

Improving Colloidal Silica Grout's Performance as an Injectable Sub-surface Barrier & Soil Stabiliser for Nuclear Decommissioning

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Colloidal silica grout can help mitigate **contaminant release** in nuclear decommissioning. But...

...must better understand behaviour
...optimise performance and cost

– Here, CS's **strength**, **flexibility** and **re-healing** are studied and enhanced

1. Background

At aged nuclear sites:

- Contaminated soil
- Deteriorated containment structures
- Lots of waste to process & dispose

Decommissioning operations risk **contaminant release** via...

- Groundwater
- Airborne particulate

Dealing with this is **expensive** & **time-consuming** with current tech.

CS grout better than conventional materials in key applications, **but not yet widely used**.

More research needed to change minds...

My Research:

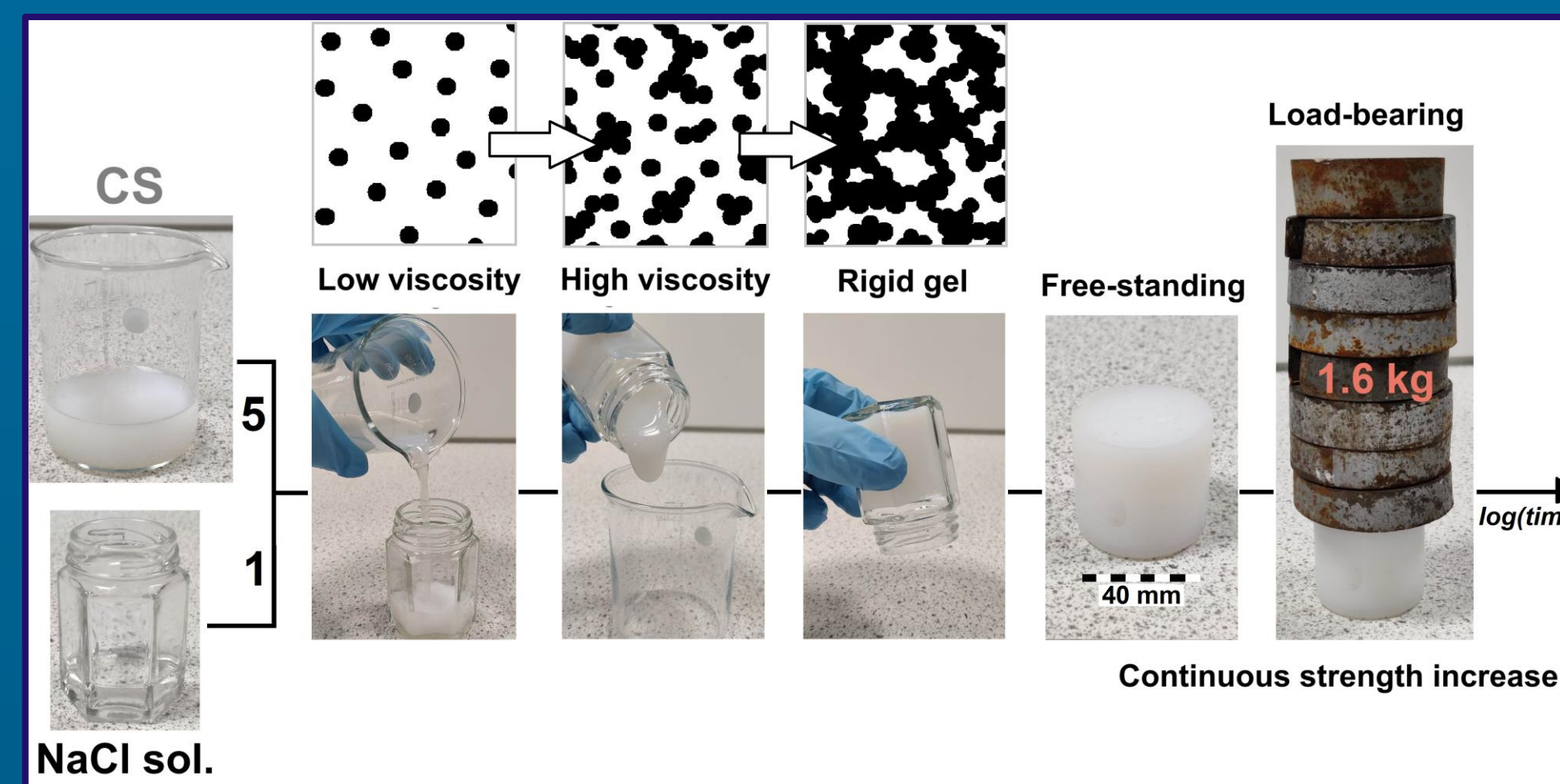
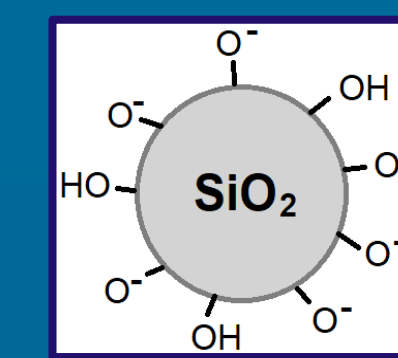
- Study CS behaviour
- Enhance properties and reduce cost
- Help CS...

