Geopolymer cement adoption in Canada

A market-focused approach

GEOPOLYMERCAMP 2019

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INDUSTRY
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Long-term outlook of GP reagents?

Fly ash

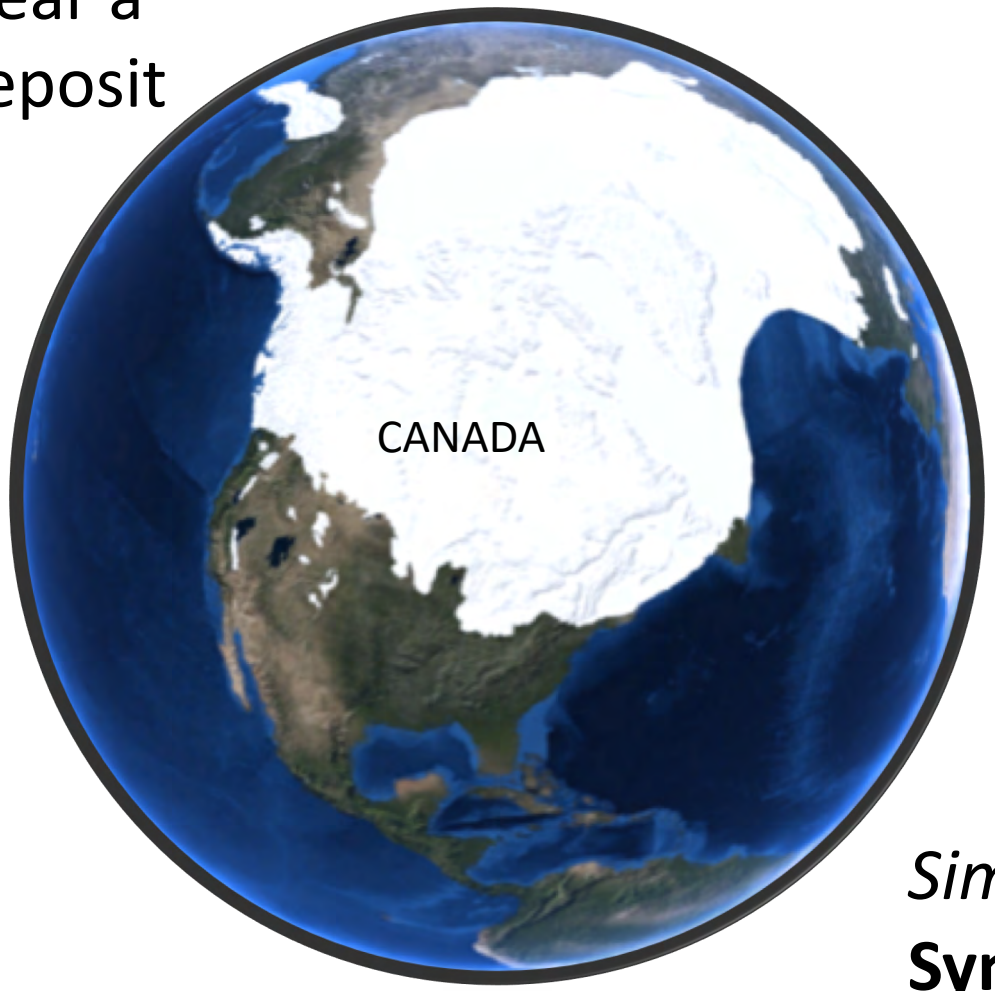
Slag

MK-750

✓ Fe-MK-750

Synthetic Glasses

Ferro-sialate:
Great! If near a suitable deposit



Simple "activation"
Synthetic glass is a global solution!

“Geosynthesis” – status quo in nature

New wide variety of feedstocks also builds on
e.g. GEOCISTEM, “synthetic lava”, “manufactured slag”

Engineered Glassy Reagents?

Minerals

Glass Reagent

Common Rocks
Unconsolidated Sediments
Concrete Dem. Waste
Some Mine Tailings
Etc.

