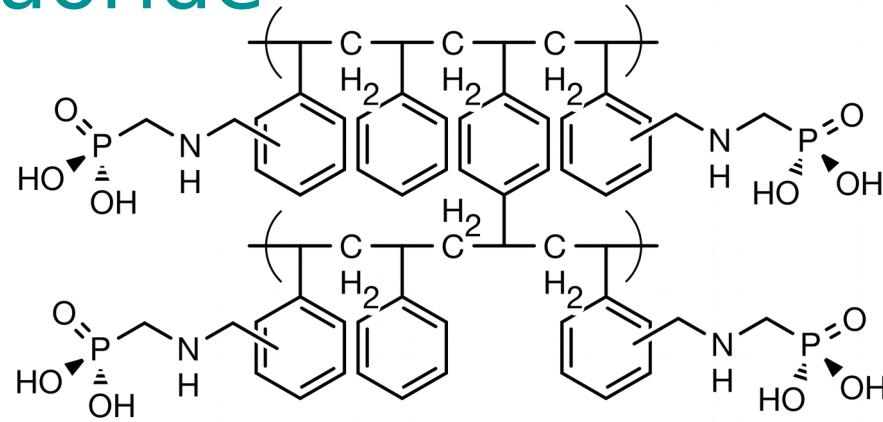
La-MTS9501 Resin



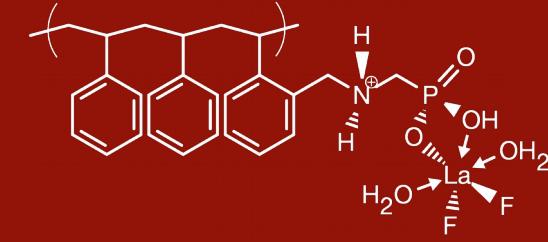
citrate > sulfate > oxalate > iodide > nitrate > cromate
> bromide > thiocyanide > chloride > formate > acetate >
fluoride

Puromet MTS9501

Bead diameter = 300 μm



Uptake Mechanisms

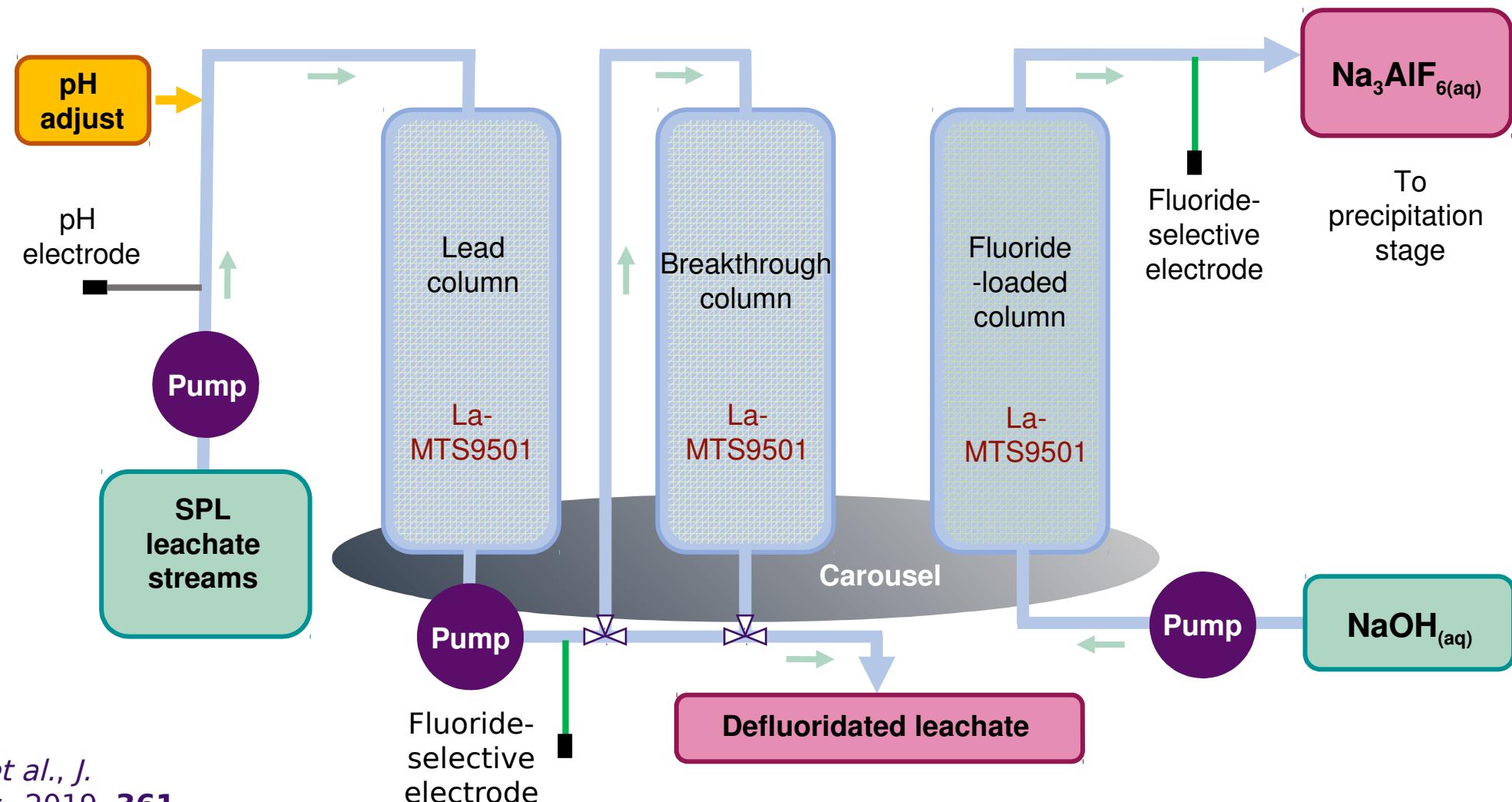
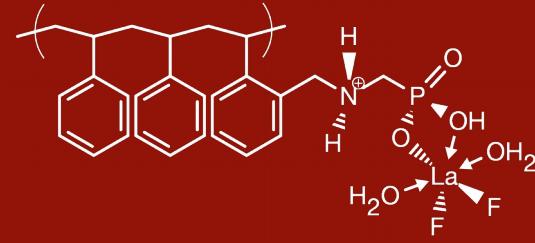