...reduce risk to workers, public & environment

...save cost & time

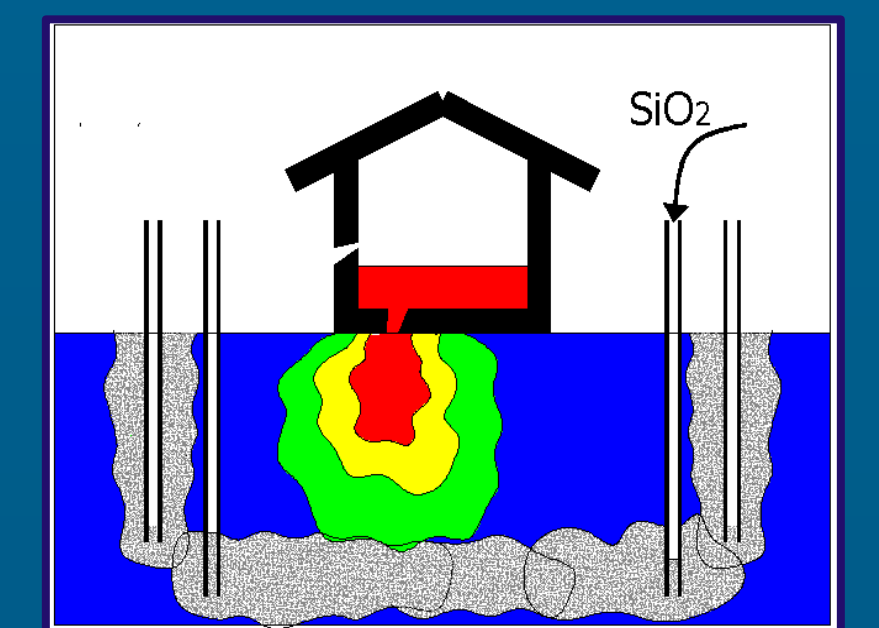
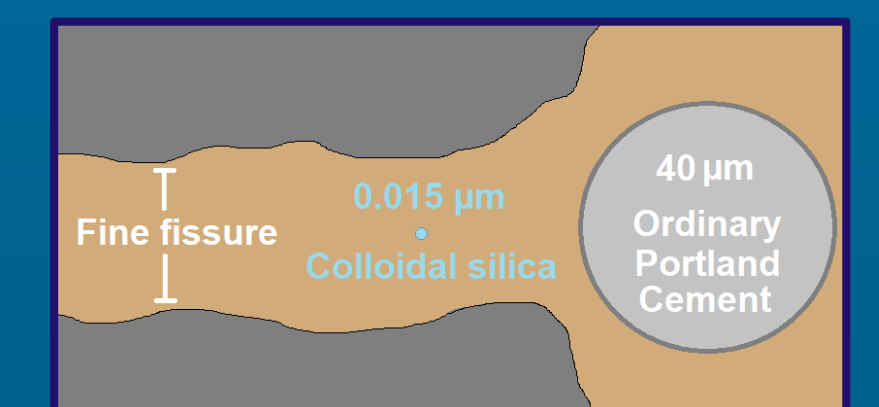
2. Colloidal Silica Grout

- Suspension of silica nanoparticles
- Forms rigid gel when mixed with NaCl sol.



Properties:

- Water-like viscosity
- Controllable gel time
- nm particle size
- Environmentally friendly
- Low hydraulic conductivity

