

SNOWMAN NETWORK

Knowledge for sustainable soils



PACMAN

Assessment and Management of polar PACs at contaminated sites and remedial processes

01/10/2011 – 30/09/2014

Consortium Partners:

Umeå University, Sweden

BRGM, France

CNRS, France



Funding organizations:

Naturvårdsverket, Swedish EPA

ADEME, French Environment and Energy Management Agency



Total project budget: 577 899 €

From SNOWMAN funders: 368 869 €

Staffan Lundstedt, project coordinator

Overall objectives

To assess to what extent polar PACs contribute to the risk at PAH-contaminated sites, and to find ways to manage and reduce this potential risk.



Typical PAH-contaminated sites

200 000 sites in Europe may house these pollutants



Gas works



Sawmill and wood preserv. sites



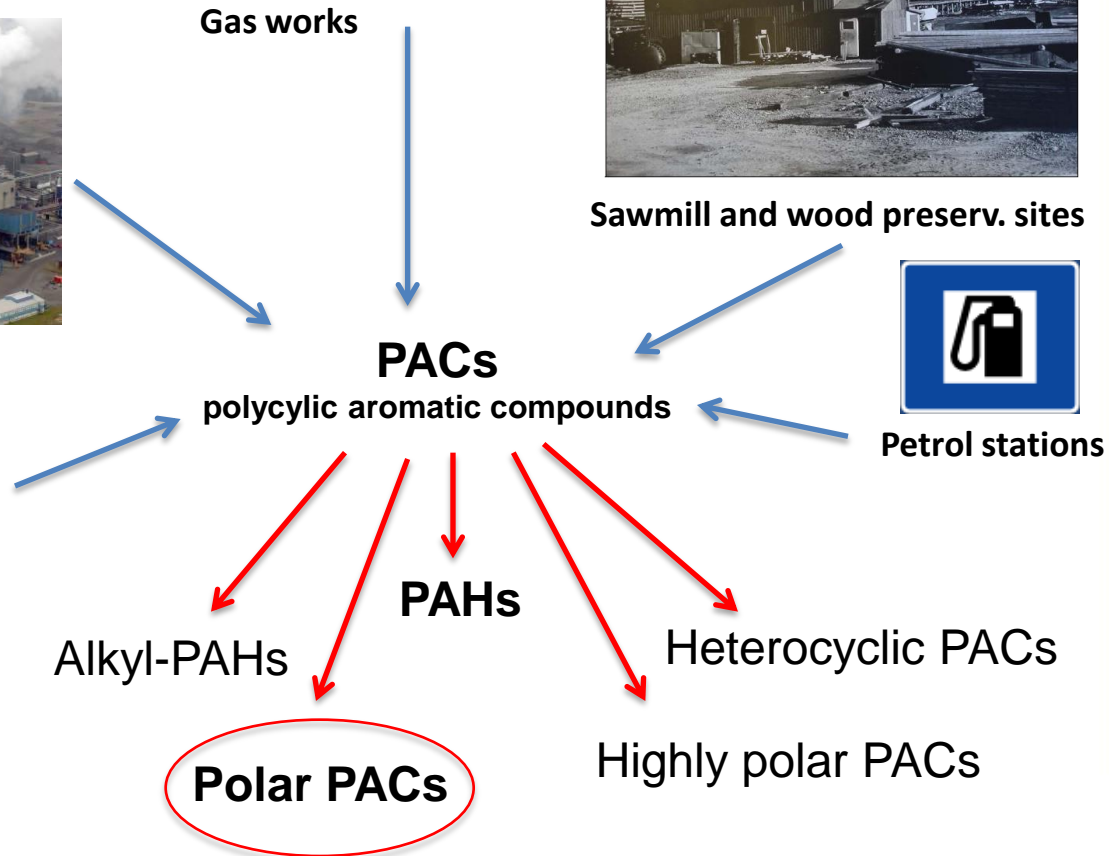
Coke oven plants



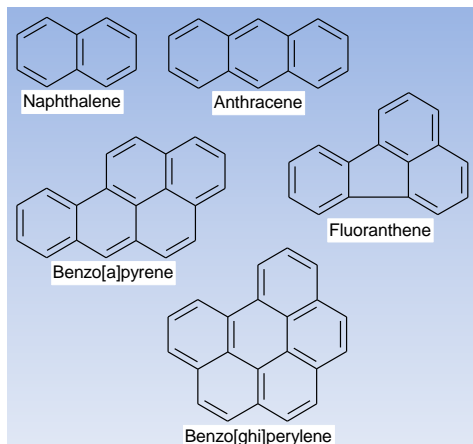
Petrol stations



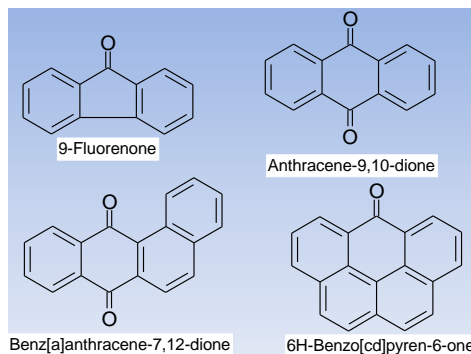
Marshalling yards



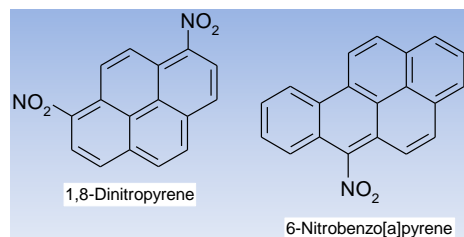
PAHs v.s. Polar PACs



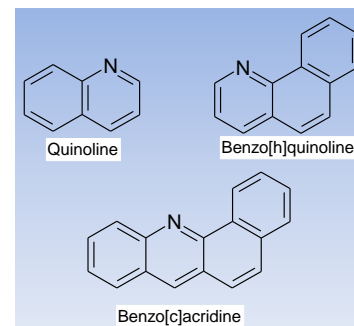
PAHs



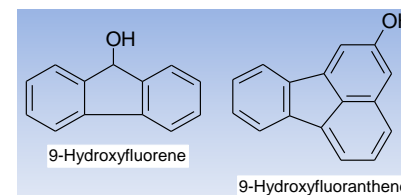
Oxy-PAHs



Nitro-PAHs



Azaarenes

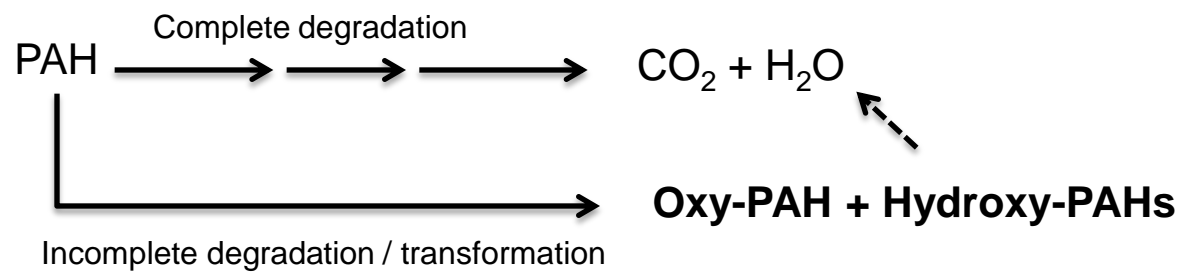
