MIND

Microbiology In Nuclear waste Disposal

This project has received funding from the Euratom research and training programme 2014 - 2018 under grant agreement No. 661880

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THE MIND CONSORTIUM

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PRAGUE, CZECH REPUBLIC OCTOBER 29-30, 2013

A technical scientific work group session on microbiological processes was organized at IGD-TP, EF4

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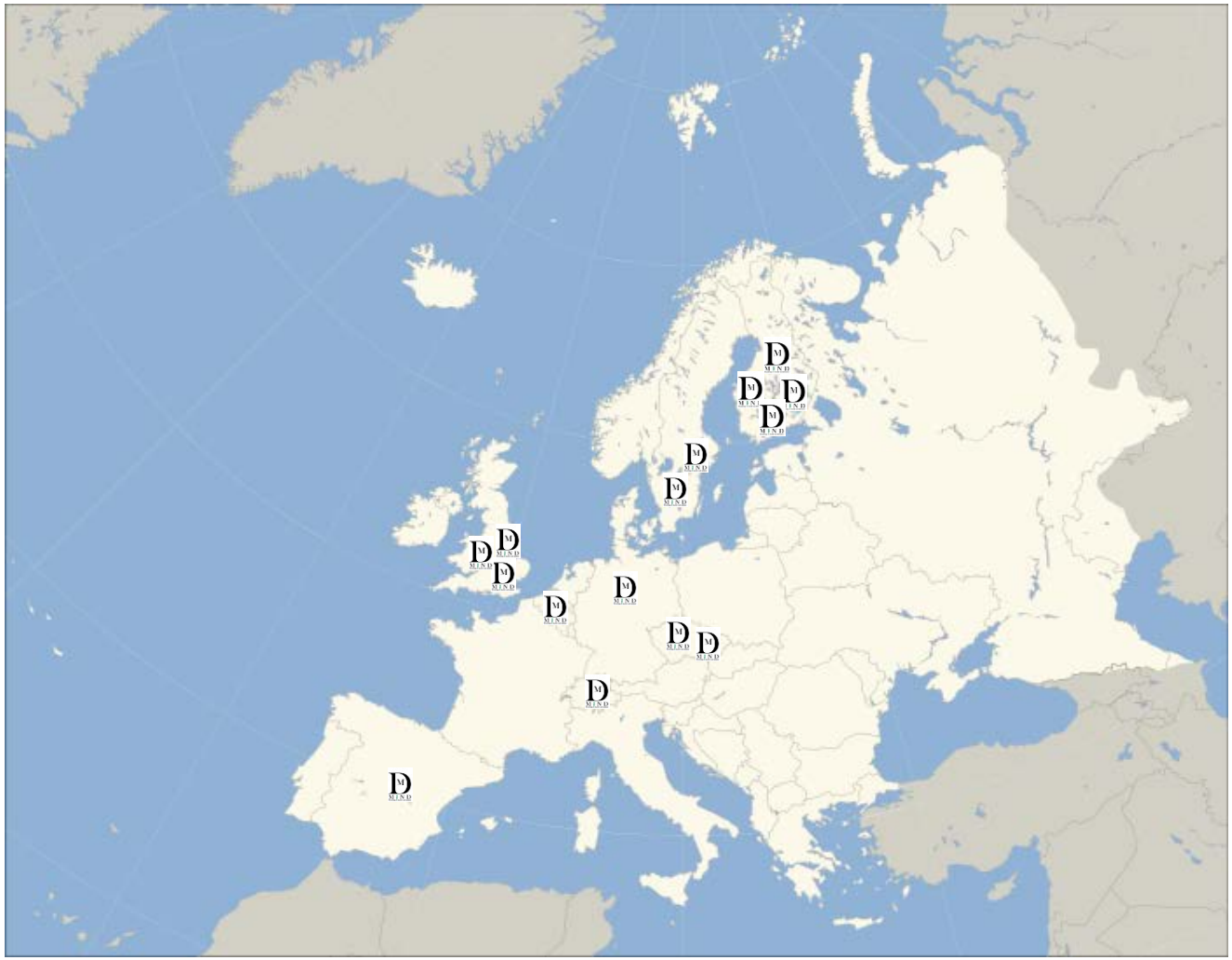
MIND CONSORTIUM DESCRIPTION