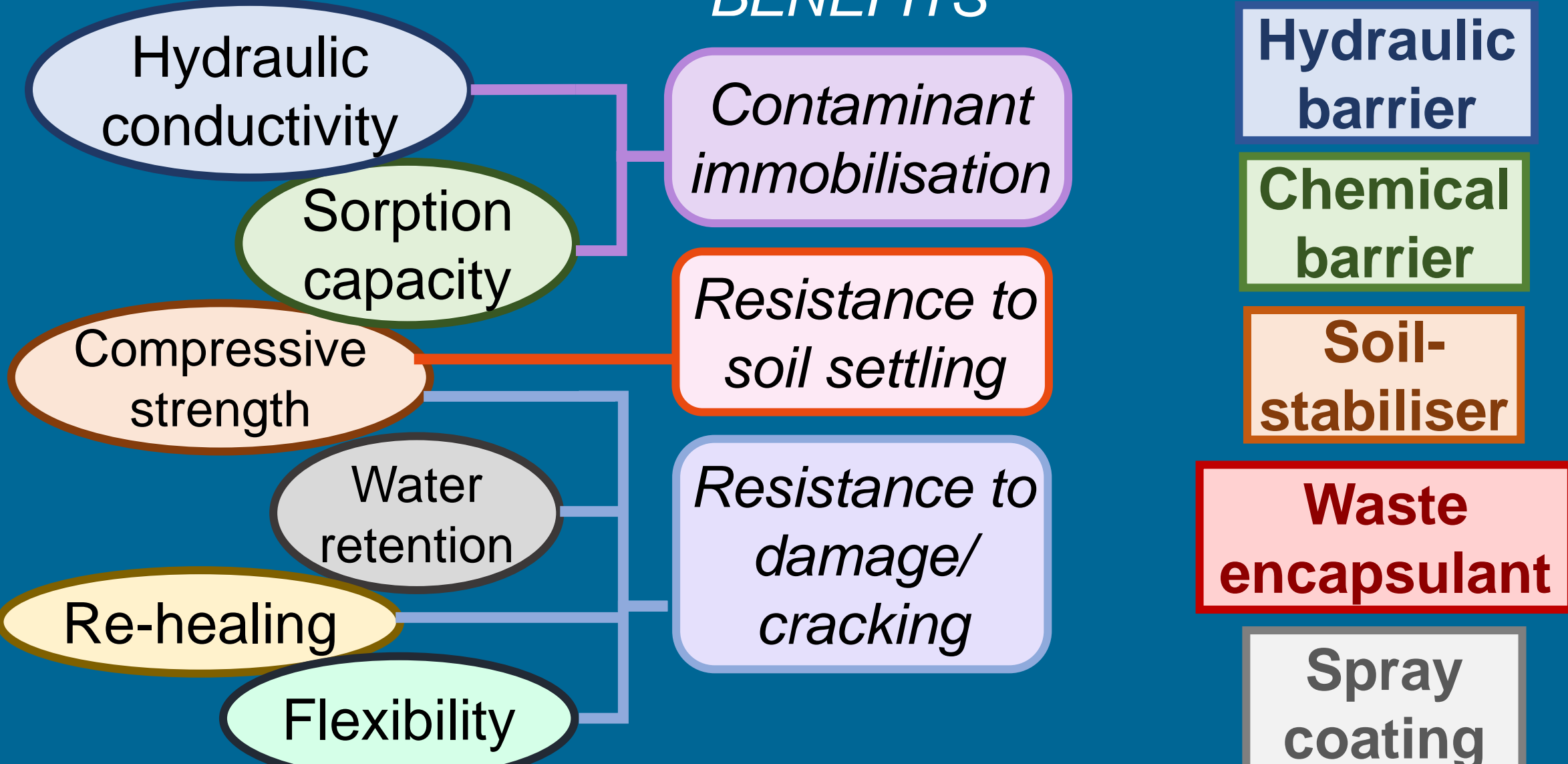


3. Experimental Methods & Results

ENHANCED PROPERTY

BENEFITS

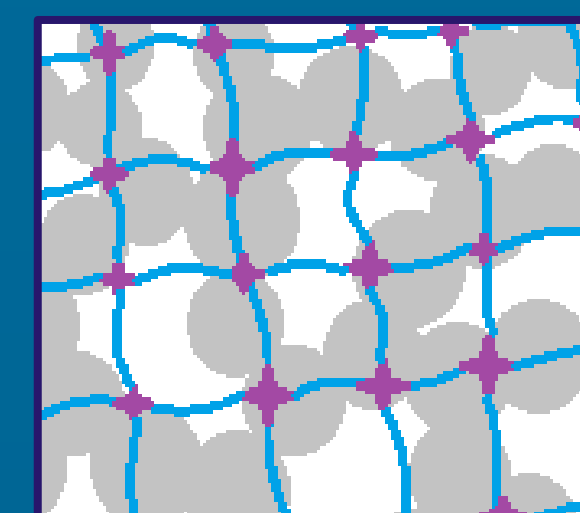
APPLICATIONS



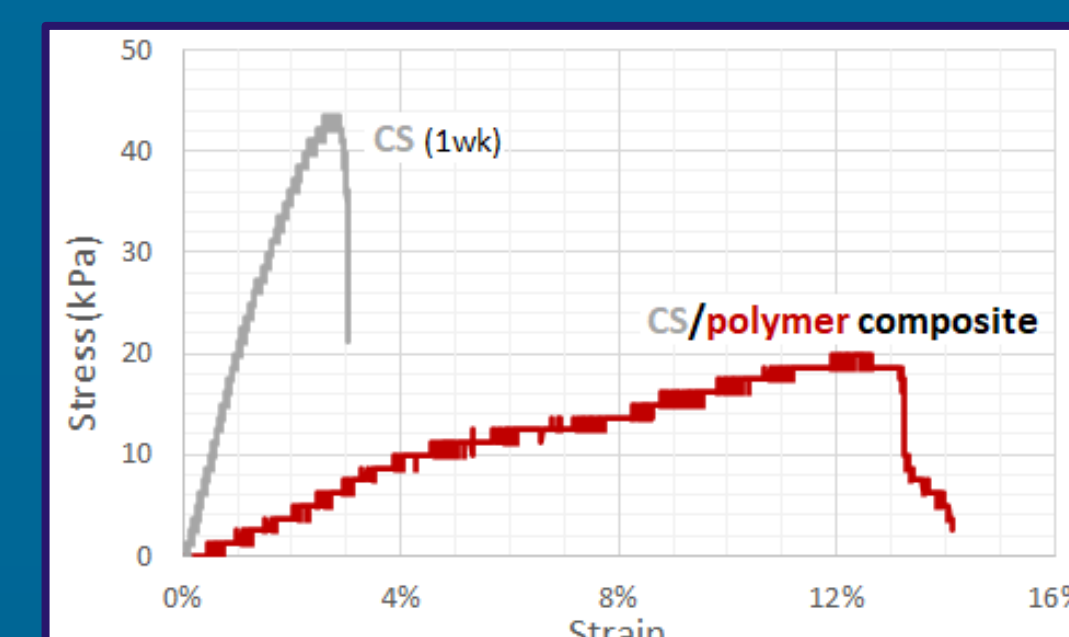
FLEXIBILITY

