

The Design, Implementation and Evaluation
of an Artificial Fracture Database for the
BELBaR Project

and Benchmark Test Results

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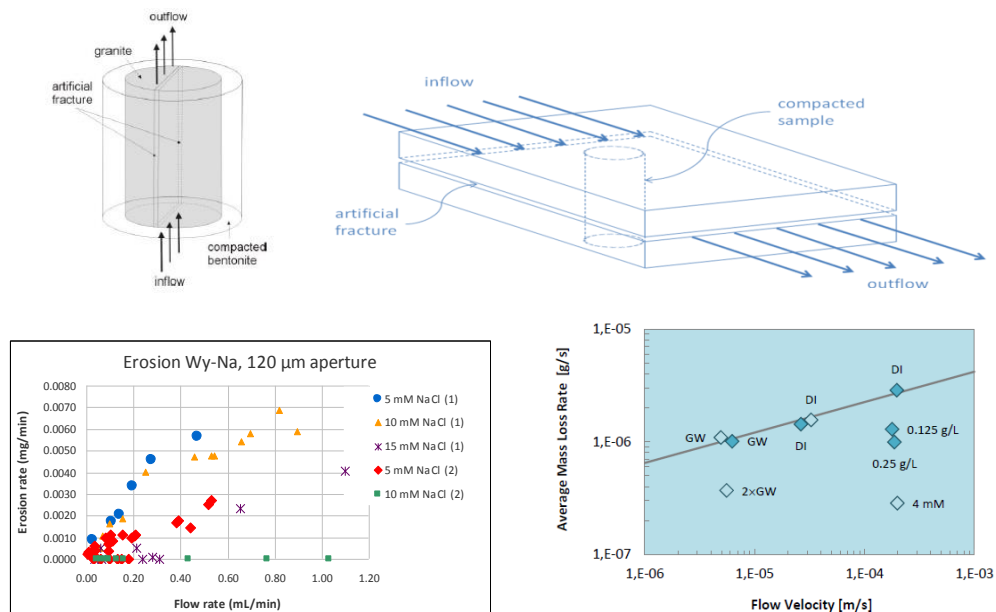
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WP2 Objectives

- ❑ “to understand the main mechanisms of erosion of clay particles from the bentonite surface and to quantify the (maximum) extent of the possible erosion under different physico-chemical conditions”
- ❑ “the joint analysis of laboratory studies from WP2 represents a good starting point for providing realistic inputs for the models used in the performance assessment of High Level Radioactive Waste (HLRW) repositories”

Joint Analysis

- At this stage of the BELBaR Project numerous erosion experiments have been carried out by the participants of WP2 leading to a large dataset on the erosion behavior of buffer materials.



Comparative Analysis

- ❑ Before being usable for any kind of comparative analysis, the original, raw erosion data needs (at a minimum) to be aggregated and possibly reduced.
- This goal can be accomplished by establishing a database of WP2 erosion experiment results.
- ❑ The database structure can be designed so that raw data or information is collected under a set of metadata describing the data characteristics and set of relationships linking the data within the database.
- The metadata should identify those aspects of the data that are potentially relevant itself but also to facilitating comparisons between different experiments.

Metadata and related Raw Data

- ❑ **Sample**
 - material (including source and any pretreatment or purification procedures)
 - initial density and water content
 - Initial size

- ❑ **Solution**
 - chemistry
 - flow velocity (documenting if multiple)
 - duration of flow regime(s)

- ❑ **Environment**
 - extrusion space (nature, i.e., fracture or otherwise, and dimensions)
 - aperture (or size)
 - position (slope angle, etc.)

- ❑ **Results**
 - extrusion distance (transient data)
 - mass loss (transient data)

- ❑ **Other**
 - ?

Example Database



BELBaR Project Artificial Fracture Database v1

Questions for you

- Is anything missing from the database (i.e., metadata, raw data)?
- Is the format of the database acceptable (excel worksheet)?
- How can the database be most effectively made accesible to both providers and end users (i.e. where hosted, etc.)?