Participants from: research, performance assessment, social science

Gender perspective: ~50/50

8 countries represented



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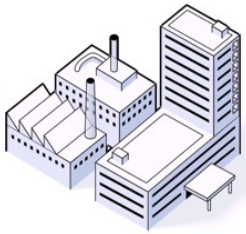
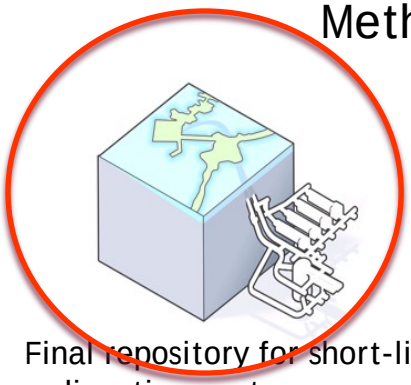
WHERE ARE THE MICROBES?

Methanogens

Final repository for LLW and ILW

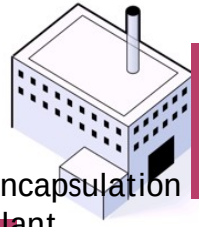


Medical care, industry and research



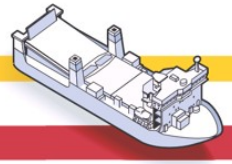
Final repository for short-lived radioactive waste

There are about 1 million and 1000 millions of cells per liter groundwater in the rock.



Encapsulation plant

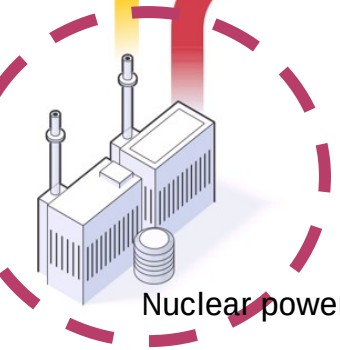
About 2 million SRB/ m^3 will be introduced with the buffer



There are even microbes growing on the fuel in the interim storages.

Central interim storage for spent nuclear fuel (Clab)

Final repository for spent nuclear fuel



Nuclear power plant

Sulphate reducing bacteria

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MAIN MICROBIAL PROCESSES

- Microbially induced degradation
  - Corrosion of metal canisters
  - Degradation of buffer, backfill and cement
- Gases
  - Production –
  - Consumption +
- Migration
  - Mobilisation –
  - Immobilisation +

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WORK PACKAGES

- ***Work Package 1*** *~ILW*

  → Key Topic 2: "Waste forms and their behaviour"

  → Lead: NNL (UK, Joe Small)

- ***Work Package 2***: *~HLW*

  →Key Topic 3: "Technical feasibility and long-term performance of repository components"

  → Lead: MICANS (Sweden, Karsten Pedersen)

- ***Work Package 3***: Integration, communication and dissemination

  → Lead: SCK•CEN (Belgium, Natalie Leys/Katinka Wouters)

- ***Work Package 4***: Management

  → Lead: SKB (Sweden, Petra Christensen)

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PRESENTATION OF WP:S

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WP1: IMPROVING THE GEOLOGICAL SAFETY CASE KNOWLEDGE OF THE BEHAVIOUR OF ORGANIC CONTAINING LONG-LIVED INTERMEDIATE LEVEL WASTES

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OBJECTIVES (WP1)

Reduce uncertainty of safety-relevant microbial processes controlling radionuclide, chemical and gas release from long-lived intermediate level wastes (ILW) containing organics (SRA Key topic 2 sub topic 2)

1. To quantify the combined rates of **biodegradation, radiolysis** and hydrolysis of **anthropogenic organic polymers** and cellulose present in ILW under disposal conditions.
2. To identify **key chemical species resulting from organic ILW** biodegradation, radiolysis and hydrolysis and their **effects on radionuclide speciation** and mobility.
3. To establish the in situ chemical and physical **conditions that may limit microbial activity** in EU repository concepts for ILW utilising cementitous materials within a neutral pH host rock.
4. To examine the microbial **generation and consumption of CH_4 and H_2** under ILW repository conditions.
5. To understand the effect of **ILW heterogeneity** on bioprocess pathways, **pH** and redox conditions, barrier degradation and radionuclide release.