- Improved by combining with **polymer**
- Currently at the cost of strength

CS / polymer double network:



Compression tests:



Standard CS breaking:

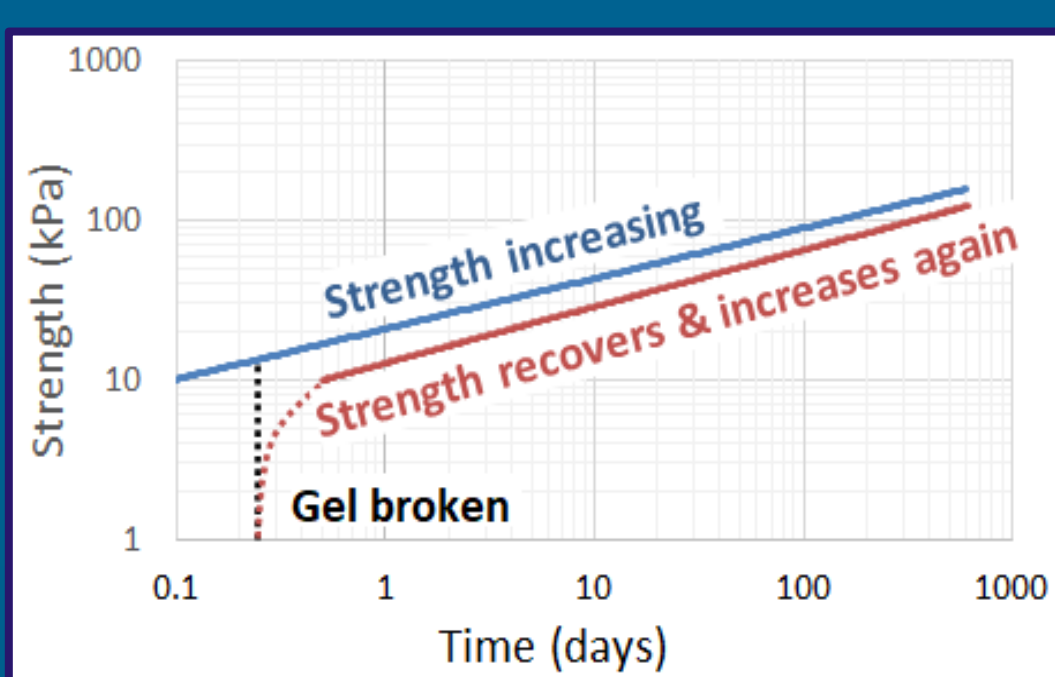
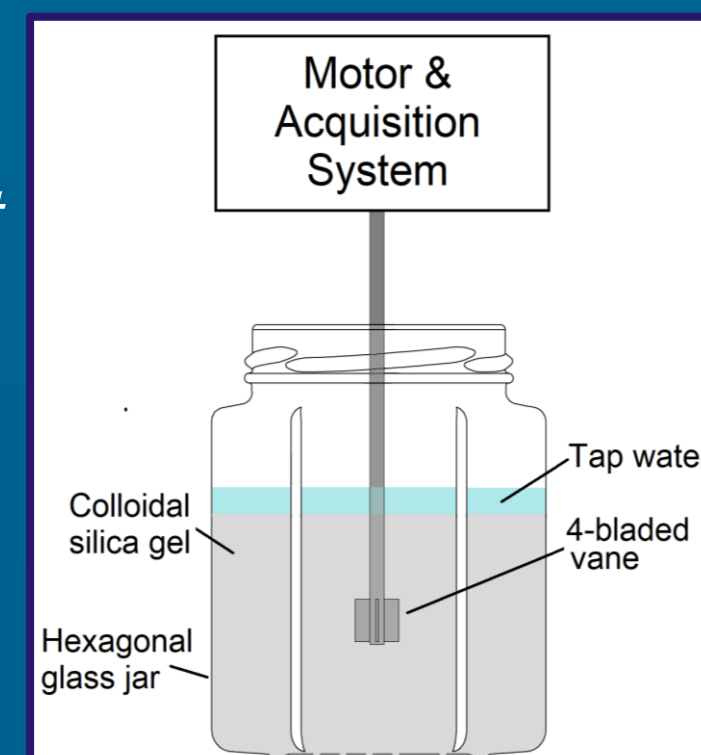