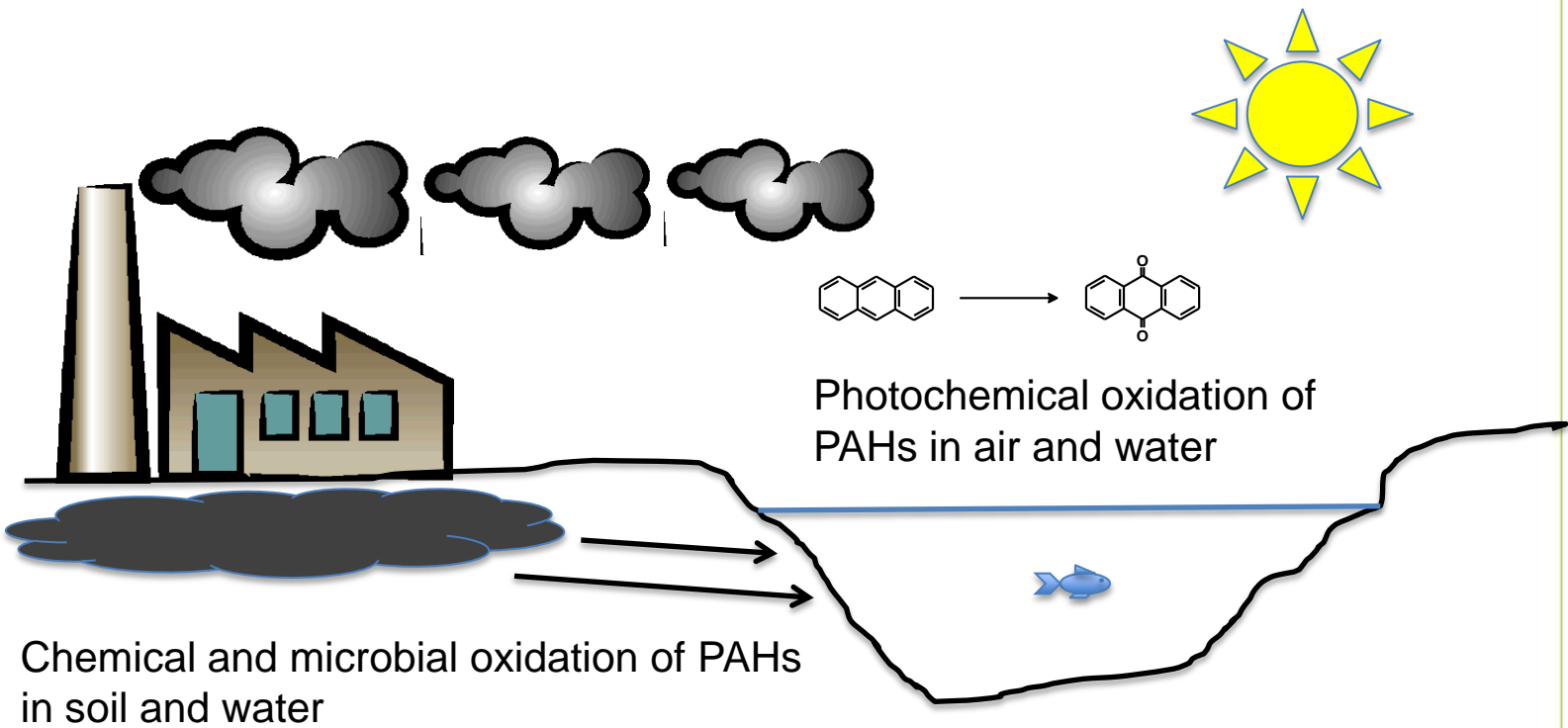


Hydroxy-PAHs



- Polar PACs are formed and emitted from the same sources as PAHs, i.e. during pyrolysis and incomplete combustion, and from coal-tar and creosote.
- Some polar PACs may also be formed as a result of PAH-transformation in the environment (oxy- and hydroxy-PAHs)

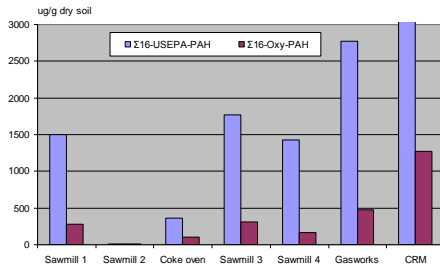
Formation of polar PACs



Why study polar PACs?



Environmental conc.

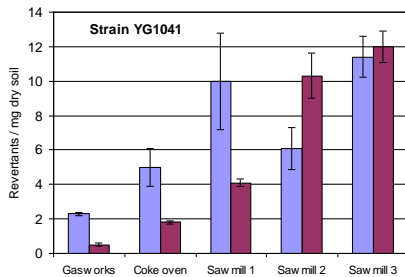


Concentrations of $\Sigma 16$ -PAH (■) and $\Sigma 16$ -Oxy-PAH (■) in soils from various contaminated sites.