CaF_2
€370 per
Tonne

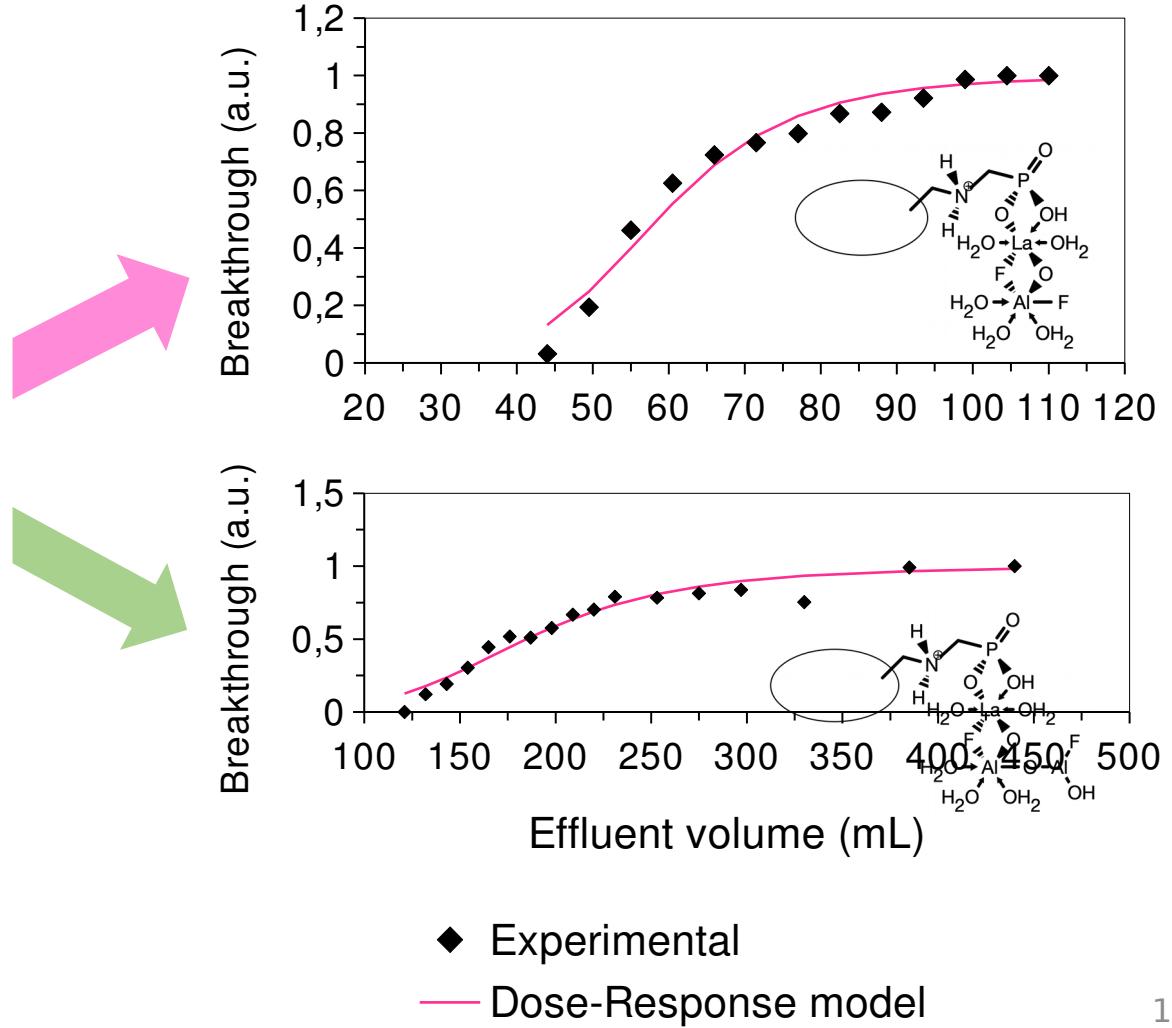
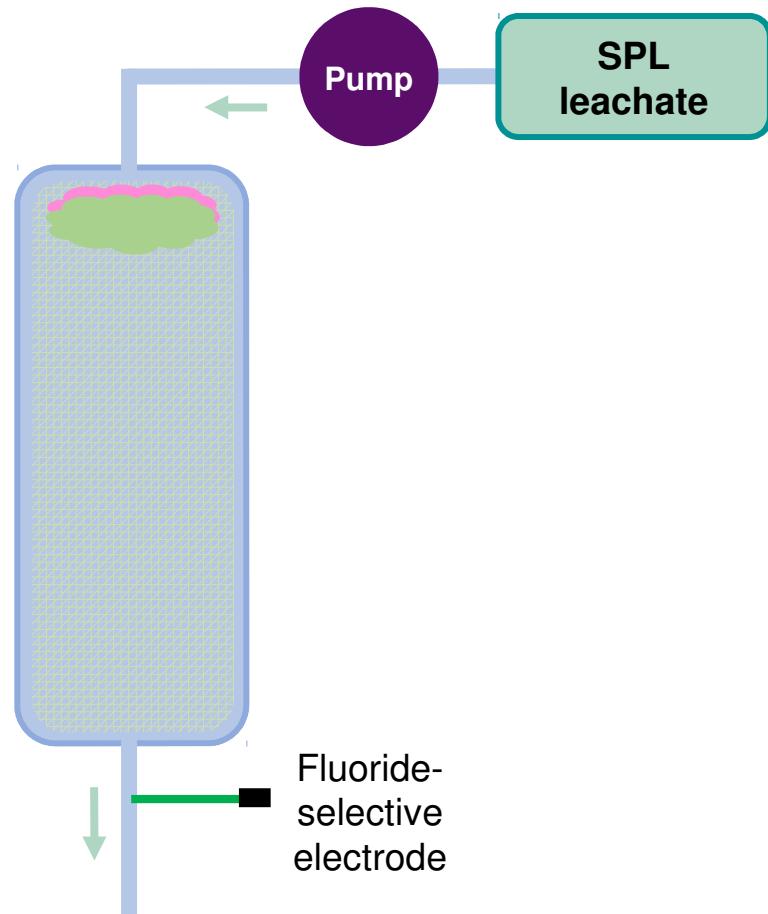
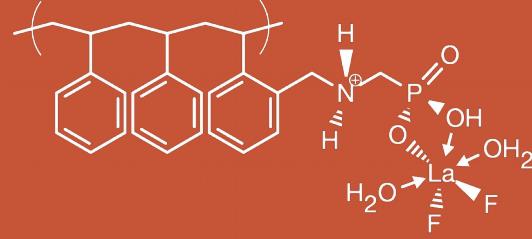