CS / polymer bending:

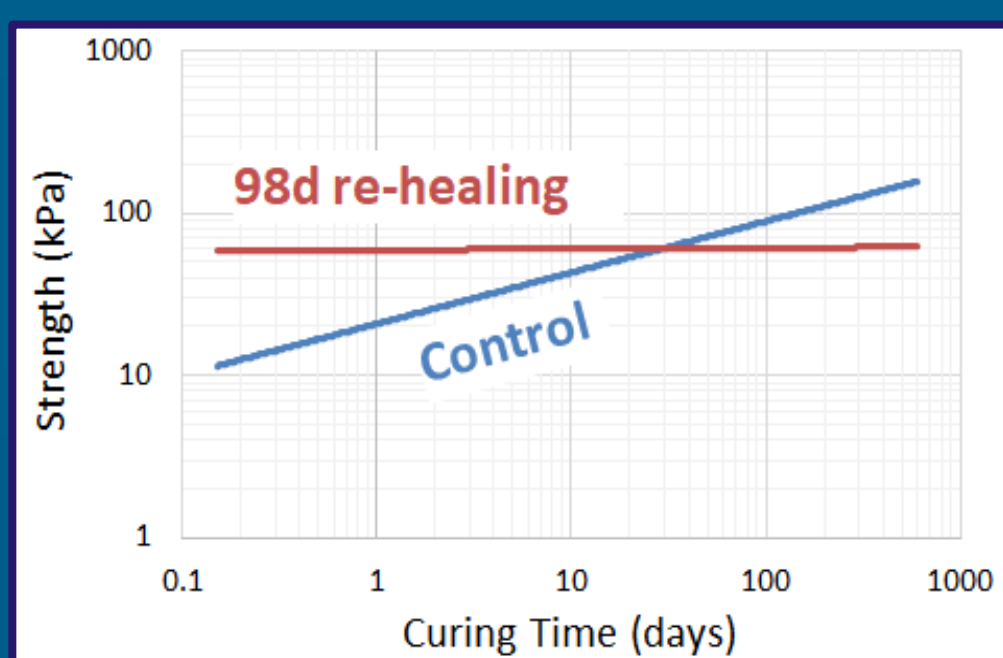


RE-HEALING

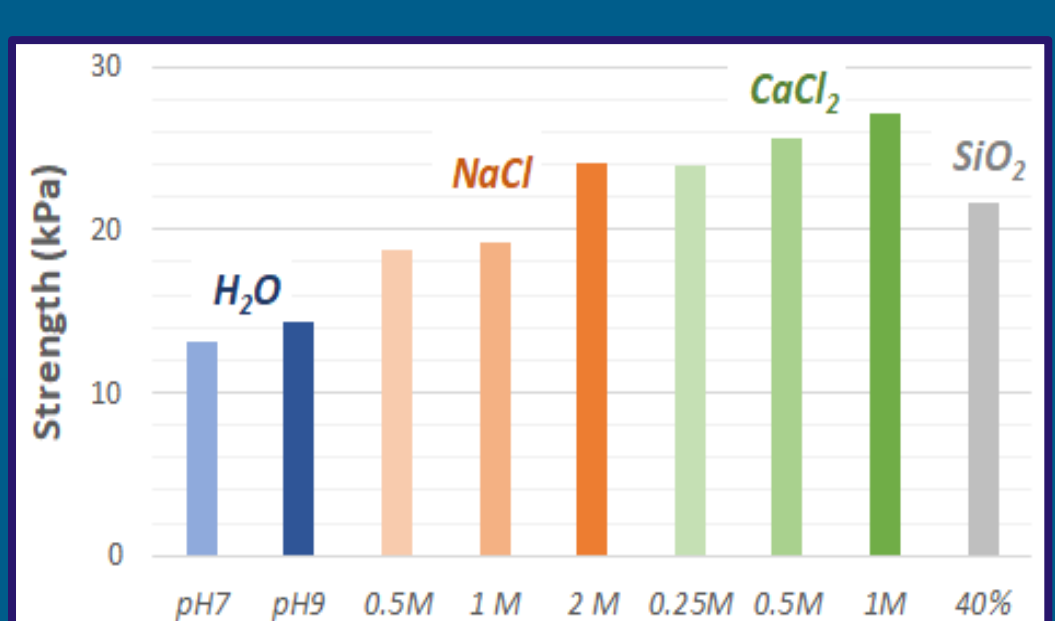
Shear vane test set-up:



