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DELIVERABLE 3.3

Modular microbiology education and training

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RE	Restricted to a group specified by the partners of the MIND project	
CO	Confidential, only for partners of the MIND project	

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1 MIND education, training and information exchange

The overall aim of both the education and training initiatives in MIND is to

- cultivate awareness of the relevance of microbial issues in otherwise typically abiotic fields of expertise, and
- dissipate the knowledge gained in the MIND project beyond the known geomicrobiology expert circles.

For this reason, **modular training courses** were developed, an **exchange programme** for Master and PhD students has been developed and **focused communication** on these initiatives has been undertaken.

1.1 Education and training

In order to bring the scientific findings of the MIND project directly available to young students, course modules were developed that can be delivered as stand-alone courses or that can be integrated in an already existing academic program.

The education and training packages are primarily composed of a set of presentations and literature recommendations, going from a general (geo)microbiology primer (e.g. Pedersen K. (2014) Microbial life in terrestrial hard rock environments. In Microbial Life of the Deep Biosphere. Edited by Kallmeyer J. and Wagner D. De Gruyter, Berlin. pp 63-81), towards the details on the MIND experiments, results and their relevance in geological disposal research. By its modular nature, they are easily adaptable according to the target audience. Pilot sessions are held at the partner institutes.

Through the project partners of MIND, as well as through the relevant networks and working groups dealing with related education (such as PETRUS III, CMET, ENEN Association), these training courses were promoted and ensured complementarity to already existing courses.

1.1.1 PETRUS training courses

The PETRUS project series (Programme for Education, Training and Research on Underground Storage) aim at a cooperative approach of education and training (E&T) in geological disposal of radioactive waste between universities, waste management organisations, training organisations and research institutes.

In the PETRUS projects, a **specialised academic programme** was setup on geological disposal of nuclear waste as a part of the European Fission Training Schemes (EFTS). This academic programme consists of a blended learning methodology where online learning modules complement a face-to-face training session. Aspects of microbiology in geological disposal were integrated in the academic programme of PETRUS. The academic programme was developed according to the Bologna principles with ECTS (European Credit Transfer and Accumulation System, a tool that helps to design, describe, and deliver study programs and award higher education qualifications) credits allocated to the courses.

In the latest PETRUS project (PETRUS III, which ran from September 2013 until September 2016, http://www.petrus3.eu/) **specific training courses on microbiology** in the domain of geological disposal, organised by MICANS, were provided during two PETRUS PhD conferences.

PETRUS PhD Conference 2015

22-26 June 2015

Université de Lorraine - Mines Nancy – France

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http://petrus2015.strikingly.com/

On Tuesday 23 June 2015, Professor Karsten Pedersen (Chalmers University / Microbial Analytics AB, Sweden) presented a training course on **'Microbiology in nuclear waste disposal'**.

Objectives of this lecture:

The objectives of the lecture were on how life processes can influence the safety and performance of future repositories for nuclear wastes. Microbiological systems are alive and thus not in thermodynamic equilibrium because living organisms preserve their internal order by taking free energy from their surroundings in the form of organic nutrients, reduced inorganic compounds or sunlight, and they expel an equal amount of energy as heat and entropy to their surroundings. This means that order is increased in the microorganisms and decreased in their surroundings, i.e. living systems strive to move away from thermodynamic equilibria. Consequently, by excluding microbial processes that may control reactions rates, too optimistic assumptions may be introduced in the safety and performance assessment of the repositories. This is because uncertainties and technical issues related to microbial processes that could undermine the repository safety case, such as microbially induced corrosion, gas formation, radionuclide transformation and migration and barrier degradation may remain overlooked.

Link to the lecture presentation: https://uploads.strikinglycdn.com/files/178529/736ca9f2-a485-4a11-a18b-14675fad97ac/Pedersen%20Petrus%20III%20presentation.pdf

PETRUS PhD Conference 2016

27 June – 1 July 2016

Delft University of Technology – The Netherlands

http://petrus-opera2016.strikingly.com/

On Wednesday 29 June 2016, Professor Karsten Pedersen (Microbial Analytics Sweden AB) presented **'Microbes, barrier functions and nuclear safety cases'**.

Objectives of this lecture:

The objectives of the lecture were to introduce the safety case and the features, events and processes (FEP:s) language with and without life involved. TAfter this introduction, the course introduced and explained the work packages in the MIND program with examples from the application and from the progress of the partners. Deliverable D.1 “A review of anthropogenic organic wastes and their degradation behaviour” was introduced. The MIND tasks in WP1 and 2 were thereafter briefly introduced and discussed, one by one.

Link to the presentation: https://drive.google.com/open?id=0BzF6iWVD9TzpV1cwR25IdVVwN2M

A recording of the lecture can be found here:
https://collegerama.tudelft.nl/Mediasite/Showcase/public/Presentation/aad52b2cc1e34592895c7cbe16b5a96a1d

1.1.2 MIND geomicrobiology primer training course

In addition to the training courses on an academic level, a specialised training module (primer) on '**Microbiology and disposal of radioactive waste**' was developed a decade ago by Micans for professionals active in the nuclear and/or waste management area. This course was refurbished to the present day knowledge and given again by Micans as a primer course. Although the course was planned and executed by Micans on their own premises, including their laboratory, the outcome and

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evaluation is communicated to the MIND consortium. It will be adopted and incorporated in the MIND education and training package.