Na_3AlF_6
€750 per
Tonne

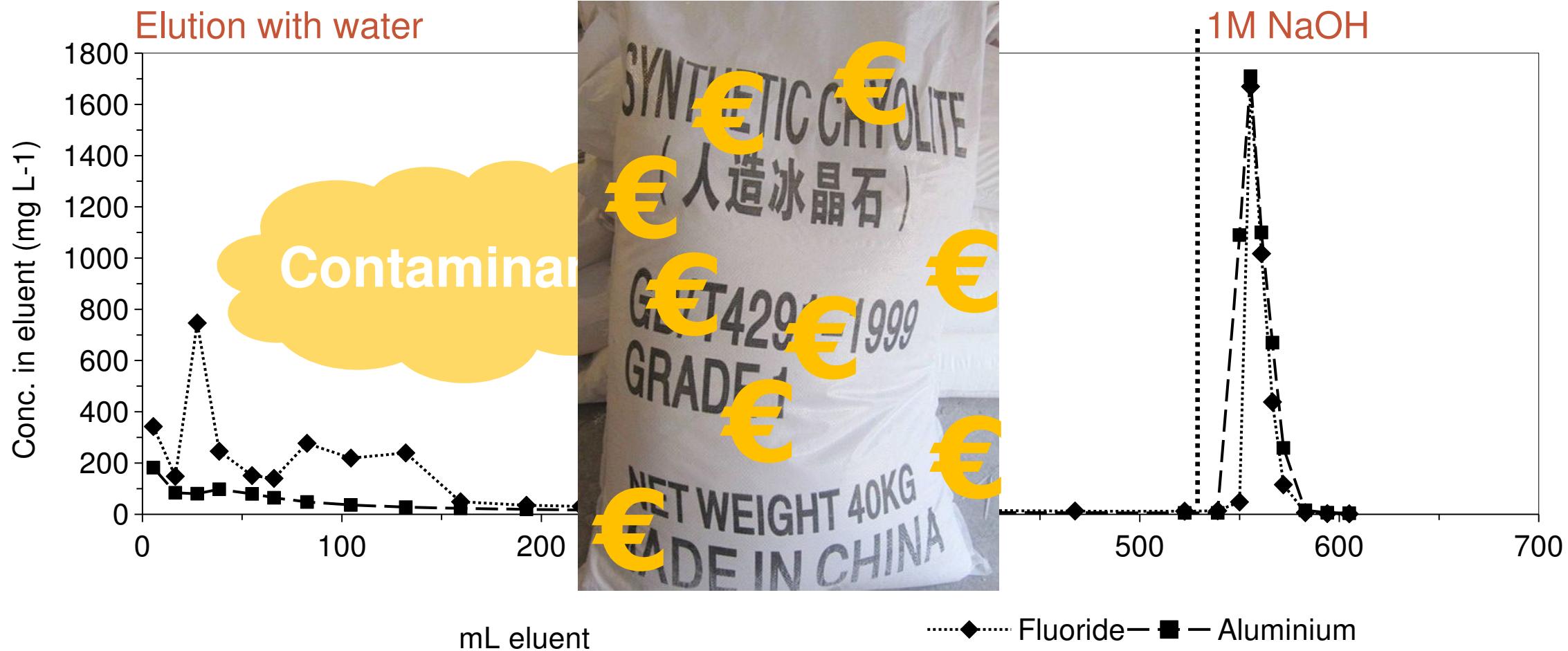
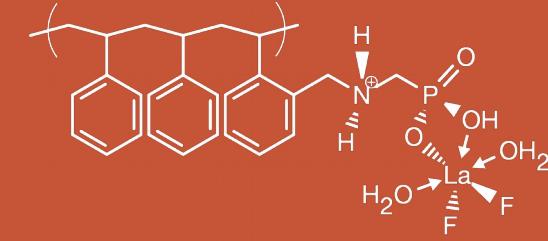
Proposed Ion-Exchange Circuit