• Longer healing gives greater strength recovery



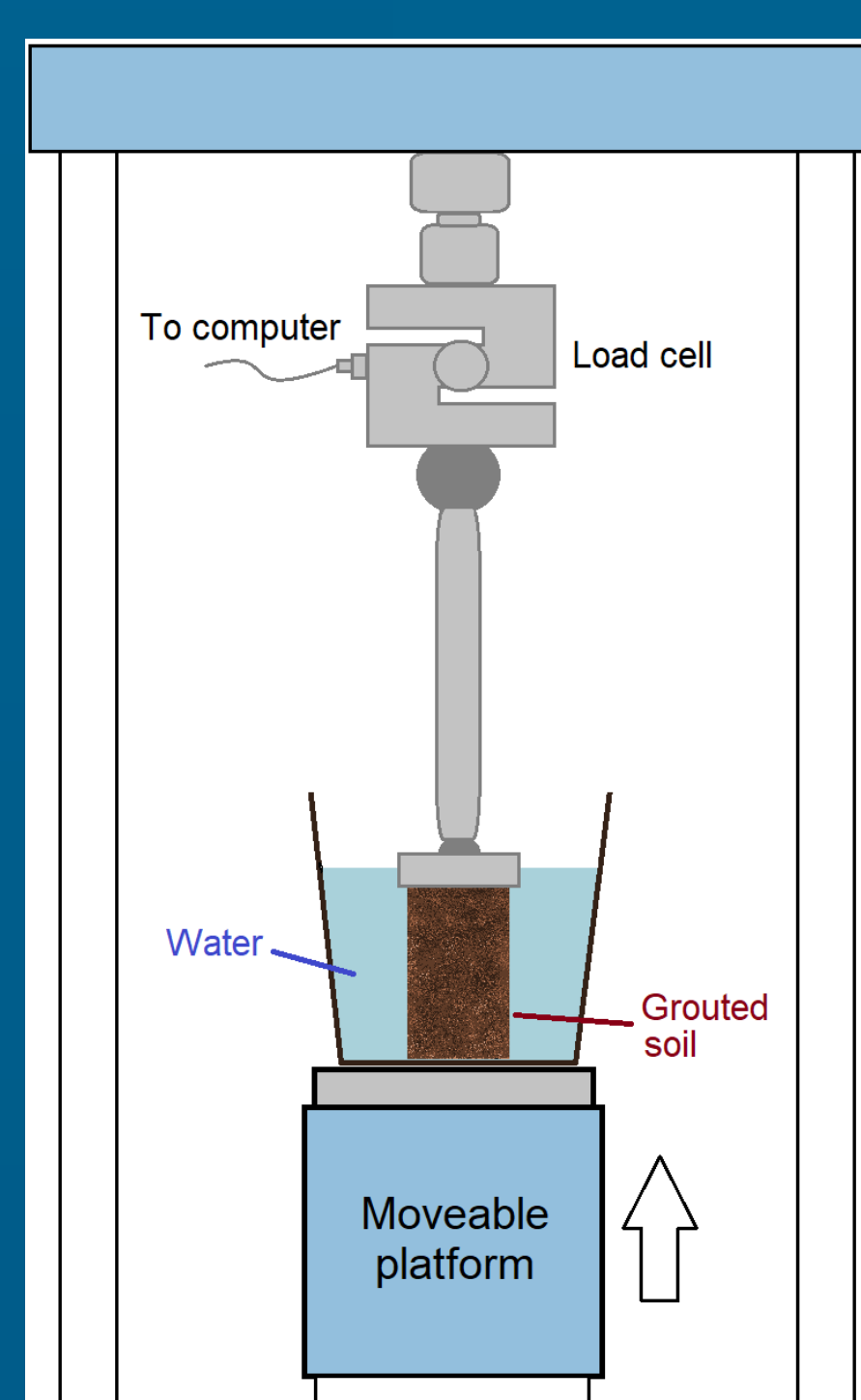
• Re-healing independent of curing time (time when broken)