This course will give an introduction to the field of microbiology and especially into microbial processes that may interact and affect different components of repositories for radioactive waste, both in low- and intermediate as well as in high-level European radioactive waste repositories.

In more detail the course will include basic knowledge about the biology of microorganisms and their versatility in metabolism including the interaction of microorganisms with geochemical cycles of important elements. Microbial processes that may challenge technical barriers are discussed and exemplified. Case studies and scientific research strategies related to the microbiology of various European repository concepts are presented. An introduction to methods for the study of microorganisms in repository environments will be given. The course includes both theoretical lectures and practical exercises in the laboratory. To gain a genuine understanding of the influence and complexity of microbial activity, analyses of natural samples will be performed.

As a target audience, this course addresses those involved in safety assessment regarding geochemical processes in the environment and chemical impact on the different components of barrier systems in European disposal concepts. The information and knowledge of microorganism's importance for safety assessment is vital for persons involved in planning of concepts, technical solutions, site investigation programs, implementation and regulation organizations, research organizations and universities. An EQF level of 6 was attributed to the course aiming at a bachelor level.

This training course was developed according to the ECVET principles, where learning outcomes were determined in terms of knowledge, skills and competences. A summary of this training course is provided in the course fiche in annex 1.

On successful completion of the training course, participants will be able to:

In terms of knowledge:

-Describe the discipline of microbiology and microbial metabolic processes.

-Define what microorganisms are and what their activity can imply for a repository.

-List methods for cultivation, diversity, detection, quantification and identification.

-Name components of a repository likely to be affected by microbial processes.

-Describe what parameters determine rates of different microbial processes.

-State safety case issues where microbial processes may influence.

In terms of skills:

-Operate under supervision methods for cultivation and detection of microorganisms.

-Apply methods for sterilization and removal of microorganisms.

-Perform light microscopy observations of microorganisms.

In terms of competences:

-Acknowledge the relevance of microbial issues in geological disposal of radioactive waste.

As training course content, the lectures start on the concept of microorganisms including their interaction with our society. The lectures include descriptions of the microorganisms, their growth, different types of microorganisms, and the great diversity in microbial metabolism. An overview of available techniques for the study microorganisms is given.

In addition, lectures are provided on the roles of microorganisms in various environments. A brief introduction is given on the origin and evolution of life on Earth and how life shaped the planet by its

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impact on geology and geochemistry. This leads to expanded knowledge about microbial processes and cycling of elements.

The interaction of microorganisms with technical barriers in repositories are treated, such as biofilm formation, biofouling, microbial induced aerobic and anaerobic corrosion, clogging, biodegradation, interaction with trace elements and radionuclides such as sorption and desorption.

Microbial processes and safety cases in the disposal of radioactive waste are discussed, as well as modelling of microbial processes.

During the course different practical laboratory exercises and demonstrations are possible.

A brief self-test and course evaluation is foreseen at the end of the training course.

A pilot session of this geomicrobiology primer course was organised on 24-28 October 2016 by MICANS in Mölnlycke in Sweden. The lecturers were Lotta Hallbeck, Karsten Pedersen, Andreas Bengtsson, Johanna Edlund and Anders Blom (Micans). In the laboratory, Linda Johansson and Lena Eriksson (Micans) served with preparations, instructions and supervision.

6 representatives from Finland, the Czech Republic, France and Switzerland, all of which are working with, or do research on the issues of geomicrobiology or radioactive waste disposal attended this training course.

Details of this training course are available on http://micans.se/microbiology-and-radwaste-course.

Course leaflet: http://micans.se/files/user/Kunskapsblad/BCM.pdf.

A course evaluation was foreseen, using a specific feedback template asking questions on the course content, course material, lecturers, practical organisation, and an overall judgement.

Annex 2 provides a general overview of the main scores of this pilot course. As a general judgement, 4 participants rated this training course as 'excellent' and 2 as 'good'. 5 Persons would recommend this training course to other persons. 4 persons followed this course out of own interest, 2 because it was recommended and 1 person indicated that it was on demand of the employer.

Using the outcome of this course evaluation, quotes and the self assessments, the education and training course module can be further optimized.

Some quotes of the participants:

- *Lectures were well structured and interesting. I liked that we were able to discuss things and the lecturers asked often if we followed. I've got motivated!*
- *Great chance to learn from experts who have been working in the field for a long time.*
- *Good balance between theoretical lectures and lab practice.*
- *I got a broad and in-depth overview about deep subsurface microbiology studies in the context of nuclear waste disposal.*

The participants were offered to write “self assessments” of their achievements during the course.

Here follows the three assessments delivered:

Participant 1

The most interesting and probably most valuable part of the course was to gain the knowledge about all the different nuclear waste disposal concepts planned and studied in the Europe and in the world. I wasn’t that familiar with those before this course as I have only been concentrating on understanding what will happen in ONKALO in the far-future. I learnt to think about the ‘big picture’ of nuclear waste disposal and understood all the different aspects that are related to disposal in addition to the

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microbiology; safety assessment and cases, FEPs and also geochemical considerations. Microbiology is an important factor having an influence on all of those different fields.

One topic I expected to learn more about during this course was the anaerobic microbiology. I have a background in aerobic microbiology and anaerobic world is quite new to me, so it's good that this course included some very basic information about anaerobic organisms (and some more advanced information too). For example, redox reactions, oxidation states and the role and functioning of electron donors and acceptors in the microbial metabolism are quite complex and difficult to piece together in the mind so I learnt something new and refreshed old learnings a lot during the lectures dealing with those.