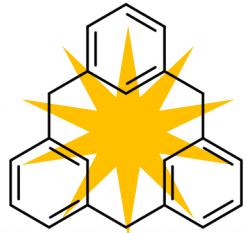
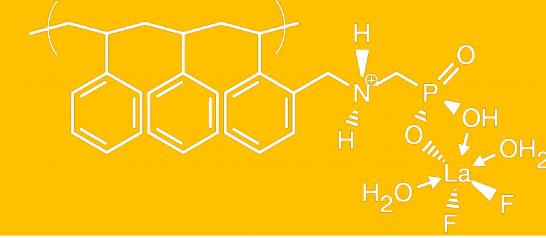
Dynamic Resin Performance



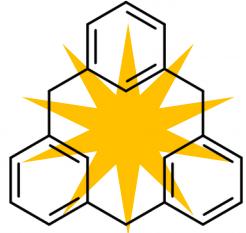
Recovery



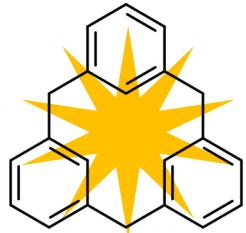
Conclusions



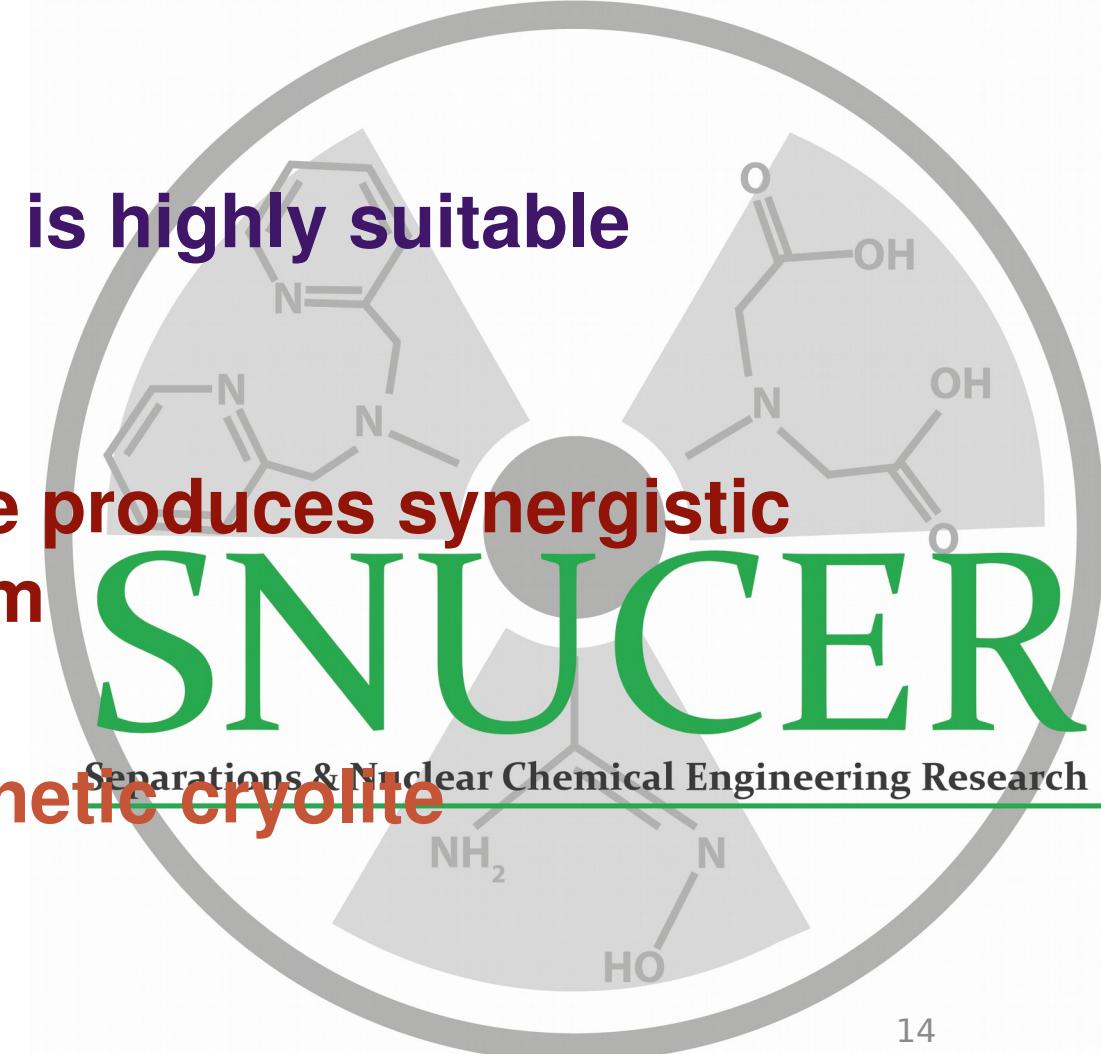
**La-MTS9501 resin is highly suitable
for purpose**



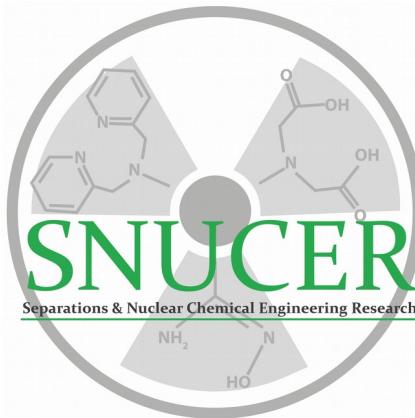
**Al in SPL leachate produces synergistic
uptake mechanism**



