Cement Working Group

IGD-TP Exchange Forum
Prague
29-30 Oct. 2013

Rapporteurs

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Objectives

- The purpose of the Working Group sessions at the EF is to
  - Bring forward new projects in a bottom-up approach in the framework of the deployment of activities described in the Strategic Research Agenda and Deployment Plan
  - Help in preparing for future projects, calls etc. and also in initiating or further deepening contacts between research organizations, waste producers and Waste Management Organizations

Background (1)

- The SRA and the Deployment Plan for the IGD-TP refer to topics under WP2 and WP3 that are related to cement interactions within repository systems. These include
  - Topic 1.1 Increase confidence in and testing and further refinement of tools used in SA
  - Topic 2.2 Release from ILW and their detailed characterisation
  - Topic 3.10 Long term behaviour of seals and plugs
  - Topic 3.11 Evolution of cement based seals
  - Topic 3.12 Interaction of cement with clays
  - Topic 3.13 Optimisation of low pH cements
- The Deployment Plan (D1.5 June 2013) – p. 29
  - Refers to SRA Topic 1.1
    - Notes the interest in supporting understanding of cement-clay interactions to provide a foundation for SA models

Background (2)

- At the IGD-TP Exchange Forum in Nov. 2012, a presentation was made regarding interest in a TSWG on cement (CEBAMA).
- The Executive Group of the IGD-TP in Feb. 2013 requested that the WMOs be surveyed to determine their needs regarding studies on cement materials interactions in support of long-term safety.
- Responses were obtained from ANDRA, NDA, SKB, POSIVA, SURAO, NAGRA, ONDRAF/NIRAS
- A further discussion of CEBAMA took place at the Ghent Cement-Waste Workshop. There was broad interest from specialists in initiating a project. From the WMO's perspective, there was no consensus on how to move forward.
- WMO representatives had a further discussion on 11 Sept. 2013 on the question of areas of common interest.

Our task

- To determine the potential scope for future joint studies on cement materials interactions with other repository components, based on
  - Input from WMOs in relation to their needs – the emphasis is on long-term performance rather than engineering aspects
  - Input from technical presentations in relevant areas
  - A round table discussion of the link between work areas and the SRA and DP (tomorrow 0900 – 1030)
- Prepare a brief presentation (tomorrow 1030 -1200) on the potential way forward for the Plenary Session 3 on Oct. 30

Today's agenda

14:00 Introduction

14:10 Discussion of commonalities & differences among WMO interests (L. Johnson)

14:20 Results and future plan of RWMC's R&D regarding cement-bentonite interaction (H. Owada)

14:40 How do we treat cement in performance assessment? (F. Neall)

15:00 Thermodynamics and modelling (L. Duro)

15:20 Radionuclide retention and redox conditions (M. Altmaier)

15:40 Coffee break

16:15 Cementitious materials: state of the art (X. Bourbon)

16:35 Status of the proposed CEBAMA project (B. Kienzler)

16:55 Immobilisation of radionuclides by a cementitious backfill (D. Read)

17:15 Discussion

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Commonalities & differences among WMO interests

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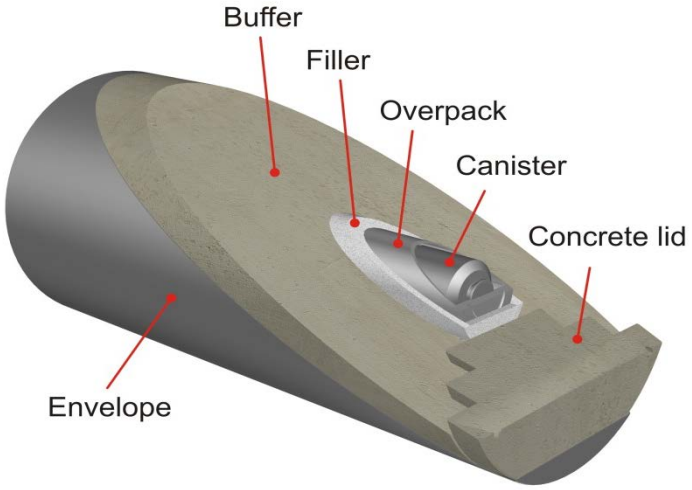
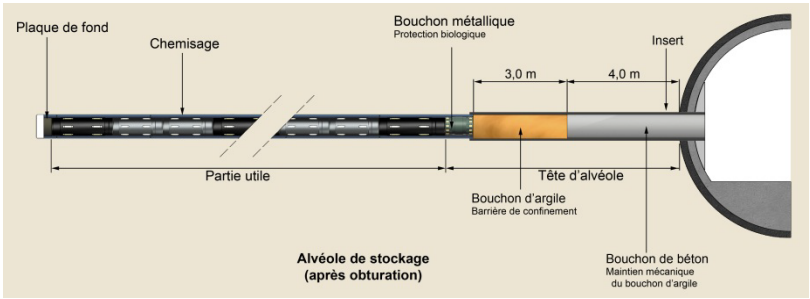
Cements in SF/HLW repository applications