Polar PACs

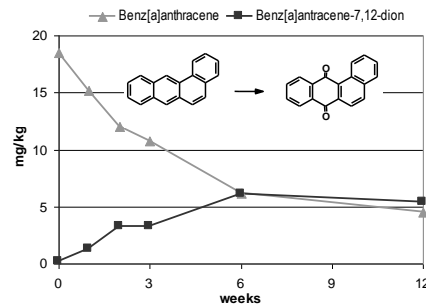
- ...are found in high concentrations
- ...may be considerably toxic
- ...may be formed as PAHs are degraded
- ...have a high tendency to leach

Toxicity

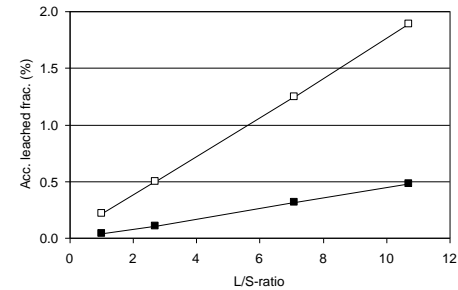


Mutagenic activity in the non-polar (■) and the semi-polar (■) fractions of soil extracts from various PAC-contaminated sites.

Environmental behaviour



Transformation of benzo[a]anthracene to 7,12-benzo[a]anthracenedione



Leaching of PAHs containing three rings (■) and oxy-PAHs containing three rings (□) from a soil collected at a wood preservation site

PACMAN

Objectives

To assess to what extent polar PACs contribute to the risk at PAH-contaminated sites, and to find ways to manage and reduce this potential risk.

- Data collection regarding the occurrence and distribution of polar PACs at contaminated sites, their potential formation in remediation processes as well as their negative effects on human health and the environment.
- Sampling and monitoring at selected contaminated sites in order to supplement the collected data.
- Experimental studies of selected remediation processes.
- Data collection aiming at identifying knowledge gaps that need to be filled for proper risk assessment of the polar PACs (e.g. generic guideline values)
- Experimental studies that will fill some of the gaps, e.g. leaching experiments
- Identification and evaluation of remediation processes that can minimize the risks associated with polar PAC formation