Overall, the course was very useful and didn't include almost any "useless" or too familiar stuff. I'm also quite sure that the contacts made during this course will become useful in the future – at least in the form of peer support while trying to get the PhD done.

At the end of this week of microbiology classes, I draw a very positive conclusion.

First, I want to rate the quality of the different instructors as excellent. They created a climate in the classroom that is conductive to learning with a very good interaction between themselves and student.

Participant 2

It was also a good thing to alternate between theoretical and practical training thanks to the experimental work that we done in your laboratory.

This course broadened my general knowledge and understanding in the field of "Microbiology and deep disposal of radioactive wastes".

This course helped me to understand the different radioactive waste disposal concept.

This course introduced me to the general microbe's description and to the different species concept.

This course also allowed me to understand the different microbial processes which can impact the performance of a deep disposal.

This course stimulated my thinking and gave me new ideas of experimental work.

The course content were appropriately challenging and were dealt with in sufficient depth.

I would have liked to have more long time lessons dedicated to the different cultivation and enumeration of microorganism techniques and to the molecular analysis.

Nevertheless, the course content met the stated objectives. I will be able to better understand the microbiological key issues associated to the experiments in which I am involved.

Participant 3

I got a broad and in-depth overview about deep subsurface microbiology studies in the context of nuclear waste disposal.

Acquired knowledge about the different national disposal concepts and their reasoning behind.

Learned about the advantages of combination of methods: classical cultivation + ATP activity + molecular based diversity.

Get awareness of the mayor challenges which are ahead in terms of low and intermediate waste (diversity and dynamics of relevant chemical compounds.

Microbial processes and their dynamic will influence the engineered barrier systems, e.g. bentonite inhabiting bacteria will influence the swelling capacity negatively (iron reducing bacteria).

Got knowledge of the overall MIND program and the key research questions.

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MICROBE44 simulation program – I will introduce that to my colleagues since it gives an impression of the possible dynamics. E.g. the influence of phages have been unknown to me.

Got new ideas and useful references for my own experiments (H_2 and SO_4^{2-} consumption rates in sand:bentonite mixtures bioreactors *in situ*; DNA extraction of pristine Opalinus clay rock).

FEP catalogue introduced, which is a rich resource of the 'so-far' acquired knowledge about the different nuclear waste disposal concepts (didn't know that such a catalogue exists).

1.1.3 MIND advanced geomicrobiology training course

An advanced geomicrobiology training course will be developed using the scientific knowledge gathered during the MIND project.

This training course will also be composed of a set of presentations and literature recommendations, enriched with the details on the MIND experiments, results and their relevance in geological disposal research. The pilot session of this training course will be organised towards the end of the MIND project, and can be combined with a dissemination workshop in the same domain of geological disposal.

1.1.4 Sustainability of the E&T initiatives

It is strived for by the MIND project partners to obtain a sustainable education and training package that will be available beyond the duration of the MIND project. To this end, contacts are established with relevant sustainable platforms such as IGD-TP/CMET (e.g. for the training courses for professionals), as well as the ENEN Association (e.g. for the training courses at PhD level).

1.2 Exchange programme for Master & PhD students and professionals

To enhance students' contribution to the relevant MIND research, an exchange program for Master and PhD students was created. Carefully selected internship topics are made available to top-level students and professionals that will contribute to the MIND research. These initiatives facilitate the cross-border mobility of students and professionals involved in the field of nuclear technologies and waste management.

For this reason, a document template was sent to all MIND partners to ask for exchange opportunities. This information was summarised and placed on the website of MIND. A new section 'exchange opportunities' was created for this purpose, displaying a list of current exchange opportunities with limited details, and separate webpages with more detail on each exchange opportunity. (See annex 3 for a screenshot of this website section and a detail page)

The following methodology is proposed to evaluate the candidates for these exchange opportunities:

1. Applications should be submitted by email to mind.project@sckcen.be (a separate mailbox was setup for this purpose)
2. Applications should contain
   - a motivation letter with MIND-reference to the opportunity as mentioned on this website;
   - a CV of the candidate.
3. The application file is evaluated by email by a Jury composed by members of the MIND project WP3, as well as the host institution.

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4. The candidate will be informed about the status of the application via email.

On date August 17, 2016, 7 different exchange opportunities were published online, with announcement on the website of MIND and in the September edition of the newsletter. On date November 9, 2016, no applications have been received for these exchange opportunities.

The MIND project members are repeatedly asked to provide input on new exchange opportunities.

2 Acknowledgement

The MIND-project has received funding from the European Union's Euratom research and training program (Horizon2020) under grant agreement 661880 The MIND-project.

3 References

[1] PETRUS III newsletter N°2 (April 2015, page 9): http://www.enen-assoc.org/data/document/petrus3_newsletter3.pdf.

[2] PETRUS III website: http://www.petrus3.eu

[3] MIND website: http://www.mind15.eu

[4] MIND newsletter (September 2016, page 4): http://www.mind15.eu/wp-content/uploads/2016/10/MIND-NL-2-October-2016.pdf

[5] IGD-TP Newsletter (July 2016, page 6): http://www.mind15.eu/wp-content/uploads/2016/10/IGD-TP-Newsletter_5.pdf

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Annex 1: Course fiche geomicrobiology 'primer' course

Microbiology and disposal of radioactive wastes	
Time frame (total number of hours)	16 hours theory
	14 hours exercises/lab sessions/visits
	EQF level 6

Target public

The information and knowledge of this course is vital for persons involved in planning of concepts, technical solutions, site investigation programs, implementation and regulation organizations, research organizations and universities

Learning Outcomes

On successful completion of the training course, participants will be able to:

In terms of knowledge:

-Describe the discipline of microbiology and microbial metabolic processes.