BELBaR Benchmark Tests

- ❑ **Material**
 - Nanocor Montmorillonite (PGN grade)
 - 20 × 20 mm dimensions (cylinder)
 - 1400 kg/m³ (dry density)

- ❑ **Fracture**
 - 0.1 mm aperture
 - 24 × 24 cm (*B+Tech*)

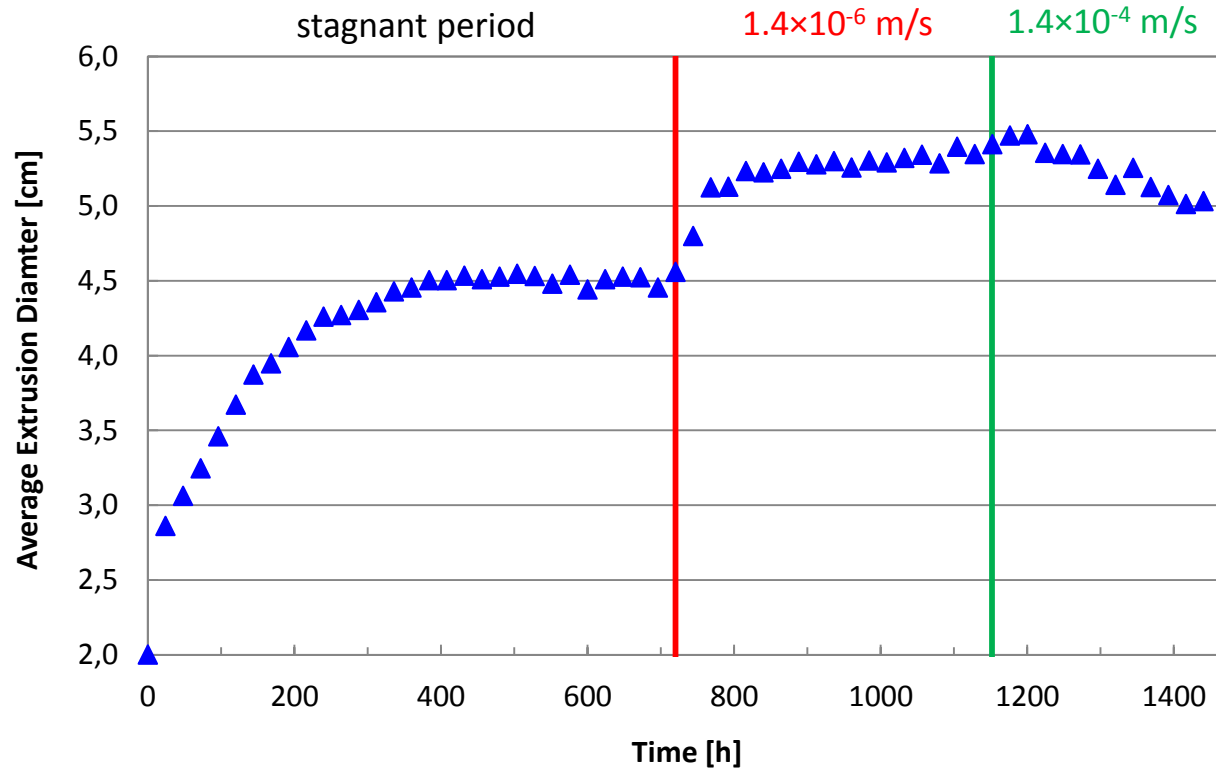
- ❑ **Solution and Flow**
 - 1 mM NaCl
 - 30 days stagnant
 - 14 days at 10⁻⁶ m/s (*18 days at 1.4 × 10⁻⁶ m/s*)
 - 14 days at 10⁻⁴ m/s (*1.4 × 10⁻⁴ m/s*)