3 reagent types by Ca Content:

Low (0-10% CaO)

Med. (10-20% CaO)

High (20-35% CaO)

Synthetic Glass Reagents

- Avoid many problems of **mineralogy**
- Control over **composition** and **reactivity**
- Tailored to purpose - **reproducible**

- Downside?
  - High T (but perhaps ½ energy can be recovered)

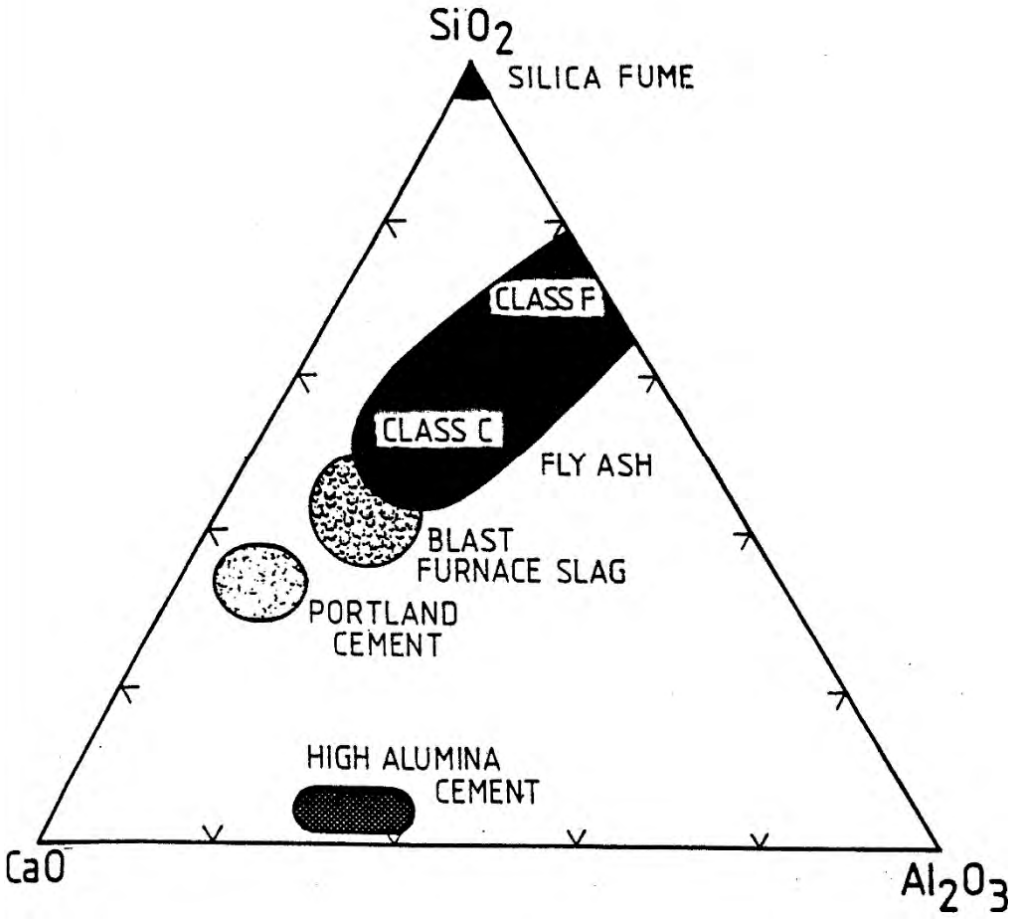
- **Strategic Advantage**
  - Control over production – reliable, local
  - Use waste materials (collect disposal fee)