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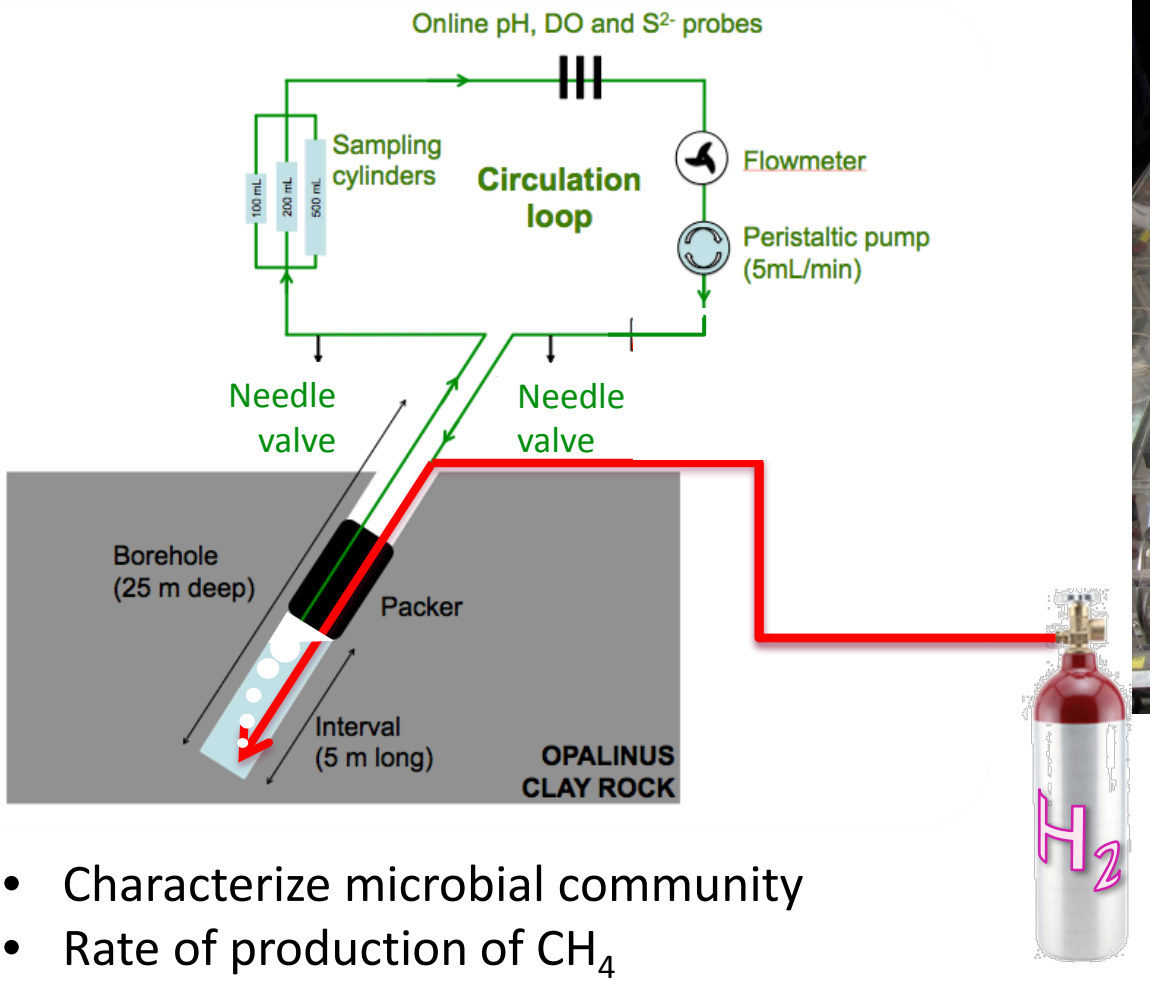
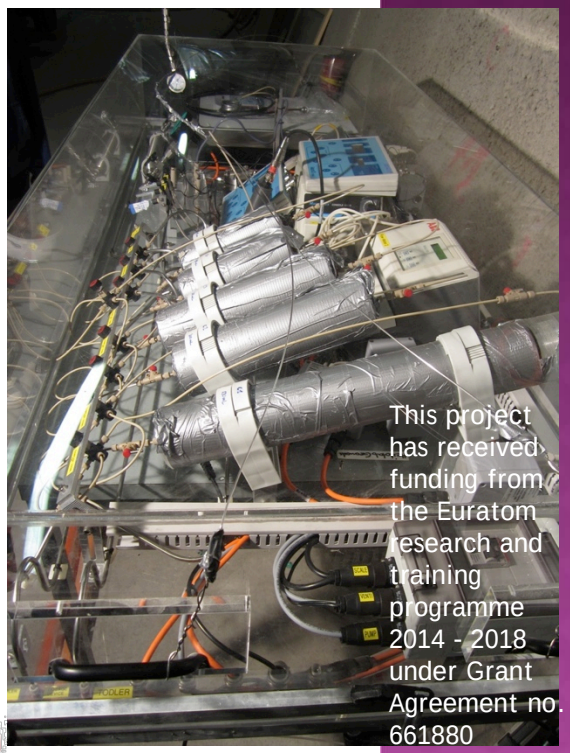
EXAMPLES T1.3: ESTABLISH METHANOGENIC CONDITIONS