-Define what microorganisms are and what their activity can imply for a repository.

-List methods for cultivation, diversity, detection, quantification and identification.

-Name components of a repository likely to be affected by microbial processes.

-Describe what parameters determine rate of different microbial processes.

-State safety case issues where microbial processes may influence.

In terms of skills:

-Operate under supervision methods for cultivation and detection of microorganisms

-Apply methods for sterilization and removal of microorganisms.

-Perform light microscopy observations of microorganisms.

I*n terms of competences:*

-Acknowledge the relevance of microbial issues in geological disposal of radioactive waste.

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Evaluation of learning outcomes (examination type)

The course ends with a brief self-test and course evaluation

Training course content (programme)

Lectures on the concept of microorganisms including their interaction with our society. The lectures will include descriptions of the microbe, their growth, different types of microorganisms, and the great diversity in microbial metabolism. An overview of available techniques for the study microorganisms will be given.

Lectures on the roles of microorganisms in various environments. A brief introduction to the origin and evolution of life on Earth and how life shaped the planet by its impact on geology and geochemistry. This leads to expanded knowledge about microbial processes and cycling of elements.

The interaction of microorganism with technical barriers in repositories. Biofilm formation, biofouling, microbially induced aerobic and anaerobic corrosion, clogging, biodegradation, interaction with trace elements and radionuclides such as sorption and desorption.

Microbial processes and safety cases in the disposal of radioactive waste. Modelling of microbial processes.

During the course there will be different practical laboratory work and demonstrations.

Course material and reference books

Brock Biology of Microorganisms, 14th edition
Strolling through the world of Microbes
Handout material, laboratory exercise instructions

Lecturers:

Karsten Pedersen, PhD in microbiology with 30 years of teaching microbiology as professor of Microbiology at the University of Gothenburg, and recently as adjunct professor of geomicrobiology at Chalmers University in Gothenburg. He is a very experienced teacher. He has been working with microbiology in radioactive wastes disposal concepts in Sweden, Finland, Belgium, Canada, Switzerland and Japan during the last 30 years. Publications and reports, see micans.se/publications-books-and-reports.

Lotta Hallbeck, PhD in microbiology, certified teacher exam in chemistry and biology. Lotta has 25 years of experience of teaching at the University of Gothenburg and secondary school. She has been working with microbiology research related to radioactive waste disposal for 25 years. Publications and reports, see micans.se/publications-books-and-reports.

Staff at Micans will support with laboratory exercises and demonstrations. See micans.se/staff.

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Annex 2: Leaflet geomicrobiology 'primer' course

micans
Microbial Analytics Sweden AB
www.micans.se

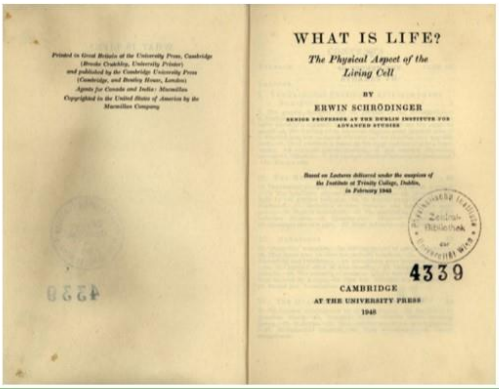
Basic course in microbiology and nuclear waste disposal

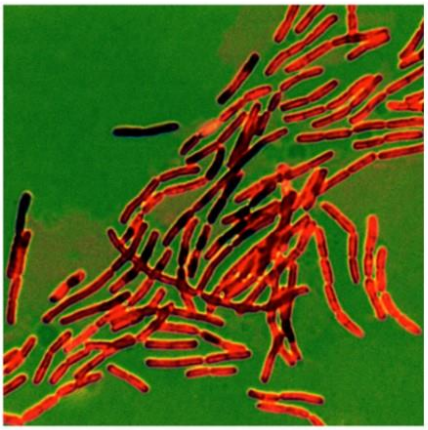
Microbiology and disposal of radioactive wastes

This course will give an introduction to the field of microbiology and especially into microbial processes that may interact and affect different components of repositories for radioactive waste, both in low- and intermediate as well as in high-level European radioactive waste repositories.

In more detail the course will include basic knowledge about the biology of microorganisms and their versatility in metabolism including the interaction of microorganisms with geochemical cycles of important elements. Microbial processes that may challenge technical barriers are discussed and exemplified. Case studies and scientific research strategies related to the microbiology of various European repository concepts are presented. An introduction to methods for the study of microorganisms in repository environments will be given. The course includes both theoretical lectures and practical exercises in the laboratory. To gain a genuine understanding of the influence and complexity of microbial activity, analyses of natural samples will be performed.

The course is initiated by two pan-European programmes, Petrus-III and Microbiology In Nuclear waste Disposal (MIND). One important aim of the MIND project, granted by European Commission, is to raise awareness of the relevance of microbial issues in otherwise typically abiotic fields of expertise, and to dissipate the knowledge gained in the MIND project to students and professionals within and beyond the known geomicrobiology expert circles. Similarly PETRUS is a project granted by European Commission whose objective is to promote education and training in geological disposal of radioactive waste.