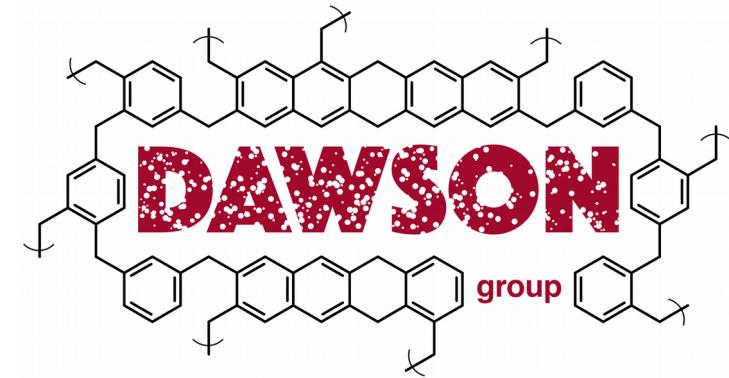
**Recovery of synthetic cryolite
may be possible**



Acknowledgements



Dr Mark Ogden & the SNUCER group
Dr Robert Dawson & research group
Polymer Centre CDT
Engineering & Physical Sciences
Research Council
Bawtry Carbon International
Trimet Aluminium
Royal Society of Chemistry
(Environment Sustainability & Energy Division)
You for listening