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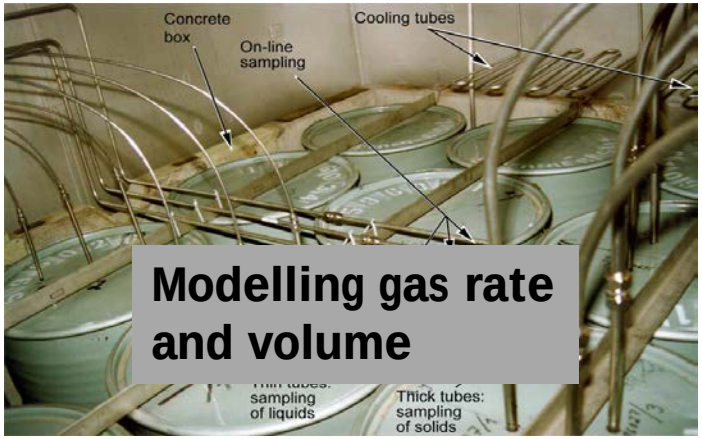
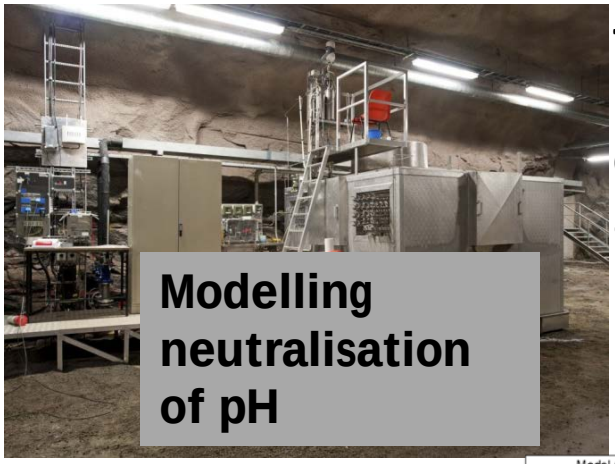
Mont Terri