- ❑ **Measurements**
 - extrusion distance
 - effluent mass loss

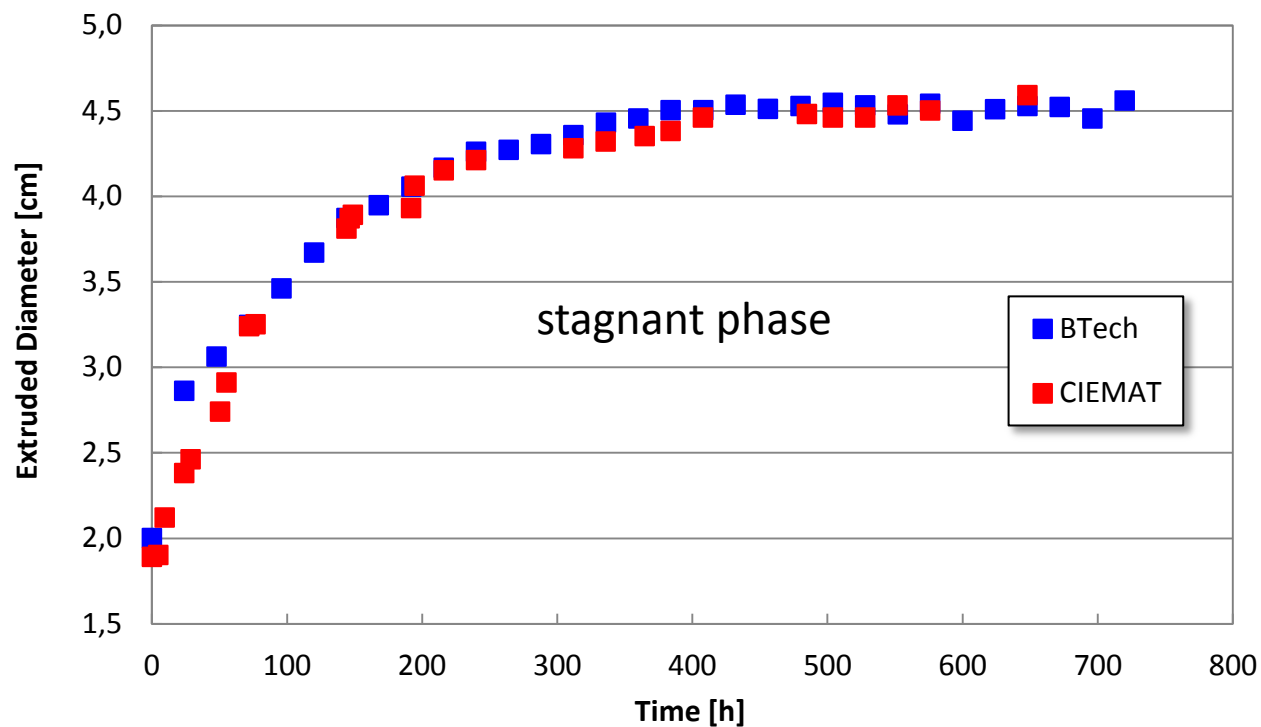
BELBaR Benchmark Test at B+Tech



Extrusion Behavior

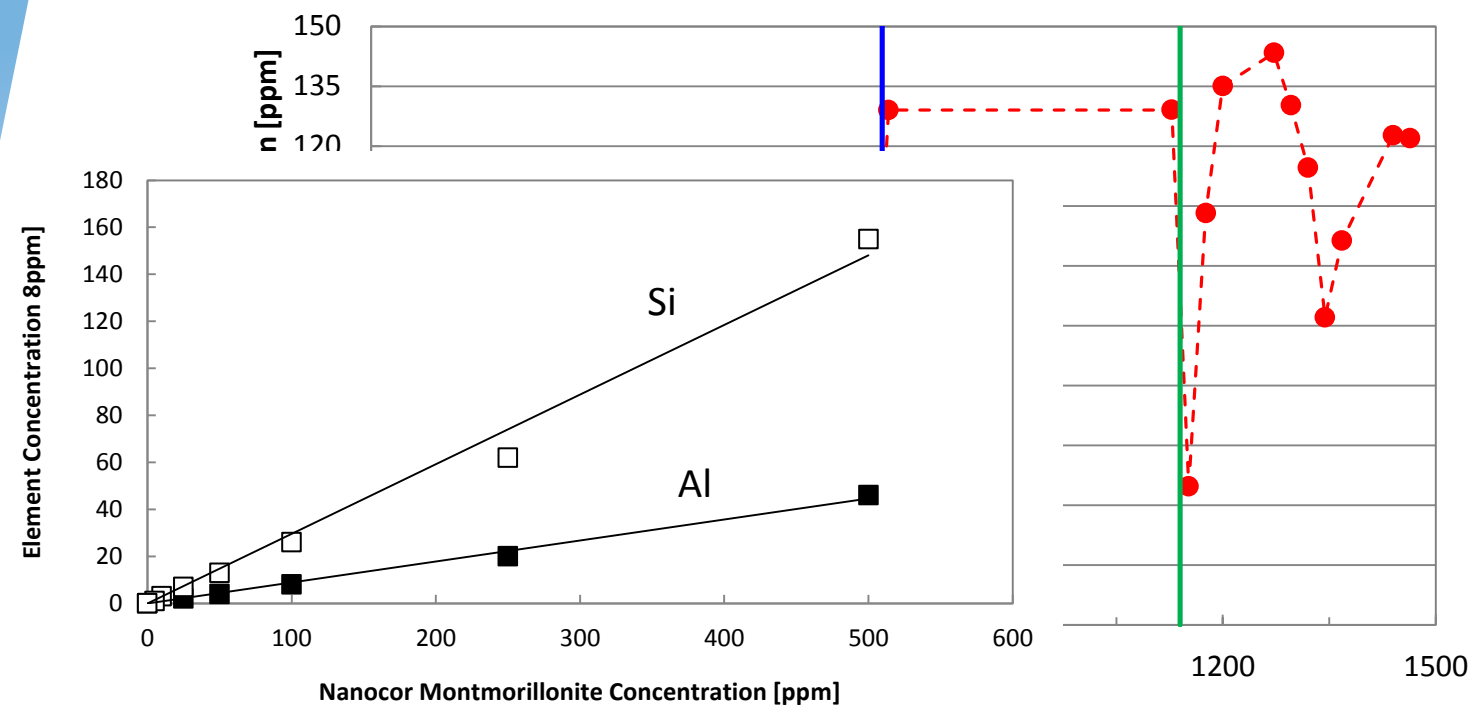


Extrusion Data Comparison



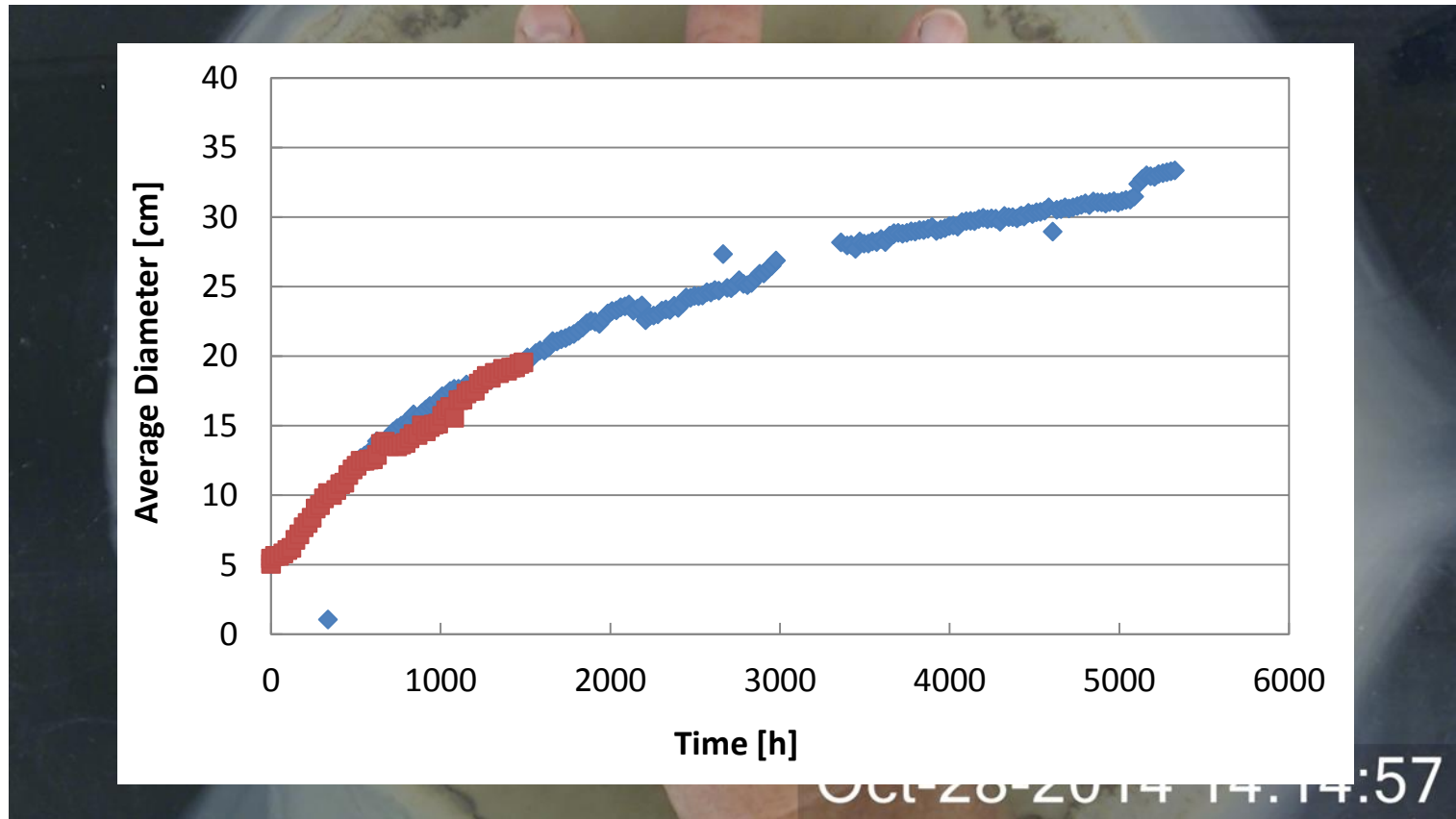
- ❑ **Emplaced montmorillonite masses were not equivalent between the two tests.**

Effluent Mass



- ❑ Rate of mass loss during high-flow period nearly order of magnitude lower than those observed under similarly dilute conditions in 1 mm aperture fracture.

Scaling



- ❑ Extrusion distance scales as sample circular area.