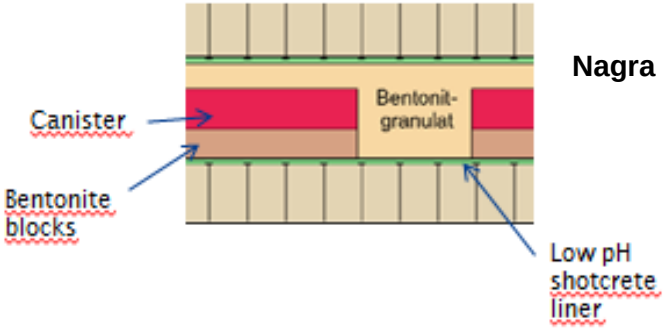
- Most SF/HLW disposal concepts do not use cements in EBS
  - Exceptions are ONDRA (concrete Supercontainer concept) and Nagra (low pH concrete liner for SF/HLW emplacement tunnels)
  - But concrete plugs for access tunnels are widely used in crystalline and clay rock concepts and grouts will also be used
- Relevant interactions involving cements include cement-bentonite interactions, cement-rock interactions, RN sorption, steel corrosion (ONDRAF-NIRAS)



ONDRAF-NIRAS



Andra



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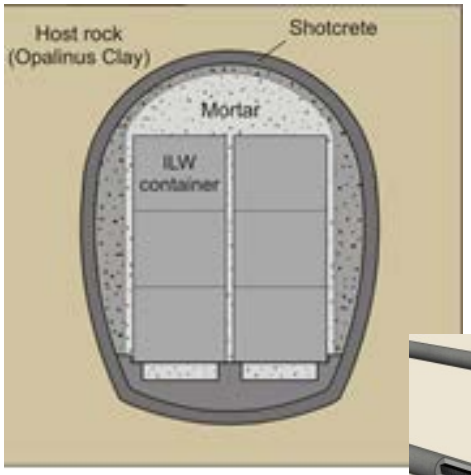
Cements in ILW repository applications

- Cementitious materials are used in waste solidification, emplacement containers (boxes), mortar backfill, shotcrete liner and access way plugs
- Relevant interactions are cement-rock and cement-clay interactions (chemical and hydraulic), RN release and sorption, metal corrosion,