Glass Considerations

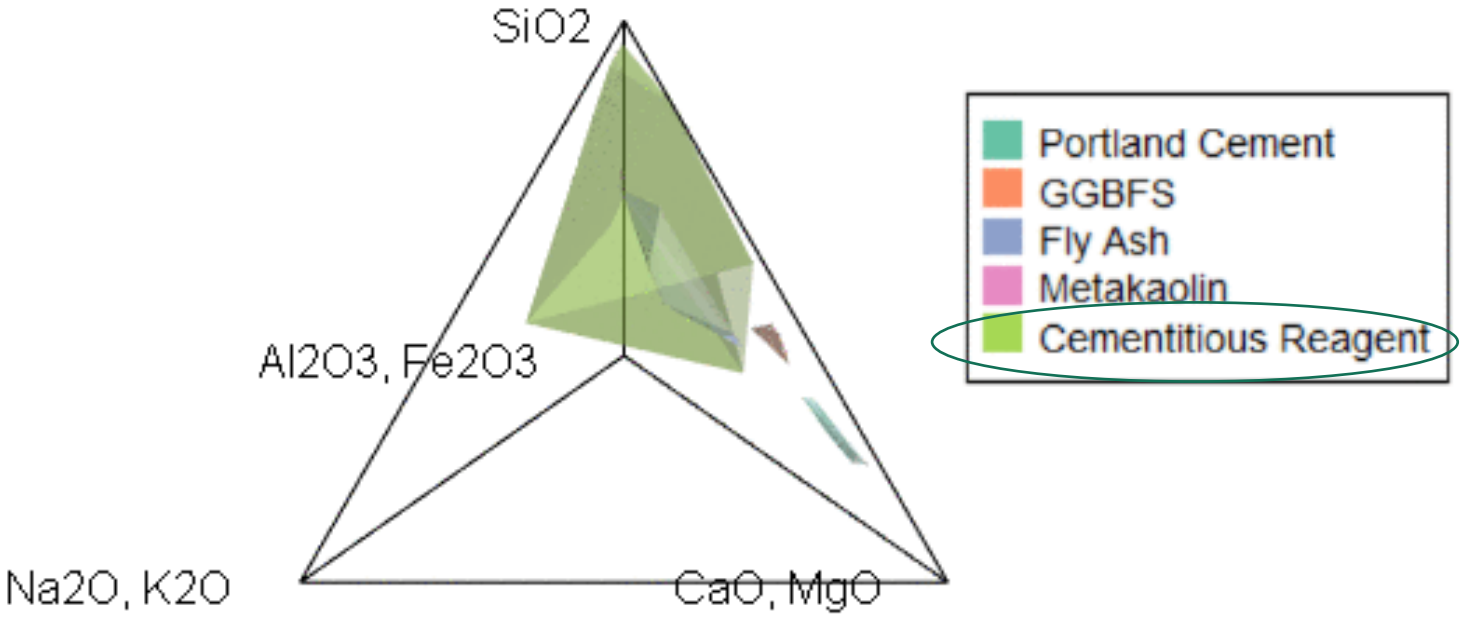
- **Composition**
- **Structure**

- Fineness, etc.