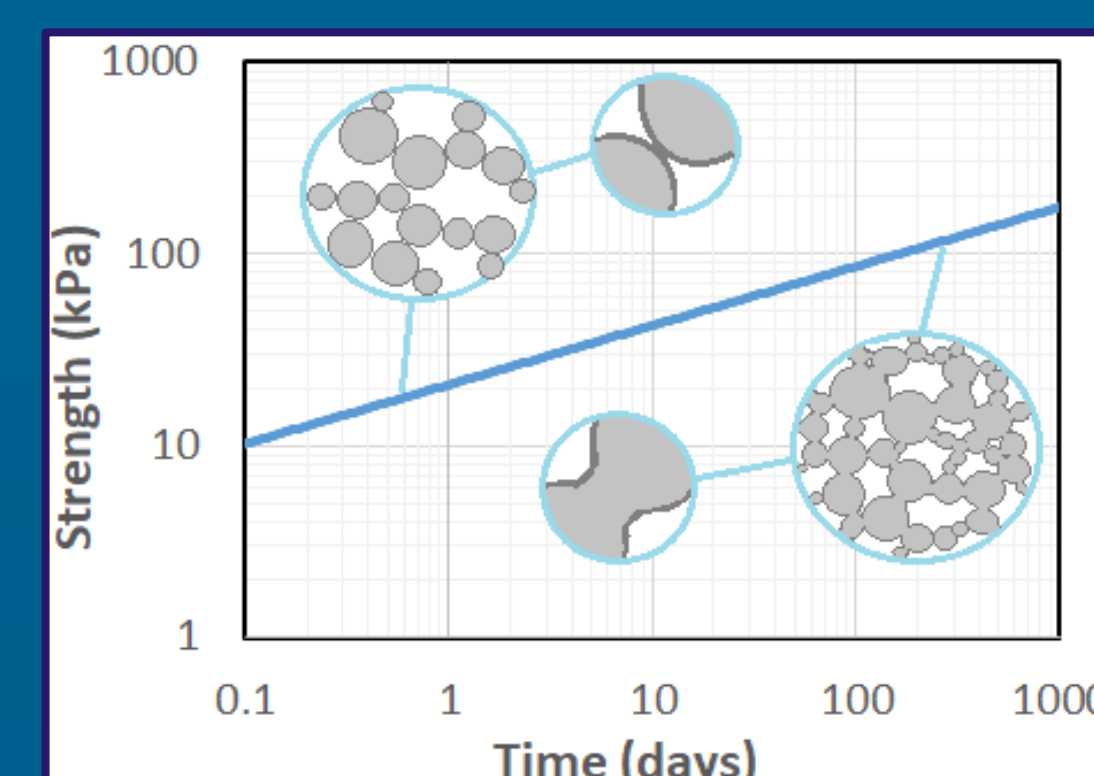
• Improved by raising pH, salt conc. & valency, and silica wt% in surrounding water