WHAT IS LIFE?
The Physical Aspect of the Living Cell
BY
ERWIN SCHRÖDINGER
4339
CAMBRIDGE
AT THE UNIVERSITY PRESS



Bacillus megaterium is a giant among the bacteria, but still, it is not more than a fraction of a millimetre tall, i.e. 0.025 mm. Most bacteria are approximately 0.001 mm.

WHAT IS LIFE?

About a decade after his thought experiment on "Schrödingers cat", Erwin Schrödinger introduced the concept and phrase "negative entropy" for living systems. This is the entropy that living organisms export to keep its own entropy low. In other words, order is increased in microorganisms and decreased in their surroundings. Living systems strive to move away from thermodynamic equilibria. This implies, for instance, that geochemical modelling is not applicable on living systems because it is assumed that modelled systems move towards thermodynamic equilibria. This is why learning about microbial life is so important in nuclear waste disposal. Microorganisms perform processes and reactions that go beyond what is described in most technical, chemical and geological textbooks.

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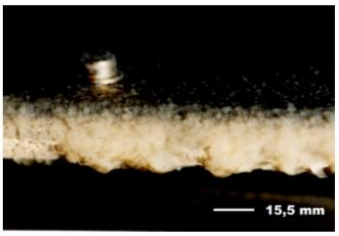
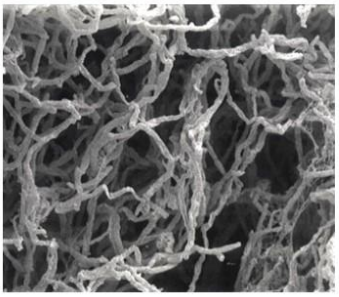
Learning outcome





A biofilm of the bacterium *Meiothermus* growing inside a pool for interim storage of radioactive waste.

This course addresses those involved in safety assessment regarding geochemical processes in the environment and chemical impact on the different components of barrier systems in European disposal concepts. The information and knowledge of microorganism's importance for safety assessment is vital for persons involved in planning of concepts, technical solutions, site investigation programs, implementation and regulation organizations, research organizations and universities.

On successful completion of the training course, participants will be able to:

In terms of knowledge:

-Describe the discipline of microbiology and microbial metabolic processes.

-Define what microorganisms are and what their activity can imply for a repository.

-List methods for cultivation, diversity, detection, quantification and identification.

-Name components of a repository likely to be affected by microbial processes.

-Describe what parameters determine rates of different microbial processes.

-State safety case issues where microbial processes may influence.

In terms of skills:

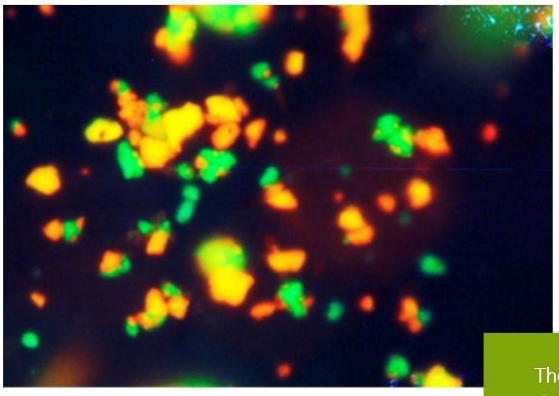
-Operate under supervision methods for cultivation and detection of microorganisms.

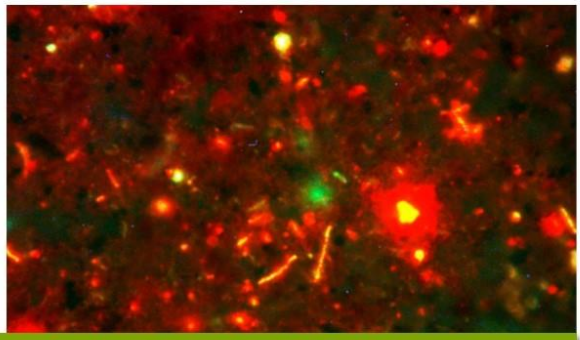
-Apply methods for sterilization and removal of microorganisms.

-Perform light microscopy observations of microorganisms.

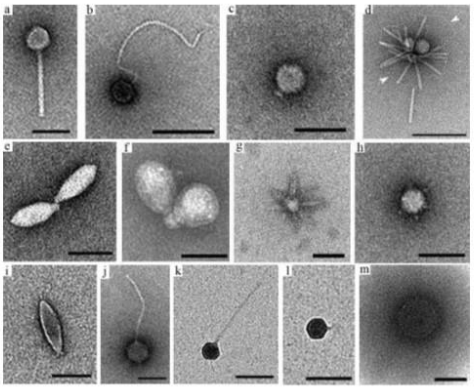
In terms of competences:

-Acknowledge the relevance of microbial issues in geological disposal of radioactive waste.





The image to the left shows a new ion exchanger for deionization of radioactive water in nuclear power plants. The image to the right shows a used ion exchanger, now containing large numbers of bacteria and degraded ion exchanger. This mix is what will go into the intermediate level repositories. We will load the repositories from start with bacteria.



Often ignored but extremely important!

Viruses that attack microorganisms, so called bacteriophages, often occur in abundances exceeding bacterial numbers 10 times or more. Bacteriophages are probably the most important regulator of microbial numbers wherever microorganisms occur. The image to the left shows a varity of bacteriophages sampled from groundwater in the Äspö Hard Rock Laboratory, Oskarshamn, Sweden.