- Characterize microbial community
- Rate of production of CH_4

EXAMPLE T1.4: MODELLING CH_4 GENERATION & PH EVOLUTION

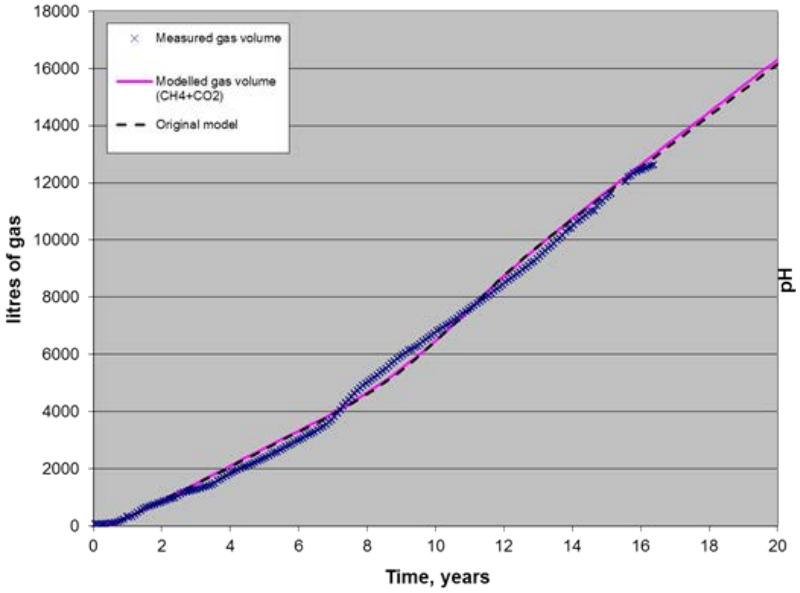


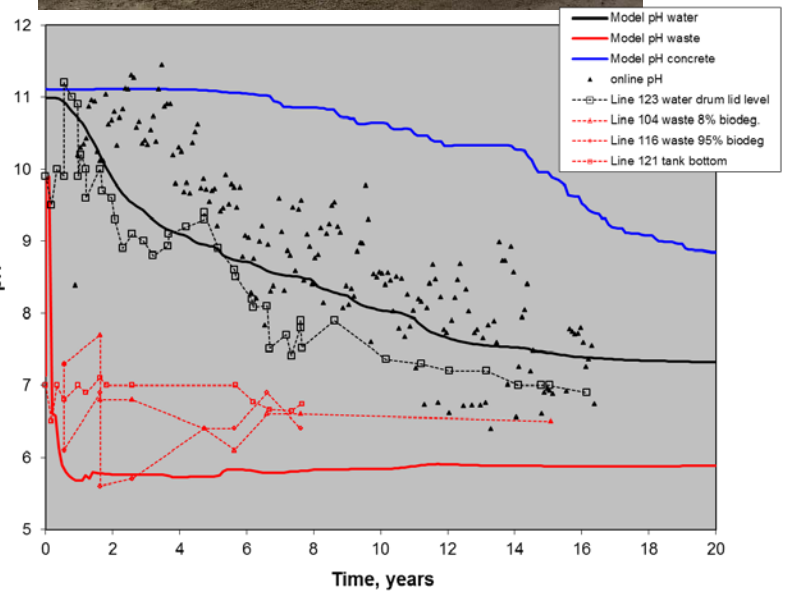
Modelling gas rate and volume



Modelling neutralisation of pH

TVO expt; 16 years of data (1998-2014)





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WP2: IMPROVING THE SAFETY CASE KNOWLEDGE BASE ABOUT THE INFLUENCE OF MICROBIAL PROCESSES ON HIGH LEVEL WASTE AND SPENT FUEL GEOLOGICAL DISPOSAL

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OBJECTIVES (WP2)

- Quantify the contribution of **microbially produced sulphide** in the **geosphere** and in **buffers** and **backfill** to the overall rate of **canister corrosion** (SRA Key topic 3).
- Characterize the **impact** of **microbial activity** on the **long-term performance** of bentonites and seals and plug systems in European geological disposal concepts (SRA Key topic 3, sub-topics 9 and 10).
- Gain systematic information on the **effectiveness of** specific **bentonite buffers** and their properties (density, pH) in **inhibiting microbial activity** (SRA Key topic 3)

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EXAMPLE T2.1 AND T2.3: MICROBIAL ACTIVITY IN THE GEOSPHERE AND IN THE BUFFER

Gas sampling at Äspö HRL

Presence and activity of SRB in host rock groundwater

Grimsel Test Site (Febex: 1997-2015 in situ experiment)