COMPOSITION: From OPC textbook



4th dimension needed for Na, K

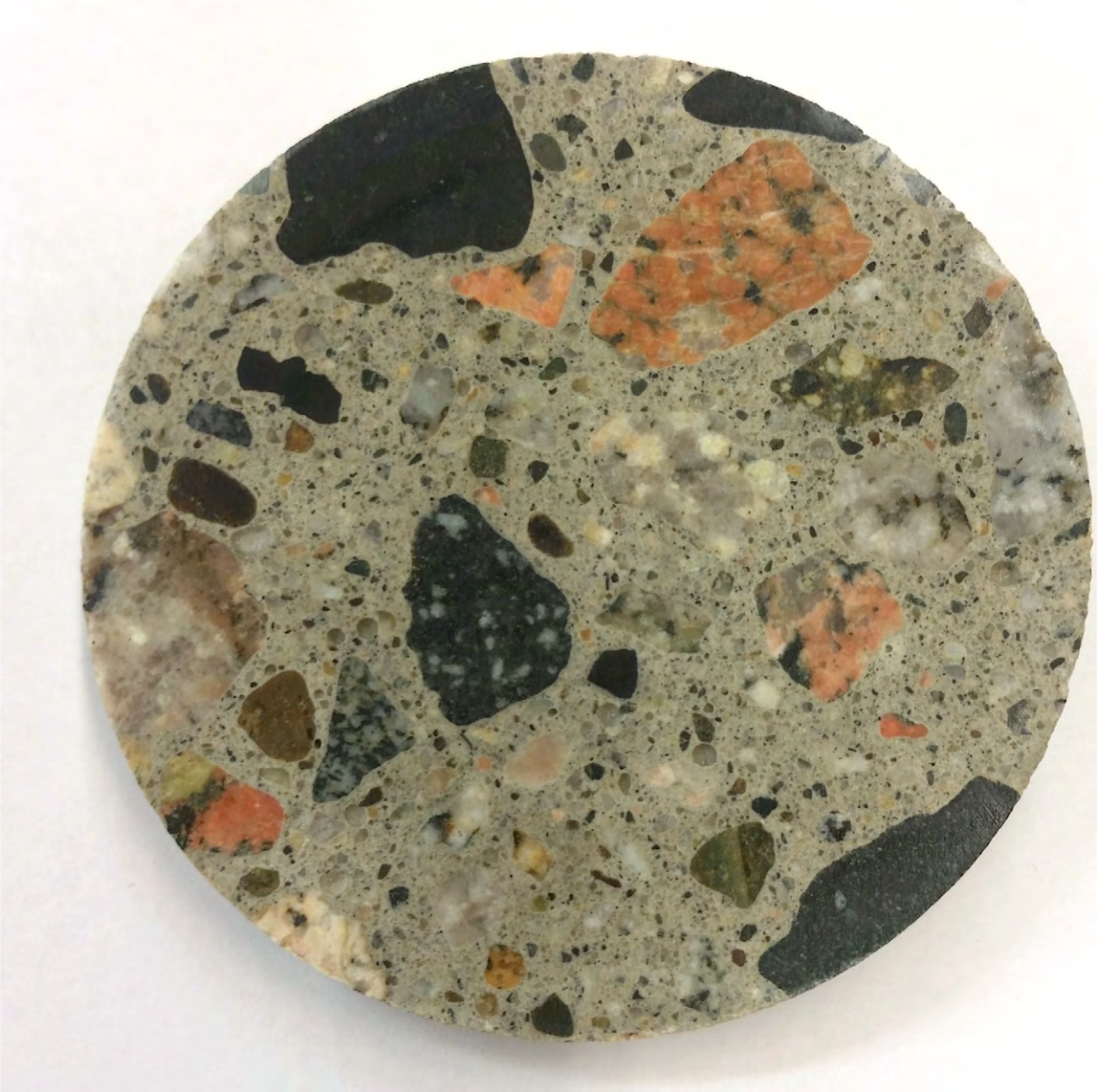


STRUCTURE: define “glassy”, “amorphous”

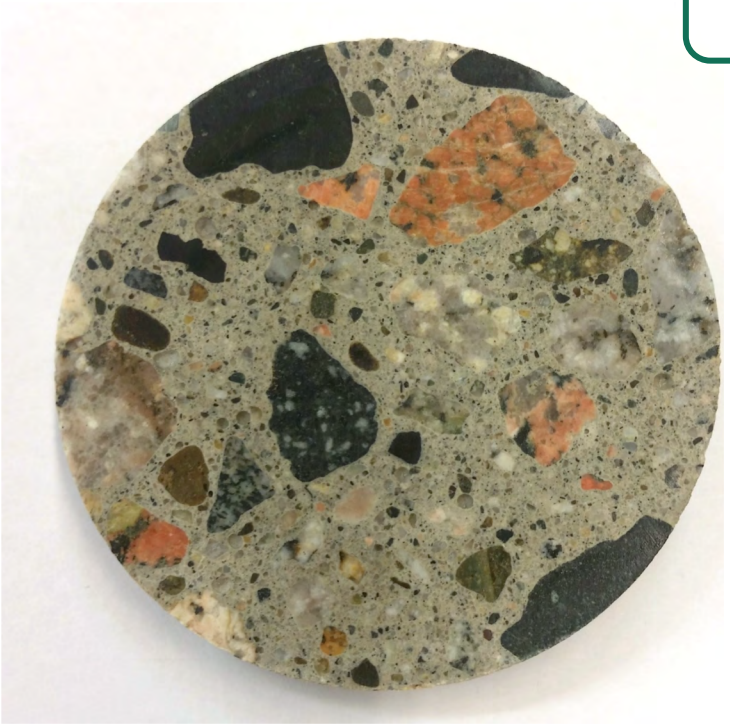
Example Feedstocks

- Demolished Concrete
- Fluvial Sediment
- Basalt

Demolished Concrete-based Reagent



Demolished Concrete-based Reagent

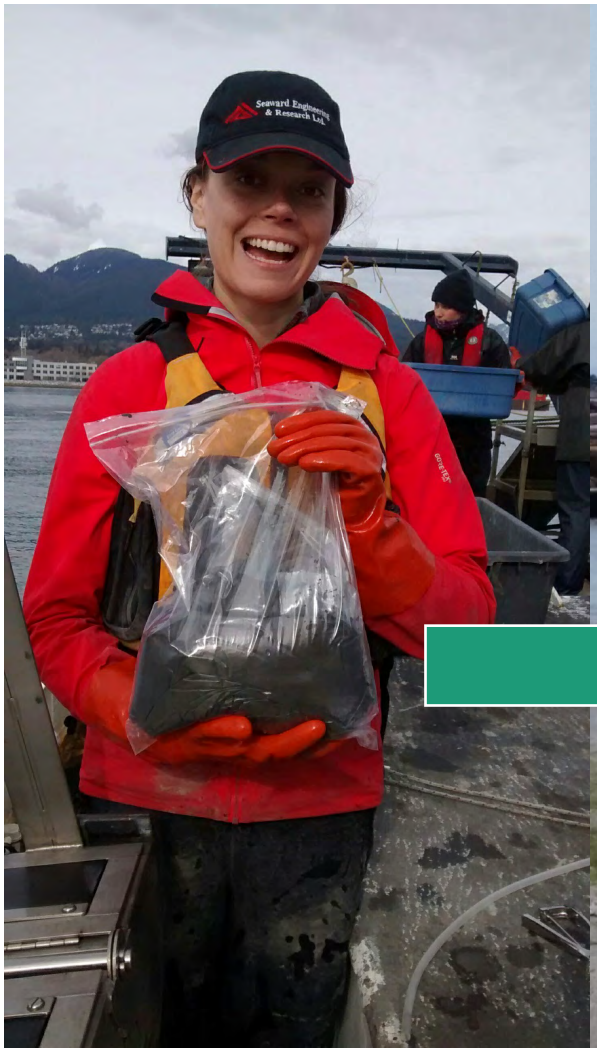


Phase	Weight %
albite-low (calcian)	31
quartz-low	21
albite-low	11
orthoclase	8
calcite	8
*CSH gel estimate	6
clinozoisite	3
actinolite	3
clinochlore II	3
biotite 1M	2
ettringite	2
C_2S beta	2
brownmillerite (Al)	1
gypsum	1