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Course content

Lectures on the concept of microorganisms including their interaction with our society. The lectures will include descriptions of the microorganisms, their growth, different types of microorganisms, and the great diversity in microbial metabolism. An overview of available techniques for the study microorganisms will be given.

Lectures on the roles of microorganisms in various environments. A brief introduction to the origin and evolution of life on Earth and how life shaped the planet by its impact on geology and geochemistry. This leads to expanded knowledge about microbial processes and cycling of elements.

The interaction of microorganisms with technical barriers in repositories. Biofilm formation, biofouling, microbially induced aerobic and anaerobic corrosion, clogging, biodegradation, interaction with trace elements and radionuclides such as sorption and desorption.

Microbial processes and safety cases in the disposal of radioactive waste. Modelling of microbial processes.

During the course there will be different practical laboratory exercises and demonstrations.

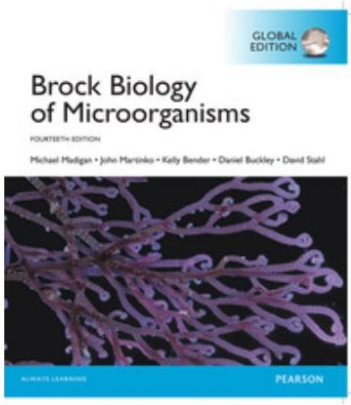
The course ends with a brief self-test and course evaluation.

Teaching staff

Lecturers

Lotta Hallbeck, PhD in microbiology, certified teacher exam in chemistry and biology. Lotta has 25 years of experience of teaching at the University of Gothenburg and secondary school. She has been working with microbiology research related to radioactive waste disposal for 25 years. Publications and reports, see micans.se/publications-books-and-reports

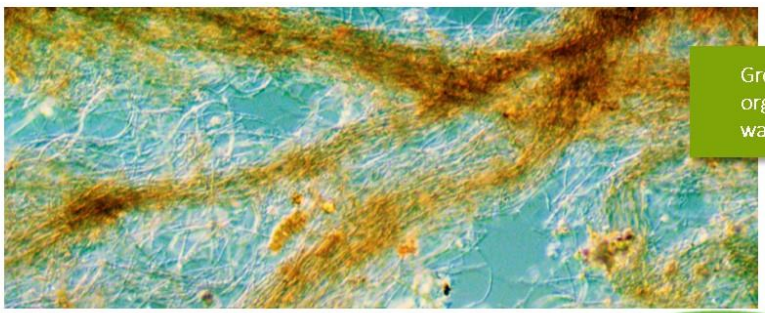
Karsten Pedersen, PhD in microbiology with 30 years of teaching microbiology as professor of Microbiology at the University of Gothenburg, and recently as adjunct professor of geomicrobiology at Chalmers University in Gothenburg. He is a very experienced teacher. He has been working with microbiology in radioactive wastes disposal concepts in Sweden, Finland, Belgium, Canada, Switzerland and Japan during the last 30 years. Publications and reports, see micans.se/publications-books-and-reports.



Brock Biology included in the course fee

Laboratory

Staff at Micans will support with laboratory exercises and demonstrations. See micans.se/staff.



Growth of filament-forming microorganisms on the walls of a supply water tank in a nuclear power plant.

The MIND-project has received funding from the European Union's Euratom research and training program (Horizon2020) under grant agreement 661880.

Course location

The course will be held at the Microbial Analytics Sweden AB's premises that include a class room in the company's library and a large well equipped laboratory. The company is located in Mölnlycke outside of Gothenburg in Sweden, 20 minutes drive from Landvetter International Airport.

Accommodation

There are two facilities nearby, both situated in very scenic environments. We will be happy to assist with booking and transportation.

Wendelsberg Hotel and Hostel: http://wendelsberg.com/?lang=en

Hällsnäs conference: http://hallsnas.se

Practicalities

Course date: 24th October — 28th October 2016

Number of participants: 18. (Minimum participants for the course to be held: 8)

Background of participant: The participant may have a scientific-technical background such as a bachelor in science or engineering (EQF level 6)

Course length: 5 days

Course fee: The registration fee amounts to 1 975 € (20% VAT included, 395 €). This fee includes the material for the course as well as lunches and coffee

Last day of registration: 16 September 2016

Last day for payment of course fee: 1st October 2016

Registration instructions: You can register by sending an email to info@micans.se. Your registration is only final when you have made your payment by bank transfer. When registered, Micans will send you a separate e-mail with further instructions related to your payment. If you would need further assistance, please contact info@micans.se. Cancellation with total refund is only possible until October 14, 2016.

Course schedule

Monday
- 08.30 – 11.30 Lectures Microbes—what are they?
- 13.00 – 16.30 Laboratory Microbes in your environment

Tuesday
- 08.30 – 11.30 Lectures Microbial processes
- 13.00 – 16.30 Laboratory Demonstrations

Wednesday
- 08.30 – 11.30 Lectures Research strategies in low and intermediate repositories
- 13.00 – 16.30 Modelling

Thursday
- 08.30 – 11.30 Lectures
- Research strategies in high level waste repositories
- 13.00 – 16.30 Laboratory Study of results from exercises

Friday
- 08.30 – 11.30 Lectures Safety cases
- 13.00 – 14.00 Wrap up
- 14.00 End of course

Contact us

Call or send an email if you need more information

Microbial Analytics Sweden AB
Mölnlycke Fabriker 9
435 35 Mölnlycke
Sweden

+ 46 31 - 338 32 30
info@micans.se
www.micans.se

SP Certified ISO 9001

SP Certified ISO 14001

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Annex 3: Feedback geomicrobiology 'primer' course

Content	excellent	good	sufficient	poor
Balance theory | practice	1	5		
Up-to-date	4	2		
Practical use of the training	3	2	1	

The degree of difficulty in comparison with the proposed level is: 0 higher; 0 lower; 5 as expected.