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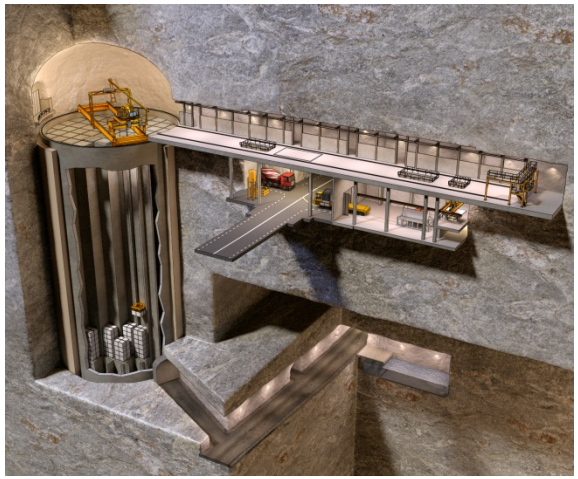
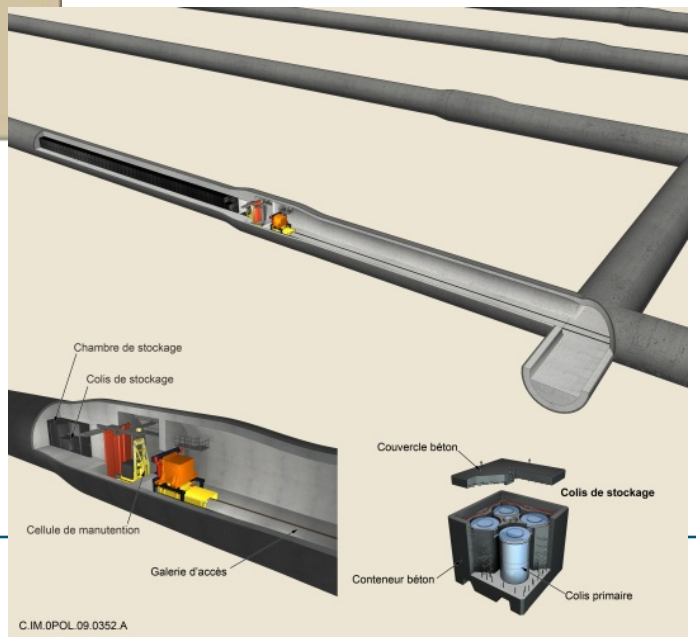
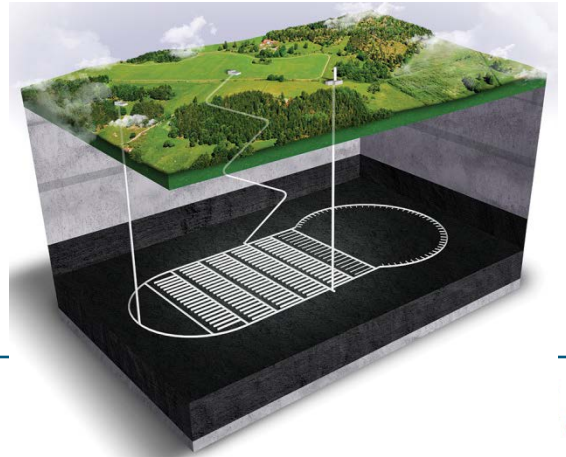
SKB





Andra



COVRA

Summary table based on responses from WMOs to questionnaire of Mar. 2013

Repository System	ANDRA	Ondraf/Niras	Posiva	SKB	SURAO	Nagra	NDA
SF/HLW	-	OPC Porosity and permeability changes due to Cement - rock interaction Corrosion - gas THMC behaviour of concrete buffer RN retention Glass – cement interaction	Low pH grout Cement-bentonite interaction Cement-Canister interaction Porosity and permeability changes due to Cement - rock interaction	-	(low pH cement)	Low pH cement (rock support) Cement - bentonite interaction Porosity and permeability changes due to Cement - rock interaction	Alteration of cements at high temperature
I/ILW	OPC Low pH cement (vitrified ILW, seals) Chemical evolution RN retention Organics-cement interaction Corrosion - Cement MC-coupling (performance of seals)	Porosity and permeability changes due to Cement - rock interaction Bituminised waste Biodegradation of organics → cement carbonation RN retention Gas generation → design measures for non-disruptive gas release	-	RN retention Organics-cement (degradation products of organics/ additives → complexing agents) Gas issues (^{14}C) Corrosion products - cement interaction Porosity and permeability changes due to Cement - rock interaction (Cement - benonite interaction)	RN retention	OPC Cement - waste package corrosion High pH on organic waste Porosity and permeability changes due to Cement - rock interaction Cement - bentonite interaction (engineered gas release system) RN retention	Waste – cement interaction RN retention Glass cement interaction Porosity – permeability changes due to groundwater interaction (sufates, Mg, CO3, …) Corrosion of ductile cast iron

Summary (1)

- Priorities vary among WMOs – hardly surprising
- The main themes based on a discussion of 11 Sept. 2013 (greatest commonality):
  - Interface reactions: porosity/permeability changes – related to
    - Topic 1 (p. 27 of SRA) – testing of materials interaction models for PA – high priority
    - Topics 3.10, 3.11, 3.12 (p. 32 of the SRA) – modelling of long-term behaviour of seals and plugs and associated HMC processes – high priority topic
  - Low pH cements
    - Topic 3.13 of the SRA (p. 32 of the SRA) – medium priority topic
  - RN retention in ILW
    - Topic 2.2 (p. 28 of the SRA) – high priority topic
  - Corrosion and gas generation in cement (not in SRA; relevant, but the WMOs have a lot of information already)

Summary (2)