Oxide	Weight %
SiO_2	64
Al_2O_3	13
Fe_2O_3	0
FeO	1
MnO	0
MgO	2
CaO	11
Na_2O	5
K_2O	2
CO2	4
H_2O	4

(Ca, Na, K) – poly(sialate-multisiloxo)

River Sediment-based Reagent

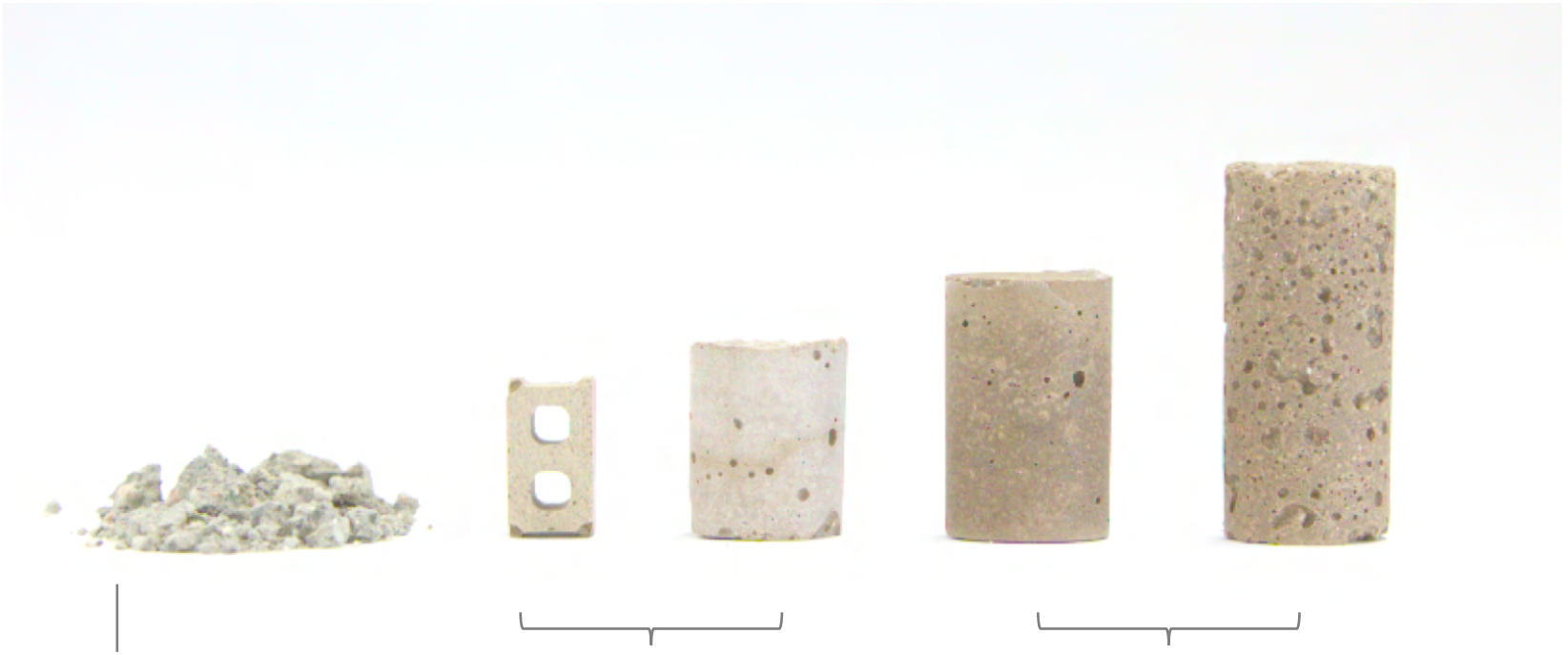


Fraser River, Vancouver, Canada
Millions of tonnes of sediment are disposed of annually.