Course material	excellent	good	sufficient	poor
Clearness	2	4		
Completeness	2	4		
Quality of the slides	3	1		

Lecturers	excellent	good	sufficient	poor
Clearness	4	1		
Possibility for questions | interaction	6			
Scientific knowledge	6			

Organisation	excellent	good	sufficient	poor
Time schedule | start, coffee breaks, lunch, end	2	4		
Course environment | training room	6			
Catering | coffee breaks, lunch	6			

General judgement	excellent	good	sufficient	poor
	4	2		

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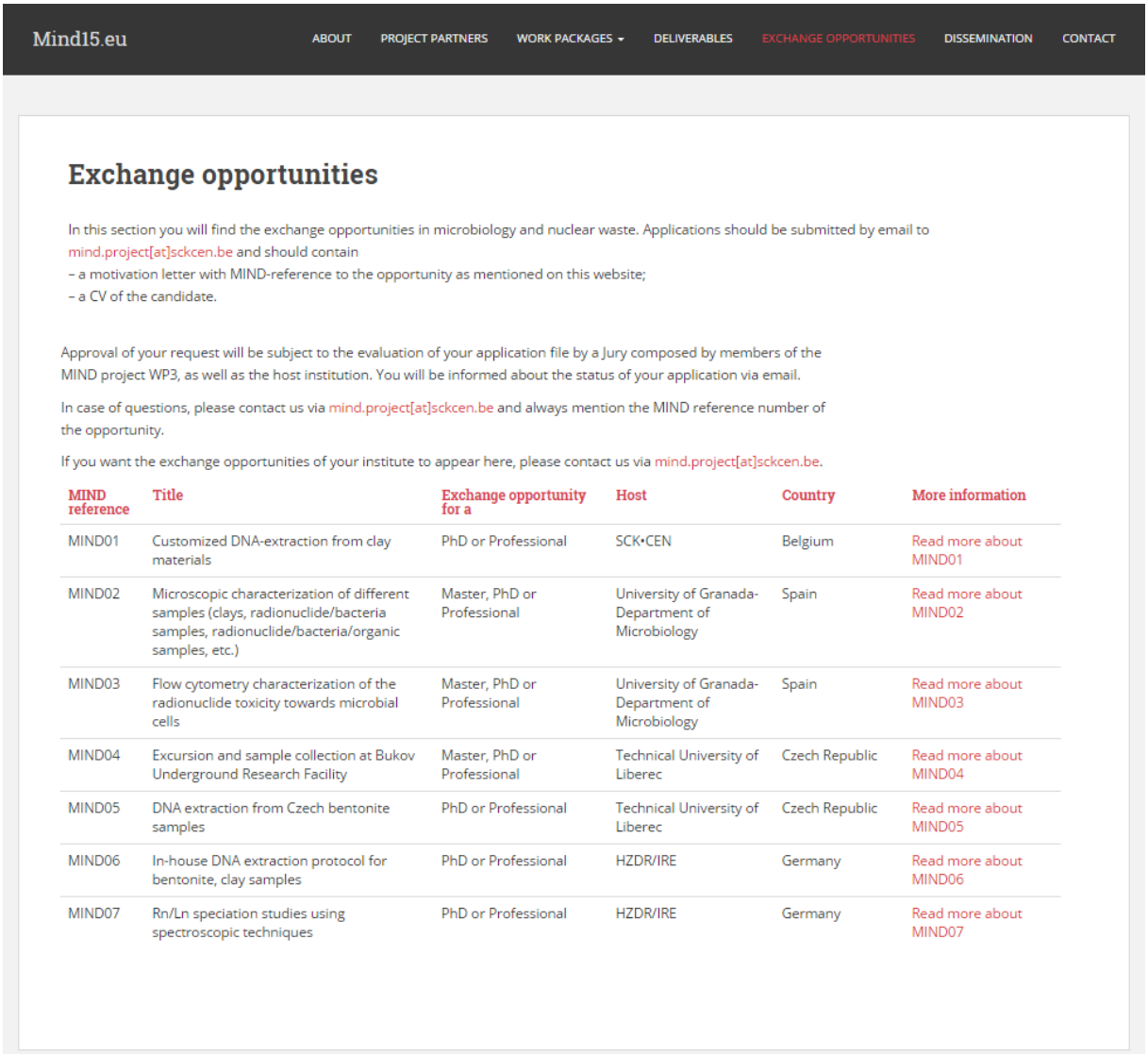
Annex 4: MIND exchange opportunities

Overview page of exchange opportunities on the MIND website.



Mind15.eu

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Exchange opportunities

In this section you will find the exchange opportunities in microbiology and nuclear waste. Applications should be submitted by email to mind.project[at]sckcen.be and should contain
- a motivation letter with MIND-reference to the opportunity as mentioned on this website;
- a CV of the candidate.

Approval of your request will be subject to the evaluation of your application file by a Jury composed by members of the MIND project WP3, as well as the host institution. You will be informed about the status of your application via email.

