

# WP4

# **Structural Integrity**

**Theme Lead: Prof Becky Lunn**  
**University of Strathclyde**

# Three Work Packages

## **WP 4.3.1 Physical Ground Barriers for In Situ Contaminant Containment**

*Strathclyde*

***Resource: 1 PDRA, 1 PhD***

## **WP 4.3.2 Remote Crack Detection, Infrastructure Health Prediction and Building Preservation**

*Strathclyde*

***Resource: 3 PhDs***

## **WP 4.3.3 Development and Real-time Management of Autonomous Systems for Decommissioning**

*Stolkin (Birmingham), Lennox (Manchester)*

***Resources: 2 linked PhDs***

# Strathclyde Work Packages

***Becky Lunn, Hamilton, El Mountassir, Saafi,  
Tarantino, Yang, Renshaw and Lord  
(Strathclyde)***

Head of Department, Civil and Environmental  
Engineering, University of Strathclyde

Consortium Leader:

- SAFE Barriers – design of bespoke monitoring systems for engineered barriers in geological disposal (£1.3M, EPSRC)
- Biogeochemical Applications in Nuclear Decommissioning and Disposal (£1.9M, EPSRC)

CoRWM member



# Strathclyde Work Packages

*Lunn, **Andrea Hamilton**, El Mountassir,  
Saafi, Tarantino, Yang, Renshaw and Lord  
(Strathclyde)*

**Senior Lecturer**, Material Scientist

**Research interests:** Fracture formation in geomaterials and built environment remediation. Experimental chemo-mechanics; multi-scale strain from grain level to visible cracking; ultra long term mineral stability and dissolution kinetics; water transport modelling in composite building materials.

**Expertise:** wet cell AFM (including surface force measurements), synchrotron X-ray diffraction, colloid stability, water transport modelling.



# Strathclyde Work Packages

*Lunn, Hamilton, **Grainne El Mountassir**,  
Saafi, Tarantino, Yang, Renshaw and Lord  
(Strathclyde)*

**Lecturer:** Geotechnical Engineering

**Research interests:** Novel grouts,  
biomineralisation, unsaturated soils, ground  
improvement

**Expertise:** Experimental geotechnics,  
development of multidisciplinary technologies



# Strathclyde Work Packages

*Lunn, Hamilton, El Mountassir, Saafi,  
Tarantino, Yang, **Jo Renshaw** and Lord  
(Strathclyde)*



**Senior Lecturer (April 2014):** Environmental Radiochemistry

**Research interests:** Microbial transformations of radionuclides;  
biogeochemistry of radionuclides, metals and organic pollutants;  
bioremediation of contaminated land and groundwater

**Key Projects:** Mechanisms for the reduction of actinides and Tc(VII)  
in *Geobacter sulfurreducens* 2003-2005, US DOE  
AQUACOLL - Colloids in the natural aquatic environment: impacts on  
pathogens and pollutant fate and behaviour 2004-2009 EC  
Biogeochemical Applications in Nuclear Decommissioning and Waste  
Disposal (BANDD) 2009-2013, EPSRC

# Strathclyde Work Packages

*Lunn, Hamilton, El Mountassir, Saafi,  
Tarantino, Yang, Renshaw and **Richard Lord**  
(Strathclyde)*

**Senior Lecturer:** Geochemistry & geo-environmental engineering

**Research interests:** contaminated land remediation & hazardous waste processing (especially bioremediation, phytoremediation, reuse of waste, biomass & renewables)

Enterprise & KE: Director of KE for Department, KTP champion for Faculty, managed University business unit for 7 years

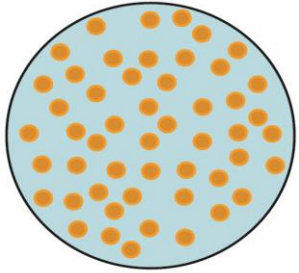




# WP 4.3.1 Physical Ground Barriers for In Situ Contaminant Containment

## Silica sol

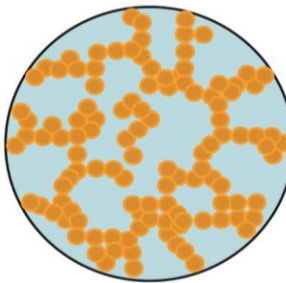
Liquid



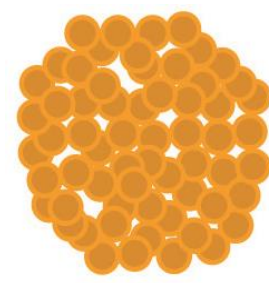
+ accelerator



Gelling



Gel



Stable dispersion of SiO<sub>2</sub>  
nanoparticles

Reduction in repulsion

Siloxane (Si-O-Si) bonds formed

BEFORE

AFTER!