Heat-cured geopolymer concrete bricks

Basalt-based glassy reagent

Heat test - 750°C – 2 hours



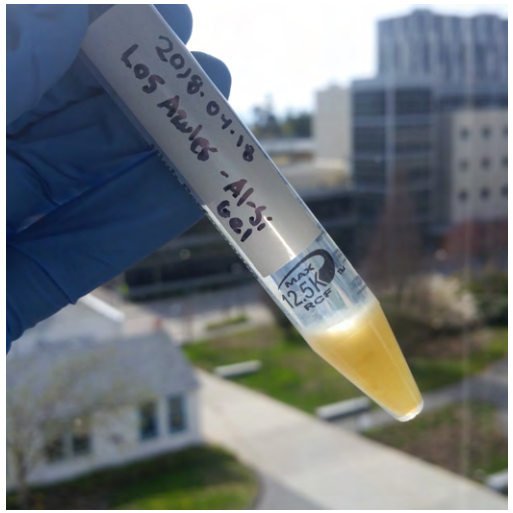
Portland Cement Paste

Demolished Concrete Reagent (Ca, Na, K)-PSMS Paste (ambient cure)

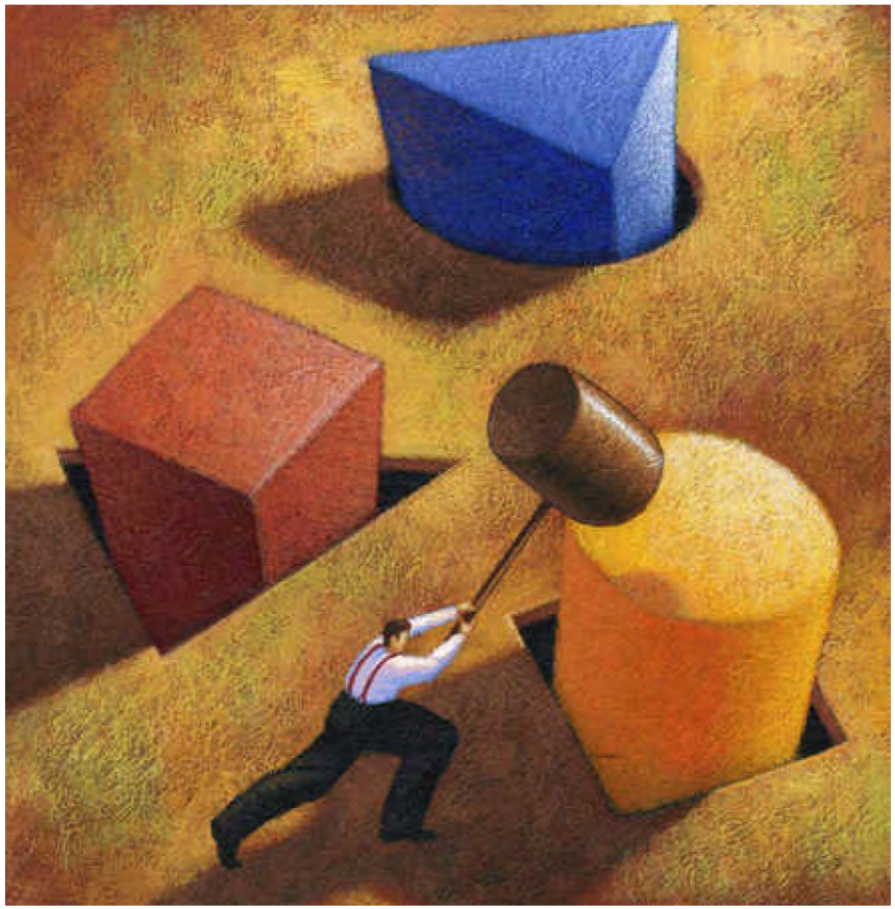
River Sediment Reagent (Na, K)-PSMS Paste and Grout (heat cure)

Why high-temperature route?

- **Simplicity**
  - Mechanochemistry
  - Wet chemistry – sol-gel etc.
- Energy – 2-5 GJ
- Still no process CO_2!