See poster 123 for more fluoride work!
Tjrobshaw1@Sheffield.ac.uk



EPSRC
Engineering and Physical Sciences
Research Council

CDT

in Polymers,
Soft Matter and Colloids



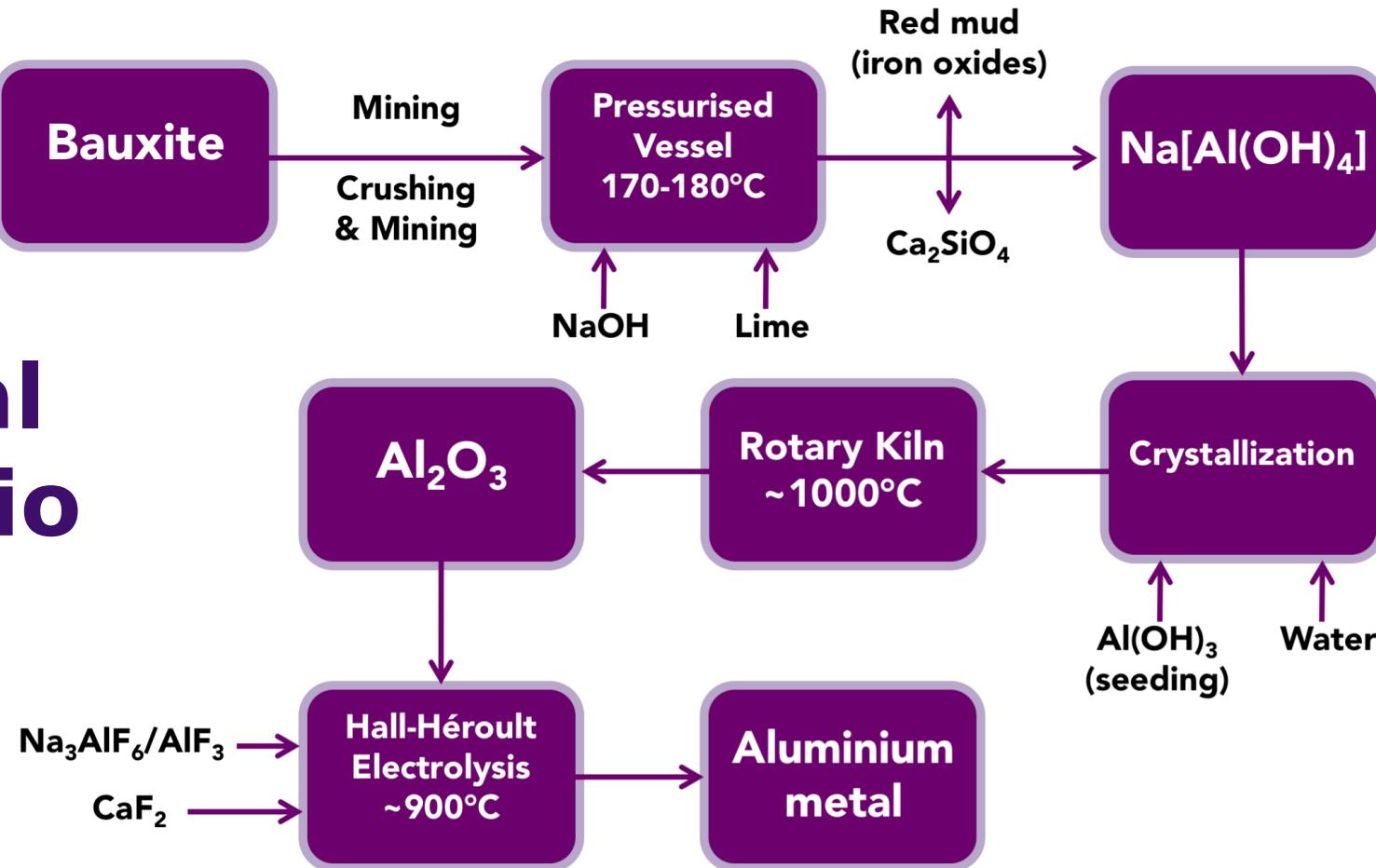
Bawtry
CARBON



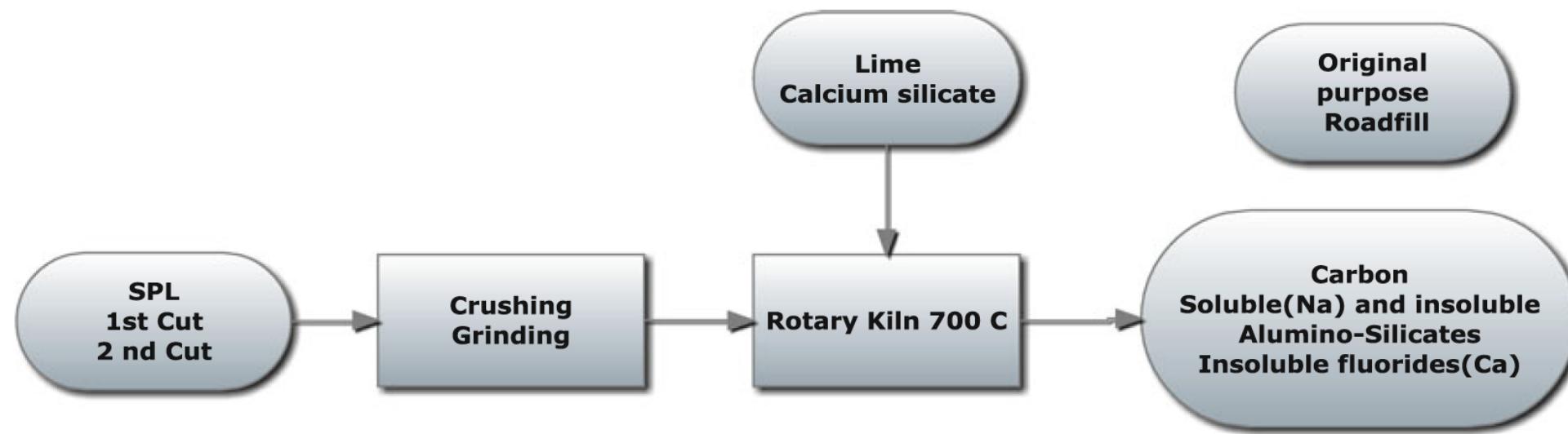
ROYAL SOCIETY
OF CHEMISTRY | ENVIRONMENT