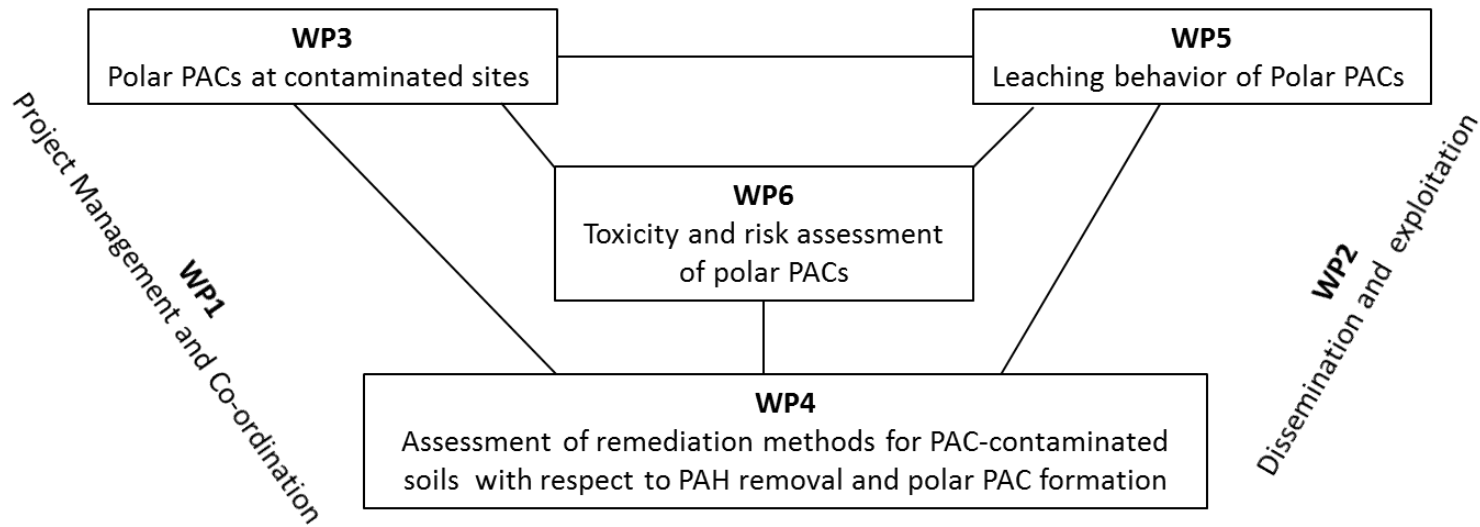


The work packages in PACMAN



PACMAN

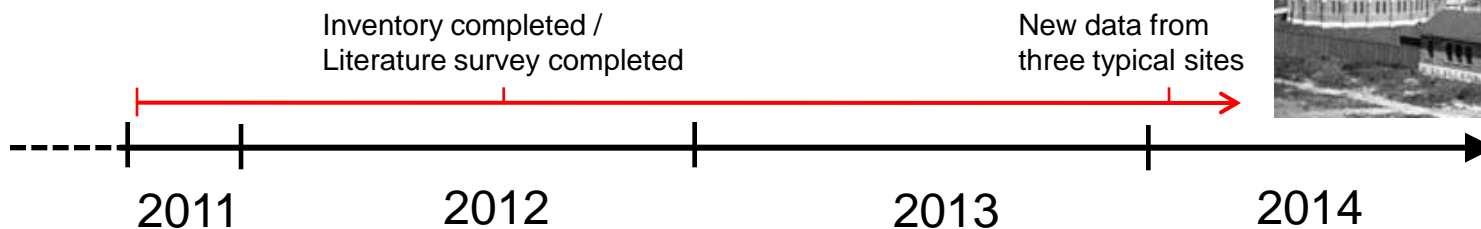
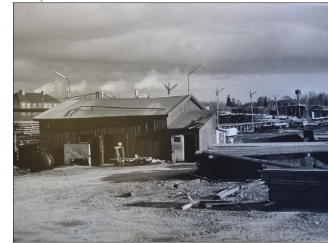
Assessment and management of polar PACs in contaminated soils and remedial processes



WP3: Polar PACs at contaminated sites



- Inventory of the numbers and types of PAC-contaminated sites in Sweden, France (and Europe).
- Literature study regarding the occurrence and distribution of polar PACs at contaminated sites
- Supplementary sampling at three typical PAC-contaminated sites in Sweden and France.
- In focus: The levels of Polar-PACs in relation to the PAH-levels and differences in their spatial distribution.
- Also: Differences in site characteristics (site history, source term, soil types, weather conditions etc.) that can explain differences in polar PAC-levels and the over-all contamination pattern.

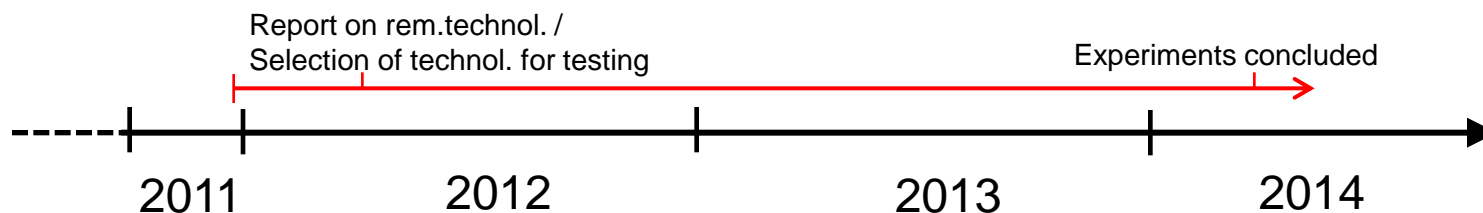


WP4: Assessment of remediation methods for PAH-contaminated soils with respect to PAH-removal and polar PAC formation