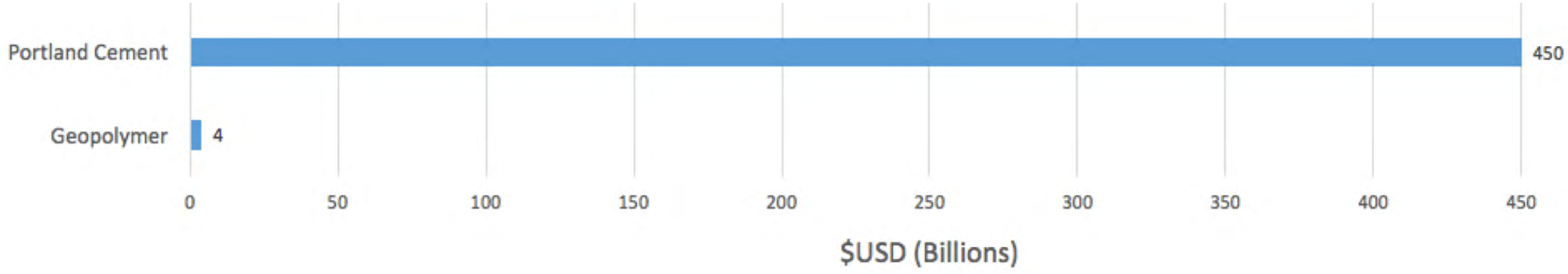


So when can we start pouring concrete?



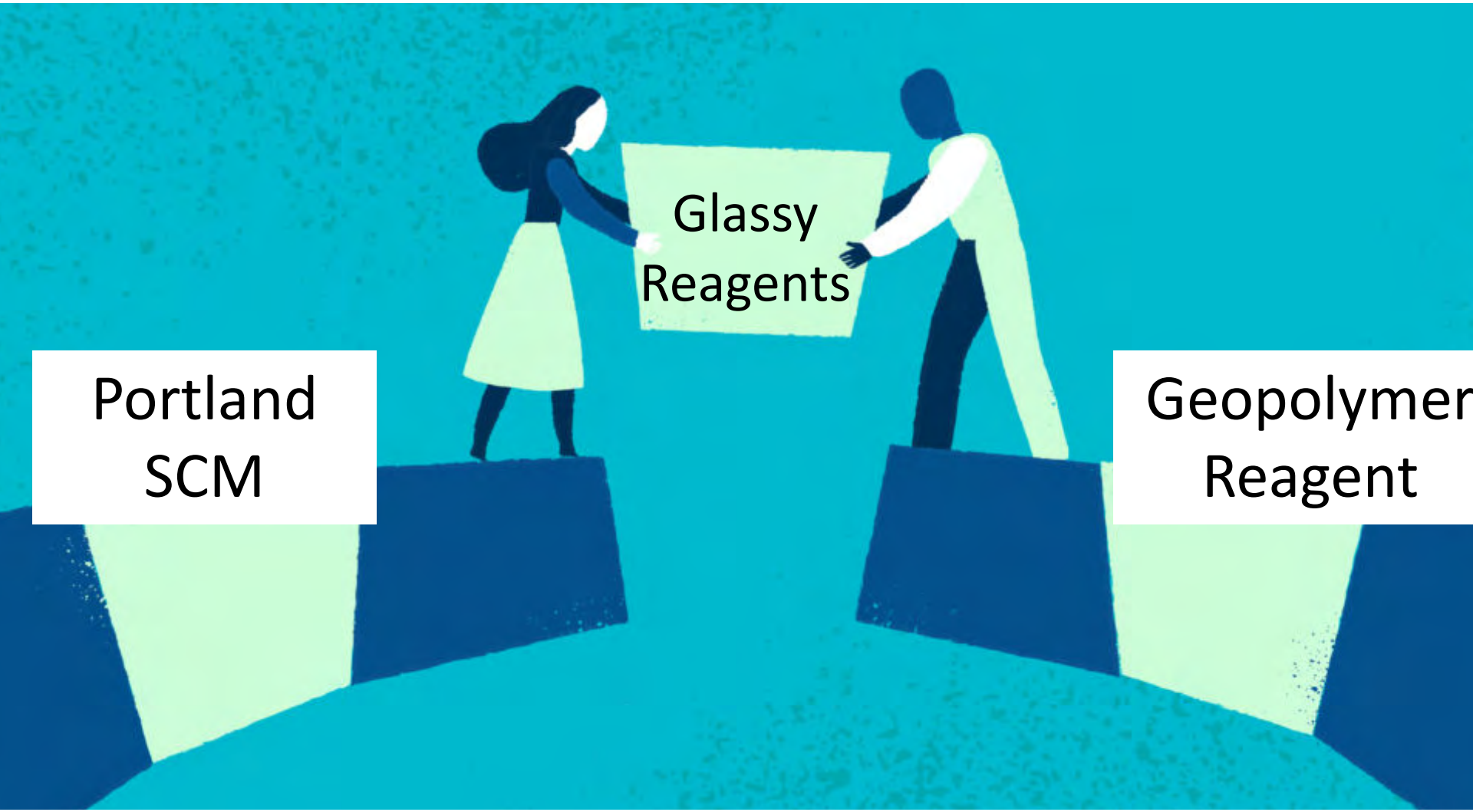
Approval process for geopolymer concrete in Canada