SUSTAINABILITY AND
ENERGY DIVISION

Supporting Information

Al Metal Production

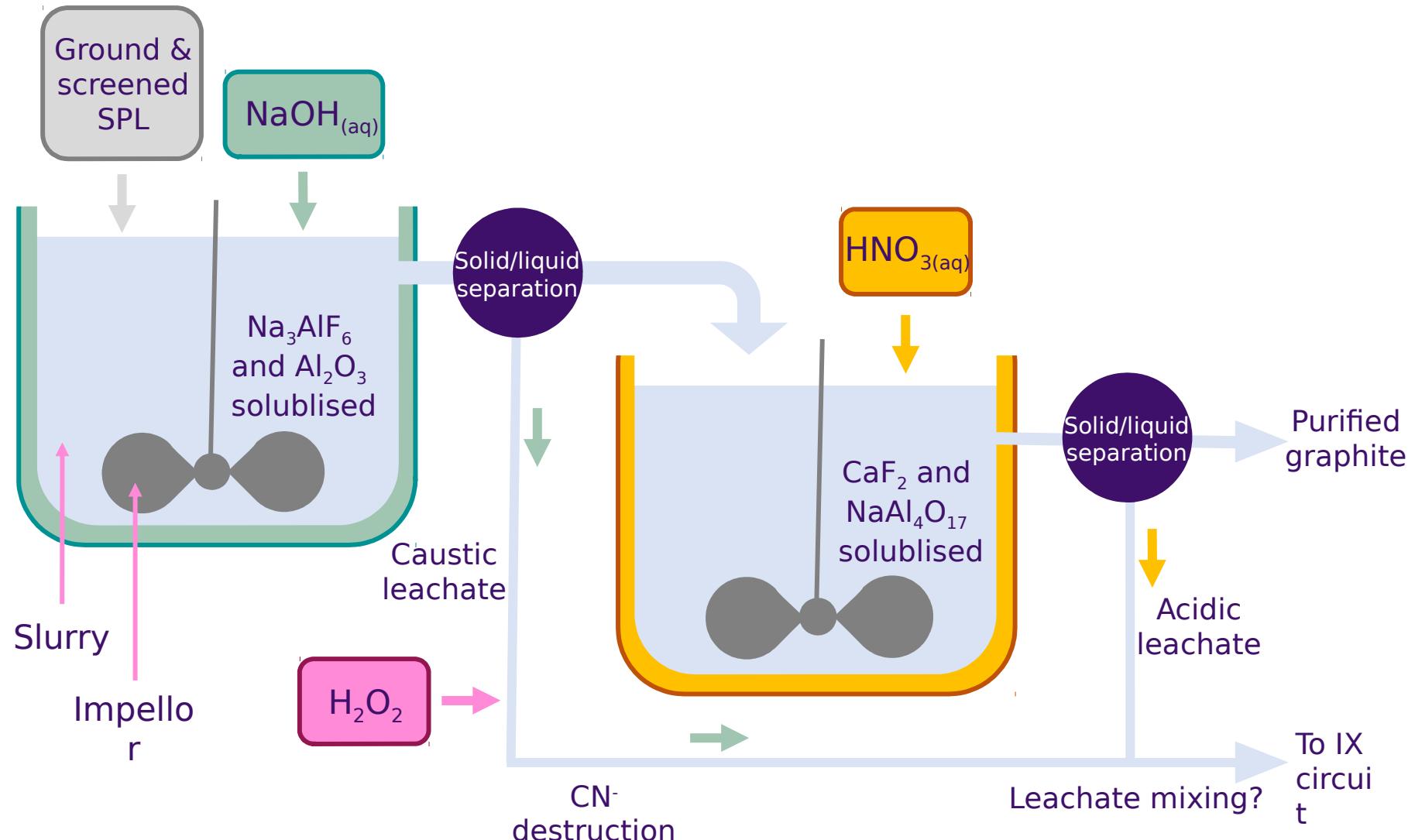


Pyrometallurgical SPL Treatment



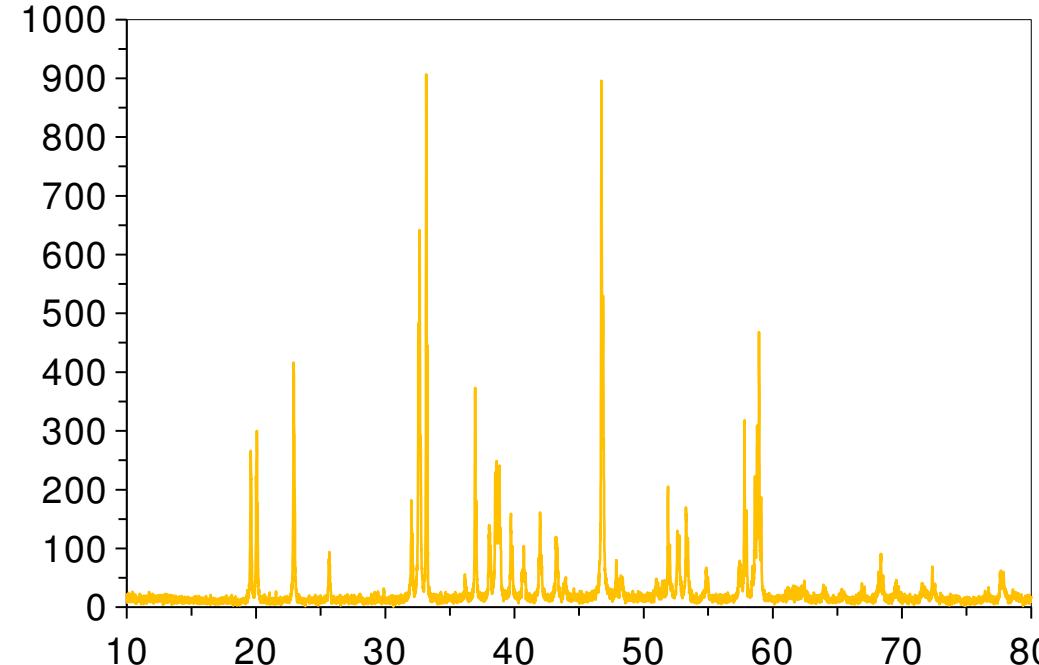
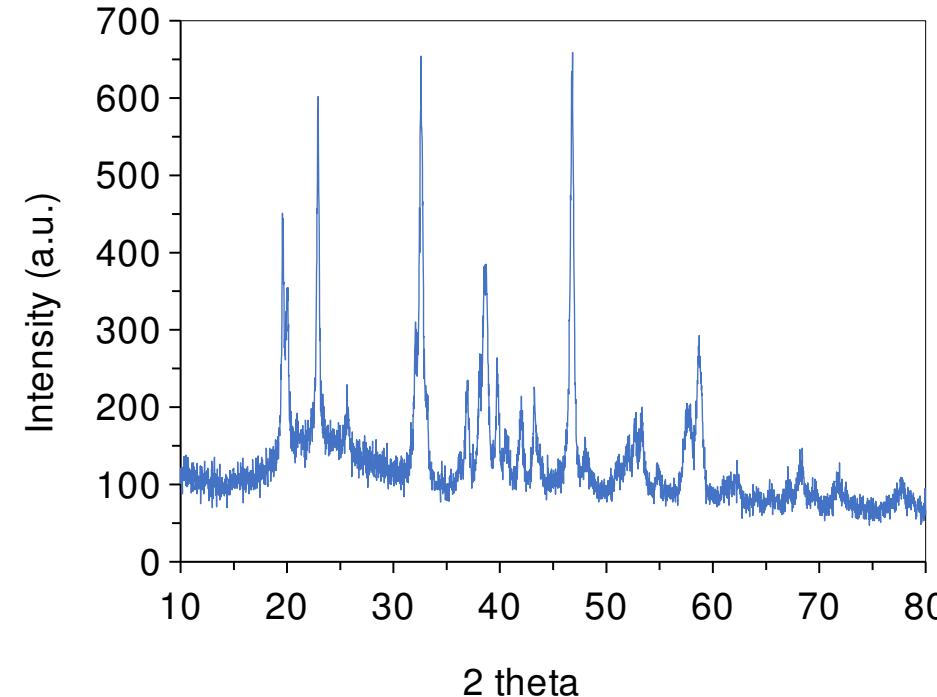
- ◆ Produces 2.5 T waste per T SPL processed
- ◆ In operation today