Microbial activity in the buffer

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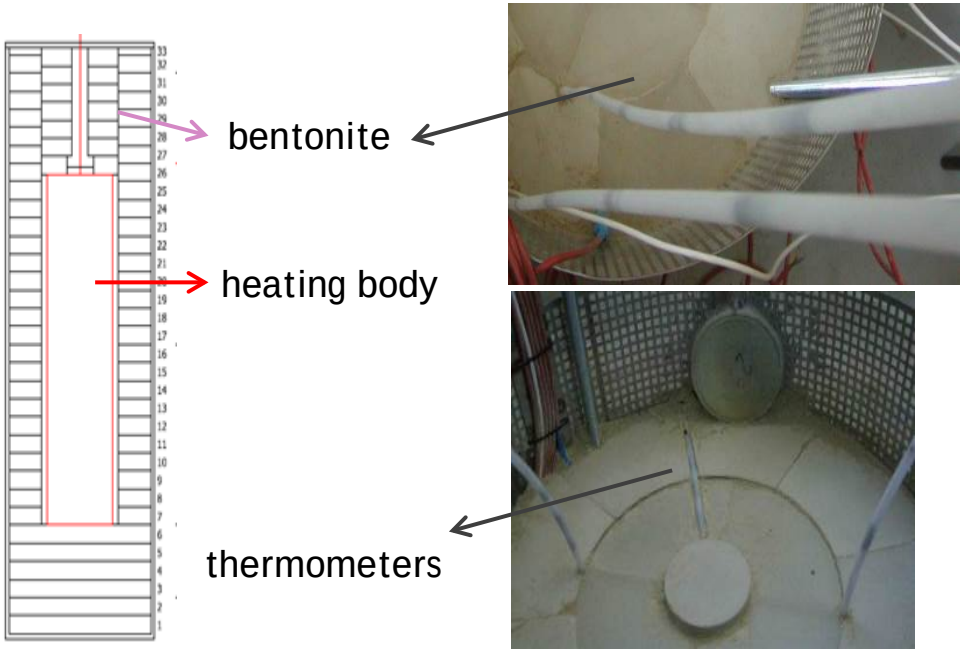
EXAMPLE T2.4: MICROBIAL DIVERSITY IN BENTONITE

Bentonite samples will be obtained from sealing barrier that was installed in Josef undeground facility in 2012; the core contains heating body that maintains 100°C and the bentonite was saturated by natural crystaline water



Mineralogy and chemistry data of aged bentonite samples will be provided by Czech Radioactive Waste Management Organisation (SÚRAO)

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WP3: INTEGRATION - COMMUNICATION - DISSEMINATION

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WP3 OBJECTIVES

Task 3.1

Synthesis, evaluation, abstraction and integration

Task 3.2

Expert conceptualization and public perception

Task 3.3

Knowledge and information exchange

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EXAMPLE T3:2 AND T3.3: PERCEPTION EXCHANGE OF KNOWLEDGE

Perception of lay public and professional: waste disposal design with and without **microbial processes** by **interviews, questionnaires**

To **distribute knowledge** on general **geomicrobiology** and the **outcome** of the **experimental work packages** to a **broad audience**, including students, professionals, the scientific community, stakeholders and the lay community.

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IMPLEMENTERS' REVIEW BOARD

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WASTE MANAGEMENT ORGANISATIONS (END-USERS)

1. **ANDRA**, Agence Nationale pour la gestion des déchets radioactifs, France
2. **BMWi**, Bundesministerium für Wirtschaft und Energy, Germany
3. **COVRA**, Centrale Organisatie Voor Radioactief Afval, The Netherlands
4. **ENRESA**, Empresa Nacional de Residuos Radioactivos S.A., Spain
5. **LLWR** Ltd, UK Low Level Waste
6. **Nagra**, Nationale Genossenschaft für die Lagerung radioaktiver Abfälle, Switzerland
7. **NIRAS/ONDRAF**, the Belgian Agency for Radioactive Waste and Enriched Fissile Materials
8. **NWMO**, Nuclear Waste Management Organisation, Canada
9. **Posiva Oy**, Finland
10. **PURAM**, Public Limited Company for Radioactive Waste Management, Hungary
11. **RWM**, Radioactive Waste Management Limited, United Kingdom
12. **SKB**, Swedish Nuclear Fuel and Waste Management Co, Sweden
13. **SÚRAO**, Správa úložišť radioaktivních odpadů, Czech Republic
14. **TVO**, Teollisuuden Voima Oy, Finland

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REGULATORS

1. **CNSC**, Canadian Nuclear Safety Commission, Canada
2. **EA**, Environment Agency, United Kingdom
3. **ENSI**, Das Eidgenössische Nuklear-sicherheitsinspektorat, Switzerland
4. **FANC**, The Federal Agency for Nuclear Control, Belgium
5. **IRSN**, Institut de Radioprotection et de Sûreté Nucléaire, France
6. **NWAT**, EA, Environment Agency, United Kingdom
7. **SUJB** State office for Nuclear Safety, Czech Republic
8. **SSM**, Swedish Radiation Safety Authority, Sweden
9. **STUK**, Finnish Radiation Safety Authority, Finland

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FOR MORE INFORMATION

- **Webpage: www.mind15.eu**
- **External communication: Follow MIND15 on Facebook**
- **Internal communication: Syncplicity**

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