Why? Market Size Paradox



If you have $ Billions in funding

Perhaps better to disguise GP reagent as “pozzolan”



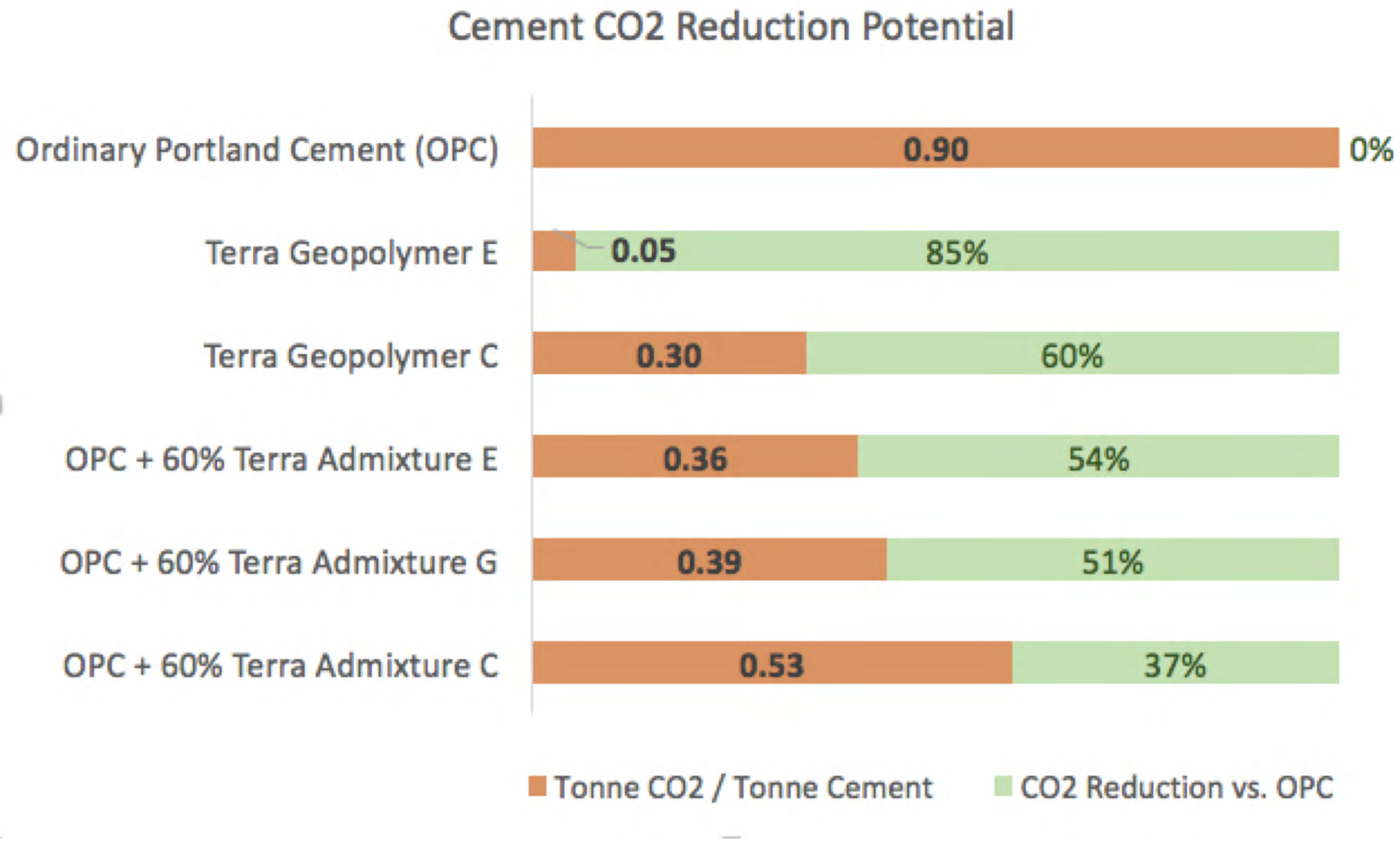
Purpose-made reagents may be the bridge from OPC world to geopolymer world.

Why bother with Portland SCM?

1. **Global Impact**: we need to displace Mt of OPC, immediately.

2. **Political Pressure**: low-CO2 cement.

Develop local capacity to support geopolymer cement when regulations catch up.



E- electric heat C – Coal heat G – Oxy-CH4

What next?

- Certifying reagent as SCM
- Raising money for pilot plant in Vancouver, Canada
- Proving economics of process

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