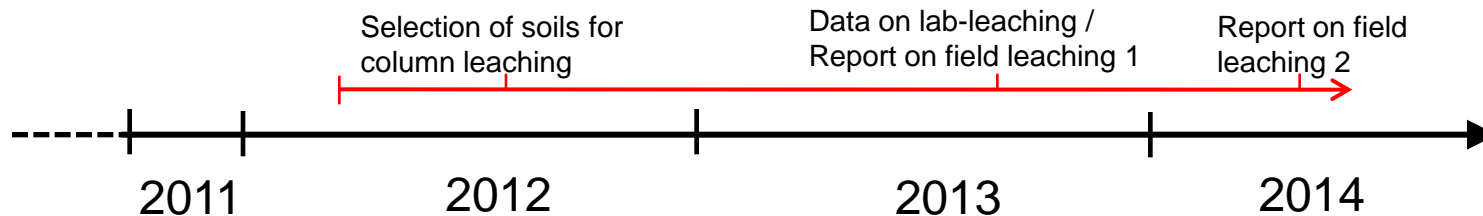
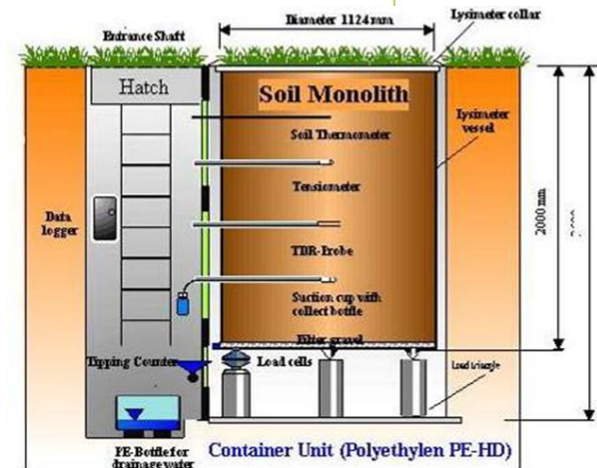
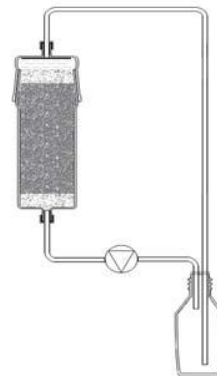
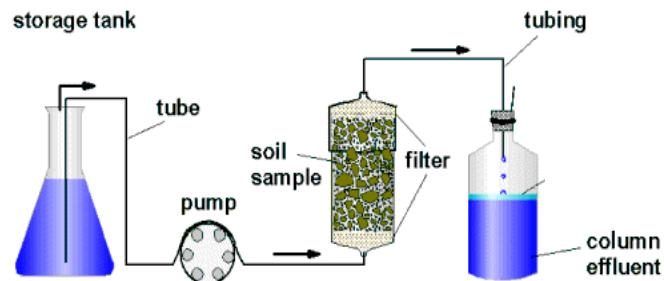
Objectives: To evaluate remediation technologies applied or applicable to PAC-contaminated sites, and to identify those that constitute the greatest and lowest risk in terms of polar PAC-formation

- Literature study to find out which technologies that are being used, or potentially can be used for remediation of PAC-contaminated sites, and to compile the existing knowledge regarding formation of polar PACs during these processes
- Experimental studies on three promising remediation technologies that need to be investigated further regarding when polar PACs are formed and how this can be prevented.



WP5: Leaching behaviour of polar PACs

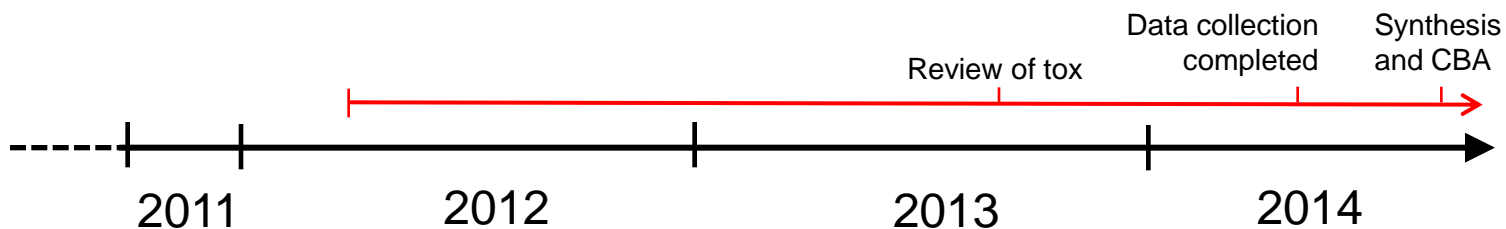
- Laboratory leaching studies to determine soil-water partitioning coefficients for the polar PACs, later to be used in risk assessment models (e.g. for guideline values).
- Field lysimeter studies to investigate how various scenarios (e.g. rainfall..) and remedial treatments will influence the mobility of the polar PACs



WP6: Toxicity and risk assessment of polar PACs



- Project synthesis, aiming at evaluating the risk posed by polar PACs at contaminated sites as well as in various remediation processes.
- Literature review of the toxicological aspects of polar PACs (in collaboration with Prof. Paul White at Health Canada).
- Identification of knowledge gaps that would need to be filled to perform a proper risk assessment of the polar PACs, using various RA-models for instance.
- Usefulness and risks of different remediation methods
- Cost-benefit analysis of including polar PACs in the risk assessment and remediation of PAC-contaminated sites.