- Other themes (lower degree of commonality)
  - Organics in cement – degradation and impacts
  - Cement at higher temperatures (ONDRAF)
  - Cement/glass interactions (Andra and ONDRAF)
  - THMC of concrete buffer (ONDRAF)

thank you
for your attention

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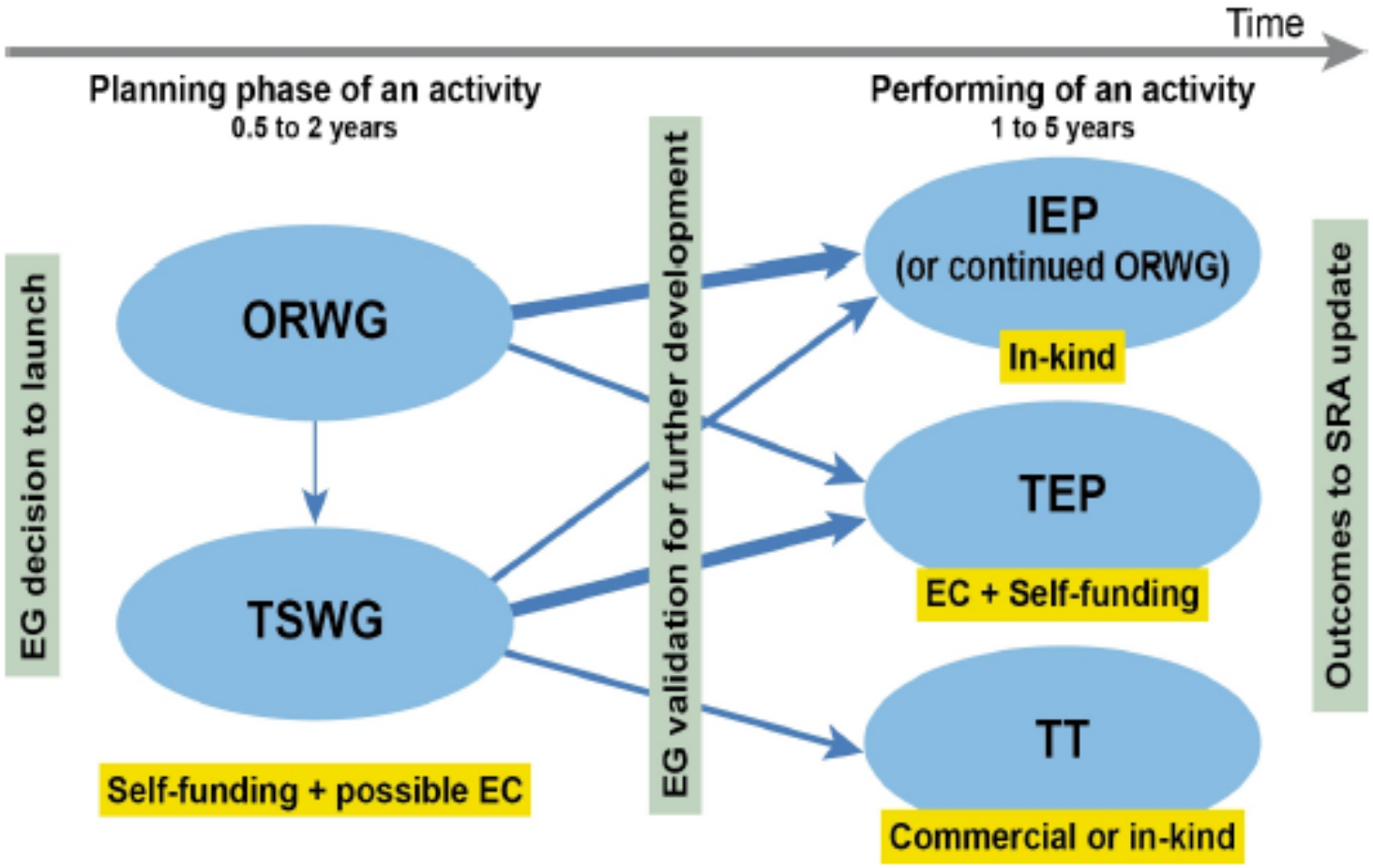
Approaches for IGD-TP activities



Focusing work

- Criteria for developing a cement materials project
  - Driven by WMO priorities
    - Implementation oriented work
    - Derived broadly from SRA – consider importance and urgency
    - Will support licensing
    - Materials interaction focus (not engineering) – request from EG
  - Focused on a few key areas (not everything, to avoid dilution)
  - Broad interest from WMOs (at least most)
  - Bring in institutes and universities
  - Could lead to both
    - An EU project areas of work)
    - An information exchange (other areas of work)