Proposed Leaching Treatment

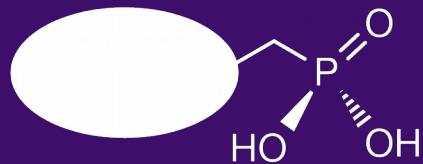


Cryolite Precipitation

**PXRD spectrum of cryolite precipitated from Literature spectrum for comparison
leachate before IX treatment**



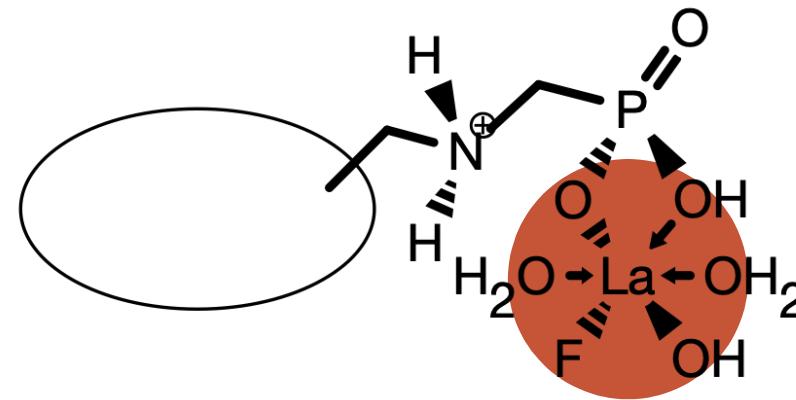
XPS Analysis of Resin Beads



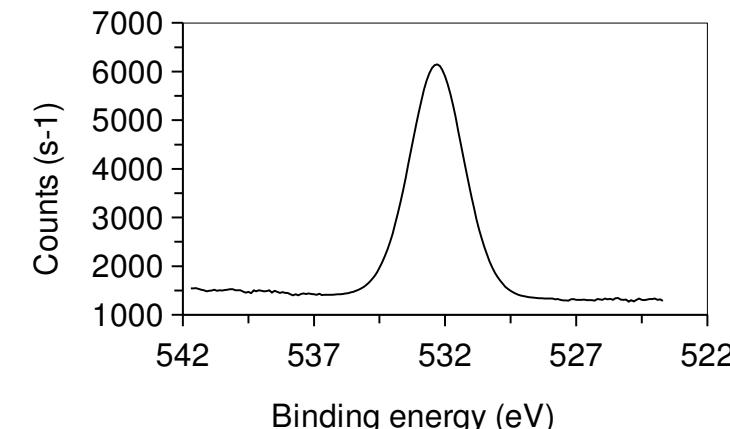
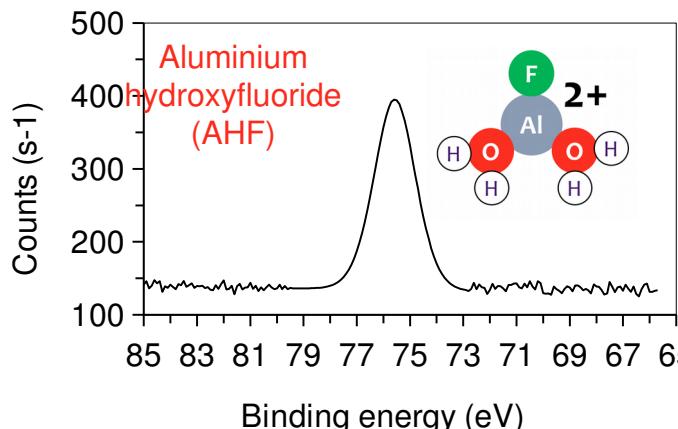
NaF solution

Al environments

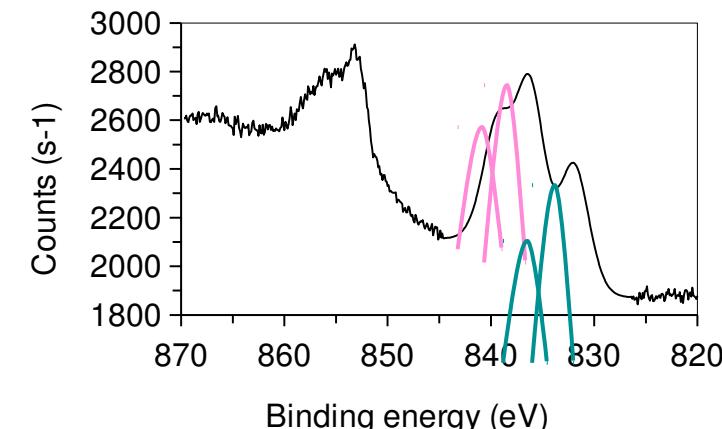
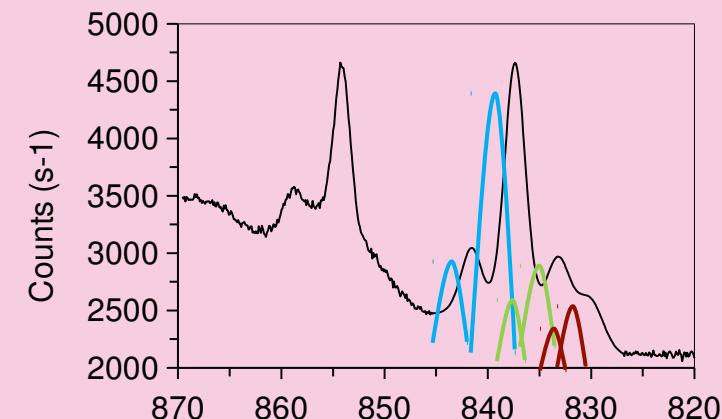
(none)



Leachate



La environments



Resin Regeneration Study

Equilibrium fluoride uptake of La-MTS9501 over 5 adsorption/desorption cycles

