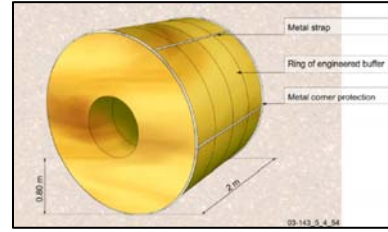


### CONTEXT

The European Research Project **ESDRED** (Engineering Studies and Demonstrations of Repository Designs) aims at demonstrating the technical feasibility of key components applicable to various underground radioactive-waste repository concepts. This ESDRED Project is supported by the European Commission via the SP6 Program. The ESDRED Project is composed of four technical modules and three functional modules. Module 1 deals with **Buffer Construction in Horizontal Drifts**. The objective of ANDRA within module 1 is to design fabricate and test, for demonstration purposes, buffer rings. The "buffer" is a man-made layer of clay material designed to surround the radioactive-waste canister and contributes to the long-term safety of the repository. The French National Radioactive Waste Management Agency (**ANDRA**) hired a pool of other organisations, including the French Atomic Energy Commission (**CEA**) and two French companies, **MPC** and **SEGULA Ingénierie** with a view to manufacturing and testing the rings. In that context, the CEA Study Laboratory on the Behaviour of Concretes and Clays (**LECB**) of SACLAY was in charge of defining and characterising a suitable swelling-clay material (bentonite) capable of fulfilling very precise specifications. The buffer, in ANDRA's concept, is a prefabricated ring containing a mixture of swelling clay and sand.



### Specifications

#### Thermal parameters

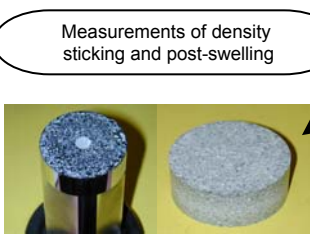
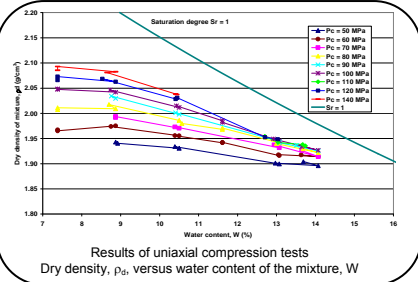
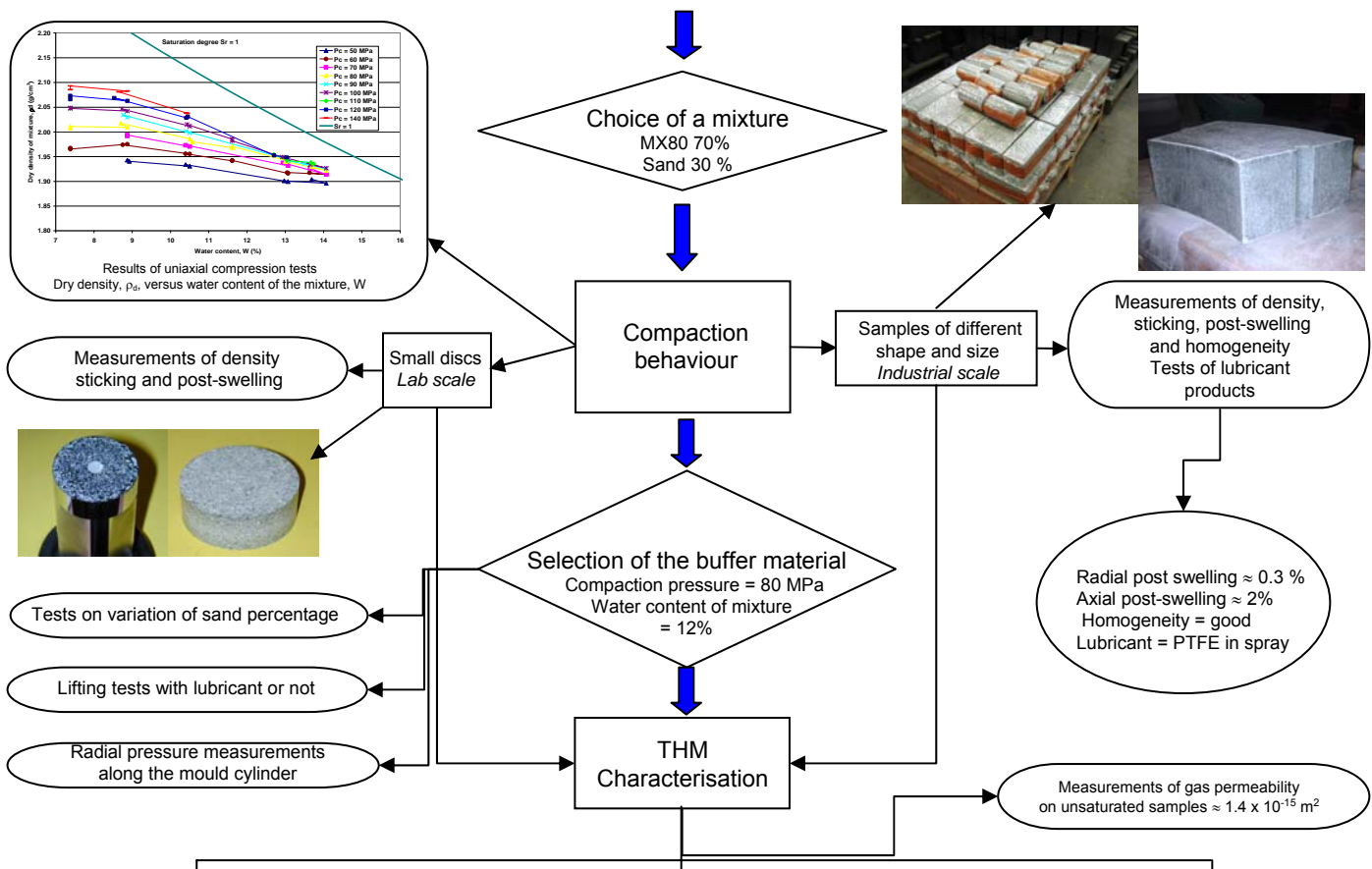
Initial Thermal Conductivity > 1.2 W/(m.K)