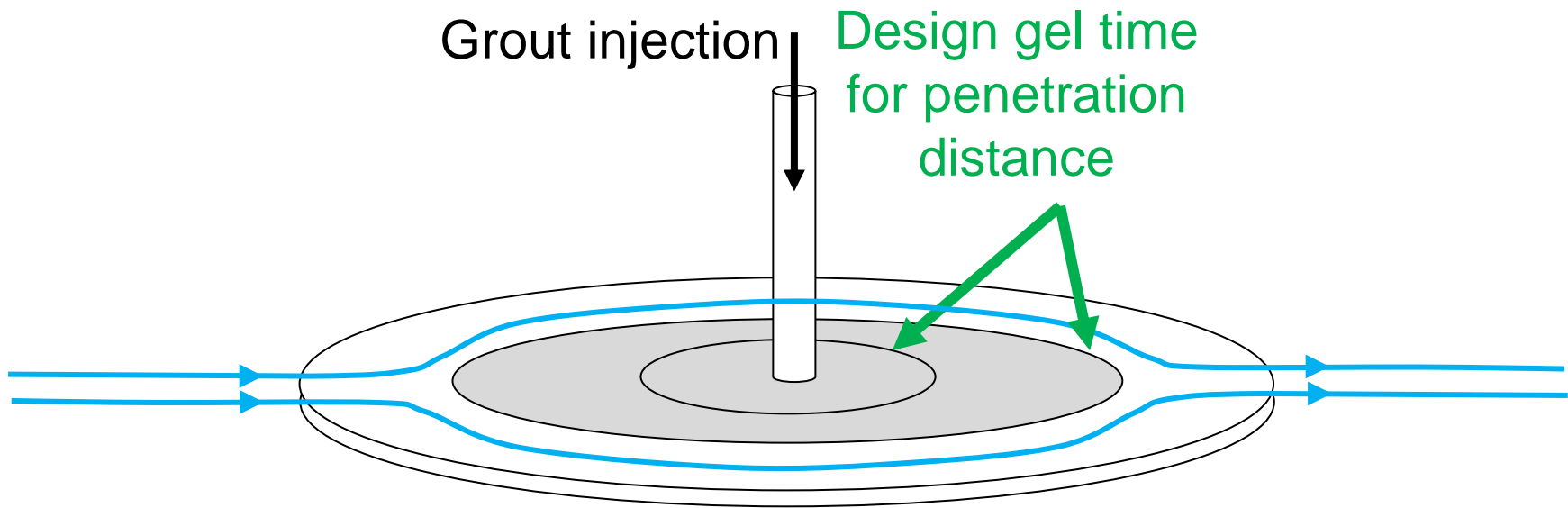


**Aim:** To develop hydraulic barriers that can be injected in low permeability sediments



## ***Challenges:***

- Groundwater will contain natural accelerators
- Can we design a horizontal barrier?
- Can we design a combined chemical/hydraulic barrier?



Desirable that the grout gains strength quickly i.e. has a high rate of gelation to minimise erosion of fresh grout by ingressing water

# WP 4.3.1 Physical Ground Barriers for In Situ Contaminant Containment

PDRA – Matteo Pedrotti, August 2014

Education:

- **M.Eng.** in Civil Engineering (2010)
- **PhD** in Civil and Environmental Engineering (2014?)



Research Interests:

- Particle interactions, Micro-to macro-behaviour, Measurement and control of soil suction, Experimental clay mechanics

PhD– Chris Wong, Started October 2013

- MEng Civil Engineering, Cardiff University

# Questions for industry partners

- What data are there on groundwater quality and sediment composition at Sellafield? Other sites?
- What is your ideal grouting scenario i.e. what would you would like to achieve with the barrier?
- What are the ideal scenarios in terms of waste and exposure?

# WP 4.3.2: Remote Crack Detection, Infrastructure Health Prediction and Building Preservation

Intelligent monitoring and preservation systems for management of concrete structures on nuclear sites.

- 2 PhD studentships: 1 EPSRC CASE, 1 Strathclyde.
- PhD 1, Water flow through complete, composite facades in concrete structures. Water transport modelling, measurement and CAD based project to determine how much water is moving through above ground structures at Sellafield, prediction of zones vulnerable to damage and remediation solutions.

Primary supervisor: Dr Andrea Hamilton

- Student: Riccardo Maddalena, civil engineer, started Jan 2014.

- PhD 2, Crack nucleation from long-term chemical alteration and attack in concrete.
  - Mainly laboratory based PhD (AFM imaging and surface force measurement) on ettringite formation/stability and CSH phase stability with crack formation modelling. Primary supervisors: Dr Andrea Hamilton/Dr Shangtong Yang.
- Studentship advertised.
  - To begin October 2014, would suit a student with a degree in chemistry, chemical engineering, environmental engineering.
- Have won some additional support (£28k) to fund 50% of a PhD on retrofitting sensor development and we are looking for industrial sponsors and buildings to retrofit

# **WP 4.3.3 Development and Real-time Management of Autonomous Systems for Decommissioning**

Two linked PhD projects at Birmingham and Manchester

- (1) Novel remote material characterization technologies in extreme radiation environments
- (2) The real-time on-site management of autonomous systems with improved control systems.