COMPRESSIVE STRENGTH

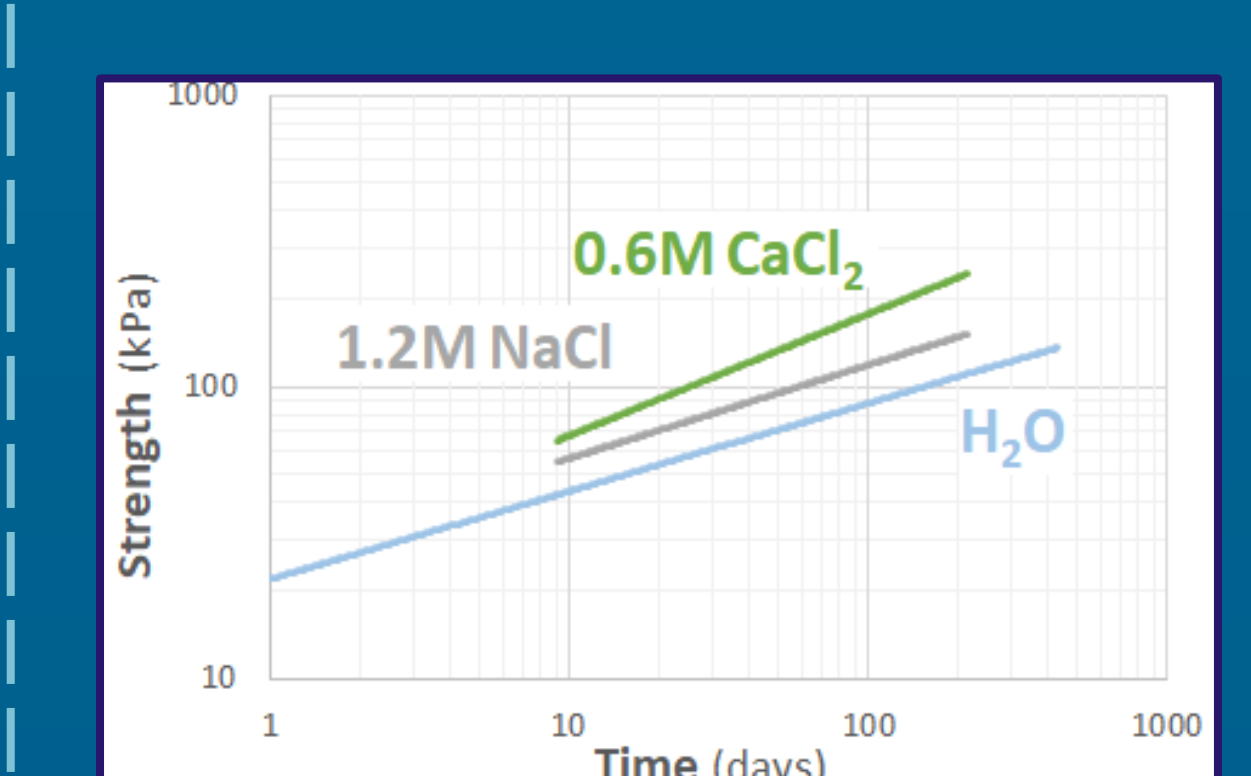
Compression test set-up:



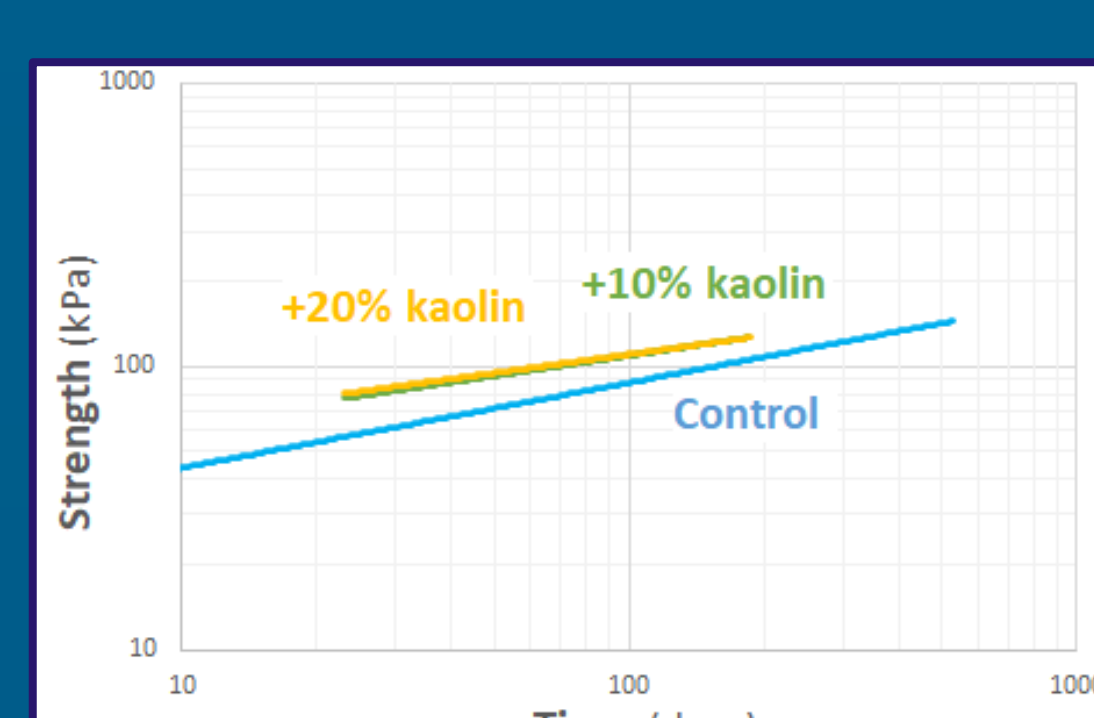
• Strength improves continuously as gel ages



• Improved by raising salt conc. & valency of surrounding water



• Improved by adding kaolin clay
• Partially replace silica to reduce cost



• Improved by faster gelation rates