#### Hydraulic parameters

Hydraulic Conductivity  $\leq 10^{-12}$  m/s  
Residual Swelling Pressure at saturation  $\geq 0.5$  MPa and  $\leq 7$  MPa

#### Mechanical parameters

Unconfined Compressive Strength  $\approx 9$ MPa  
Tensile strength  $\approx 1$  MPa



- Measurements of density sticking and post-swelling
- Tests on variation of sand percentage
- Lifting tests with lubricant or not
- Radial pressure measurements along the mould cylinder



- Measurements of density, sticking, post-swelling and homogeneity
- Tests of lubricant products
- Radial post swelling  $\approx 0.3\%$
- Axial post-swelling  $\approx 2\%$
- Homogeneity = good
- Lubricant = PTFE in spray
- Measurements of gas permeability on unsaturated samples  $\approx 1.4 \times 10^{-15} \text{ m}^2$

**Thermal parameters**  
Thermal conductivity = 1.56 W/(m.K)

**Hydraulic parameters**  
Swelling pressure at constant volume = 28 MPa  
Swelling pressure with a 20% volume expansion = 2.0 MPa  
Hydraulic conductivity at constant volume  $\approx 8 \times 10^{-15}$  m/s  
Hydraulic conductivity with a 15% volume expansion  $\approx 10^{-13}$  m/s

**Mechanical parameters**  
Compressive strength  $\approx 8$  MPa  
Tensile strength  $\approx 0.9$  MPa  
Young modulus  $\approx 1.3$  GPa  
Poisson ratio  $\approx 0.15$

