



“World Practices” for geopolymers, and PREDIS challenges

J. PROVIS (UNIVERSITY OF SHEFFIELD)

j.provis@Sheffield.ac.uk



This project has received funding from the Euratom research and training programme 2014-2018 under grant agreement No 945098.

What are we asking of our cements?

Construction

- Low cost
- Fast strength development
- Control of flow properties with organic admixtures
- High strength
- Durability for 50-200 years service life
- Passivation of mild steel

Waste immobilisation

- Durability for up to 100k+ years service life
- Dimensional stability
- Binding of radionuclides
- High flowability
- Low heat evolution
- Compatibility with challenging waste types (e.g. organic liquids of interest here)
- Stability under irradiation

Can we realistically expect all this from a single material?



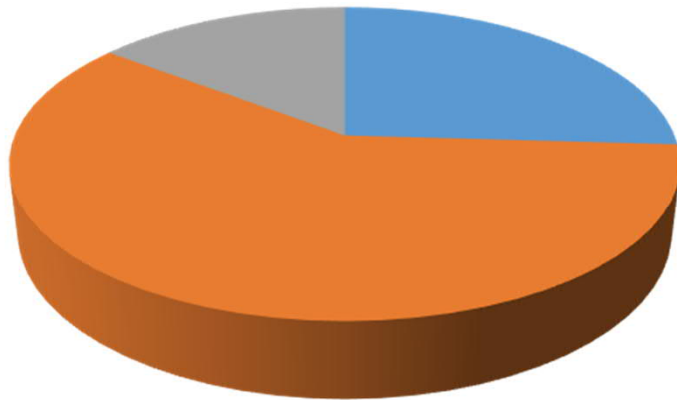
What do we mean when we say “geopolymer”?

- Alkali-aluminosilicate cement
 - Usually starting from a commonly used pozzolan/SCM (metakaolin, GGBFS, fly ash)
 - React this with a source of alkalis: Na or K silicate/hydroxide/etc.
- In the context we’re using here – mostly low-calcium binders
 - Key binder phase is “(N,K)-A-S-H”; 3-dimensional structure resembling a zeolite, but lacking long-range crystallographic order
- Metakaolin activated by (Na,K)-silicate works well for a lot of things we want to do



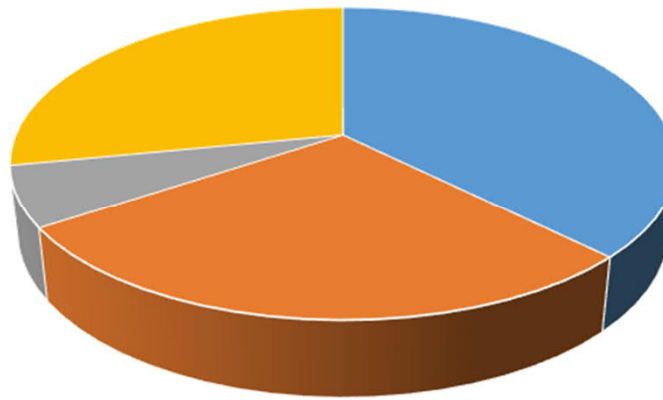
How does this differ from existing “PC-based” wasteform materials?

UK (Sellafield)



■ Water ■ BFS ■ PC

Saltstone - SRNL LAW



■ Alkaline waste (>5 M NaOH) ■ BFS ■ PC ■ Fly ash

We use similar chemistry already – we just call it “Portland-based” although it’s only 10-20% PC



What is already being done, and where to next?

- Many studies on ^{137}Cs immobilisation, and oil encapsulation
 - Wastes that are problematic for Portland cement
- Already deployed in central Europe for some complex wastes
- Work in France, UK & others, for oil & Mg immobilisation
- Work in USA, Israel, & others, on concentrated salt solutions/liquors
- Possibilities to explore for ion exchangers (e.g. UK-Japan joint project), sludges (inorganic and mixed organic-inorganic), and others
 - Need to understand robustness, processability, durability, disposability, &c.