In case of questions, please contact us via mind.project[at]sckcen.be and always mention the MIND reference number of the opportunity.

If you want the exchange opportunities of your institute to appear here, please contact us via mind.project[at]sckcen.be.

MIND reference	Title	Exchange opportunity for a	Host	Country	More information
MIND01	Customized DNA-extraction from clay materials	PhD or Professional	SCK•CEN	Belgium	Read more about MIND01
MIND02	Microscopic characterization of different samples (clays, radionuclide/bacteria samples, radionuclide/bacteria/organic samples, etc.)	Master, PhD or Professional	University of Granada-Department of Microbiology	Spain	Read more about MIND02
MIND03	Flow cytometry characterization of the radionuclide toxicity towards microbial cells	Master, PhD or Professional	University of Granada-Department of Microbiology	Spain	Read more about MIND03
MIND04	Excursion and sample collection at Bukov Underground Research Facility	Master, PhD or Professional	Technical University of Liberec	Czech Republic	Read more about MIND04
MIND05	DNA extraction from Czech bentonite samples	PhD or Professional	Technical University of Liberec	Czech Republic	Read more about MIND05
MIND06	In-house DNA extraction protocol for bentonite, clay samples	PhD or Professional	HZDR/IRE	Germany	Read more about MIND06
MIND07	Rn/Ln speciation studies using spectroscopic techniques	PhD or Professional	HZDR/IRE	Germany	Read more about MIND07

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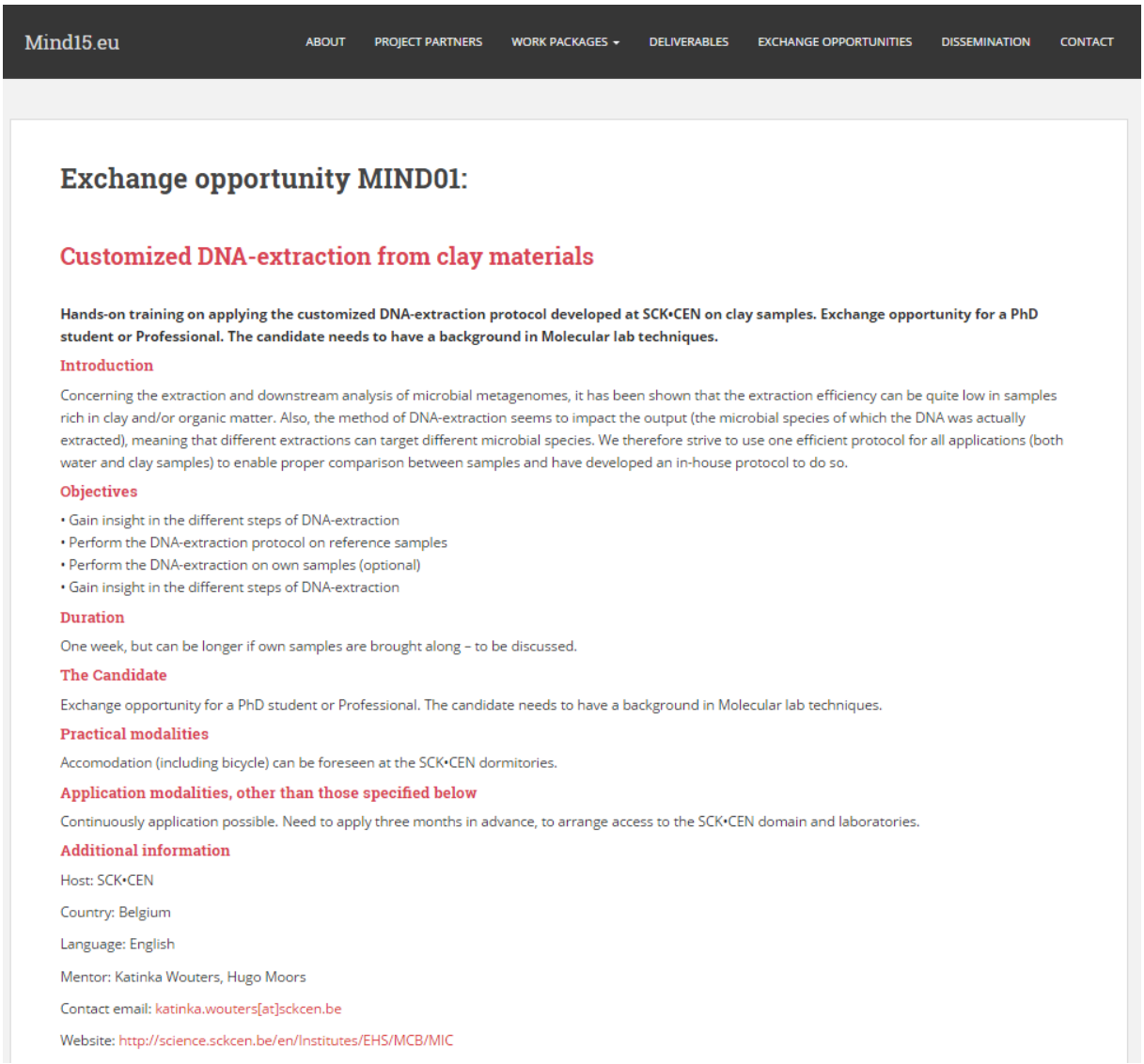
Example of a detail page on one of the MIND exchange opportunities.



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