Deliverables – in summary

- Increased knowledge of the occurrence and distribution of polar PACs at contaminated sites, focusing on the situation in Sweden and France.
- Increased knowledge concerning the potential formation of polar PACs in remediation processes that are being used or potentially may be used during remediation of PAC-contaminated sites.
- Increased knowledge of the mobility of polar PACs in soil, both regarding untreated soil and soil that is being remediated with various technologies
- A synthesis of the existing knowledge concerning the toxicity of polar PACs.
- A better base for risk assessment of polar PACs at contaminated sites and in remedial processes, including data that can be directly used as input data in risk assessment models.



Risks and Solutions

- R: That the existing information on polar PACs is limited, both regarding occurrence, formation and toxicity.
S: To use a comprehensive approach, including detailed and wide literature searches, utilization of existing contact networks, and to perform complementary experimental studies.
- R: To identify and get admittance to suitable contaminated sites for field experiments (in WP 3 and 5).
S: To utilize the extensive contact networks possessed by the project members.
- R: Difficulties to determine the levels of polar PACs in soil and water samples.
S: Knowledge and experience available at two of the project's partner organizations.
- R: Unsuccessful duration of the lysimeters studies under natural rainfall leading to limited downward movement of the contaminants (WP 5).
S: Artificial rainfall with an inert tracer added for water movement



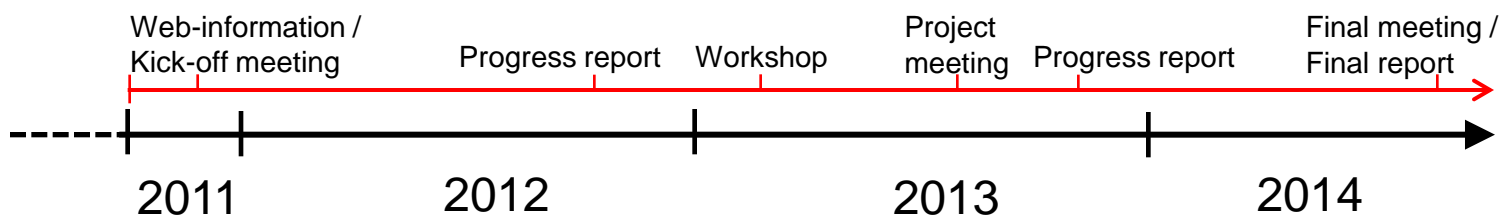
WP1: Project Management and Co-ordination

- **Umeå University**, Sweden, co-ordinator
Dr. Staffan Lundstedt, and Prof. Mats Tysklind
Several years of experience on studies on PAHs and polar PACs in soil and remediation processes. Project leaders of the "Polar PAC Network" and the "Northern Sweden Soil Remediation Centre" (MCN), respectively.
- **BRGM**, France
Dr. Christophe Mouvet, Dr. Bruno Lemière, Dr. Alain Saada, M.Sc. Stéfan Colombano
Expertise in studying fate of PAHs in soils and groundwater, as well as in assessing remediation processes at various scales. Experienced in linking research outputs with stakeholders expectations
- **CNRS**, France
Dr. Pierre Faure and RI. Catherine Lorgeoux
Experienced in pilot scale studies on in-situ remediation and leaching, as well as in chemical analysis of PAHs and polar PACs.



WP2: Dissemination and exploitation

- Information on the SNOWMAN website, the EUGRIS web-portal and a project specific website
- Kick-off meeting, the all-project-workshop and the all-project-final meeting
- Project meeting combined with a thematic day for stakeholders
- National and international conferences. A special session will be organized at one of these (e.g. ConSoil 2012/2014)
- Existing contact networks, e.g. Polar PAC Network, NICOLE etc.
- Annual progress reports, a final report, and scientific publications
- Exploitation of analytical methods and new data for RA
- Aim: Inclusion of polar PACs among regulated compounds...if needed.



Dissemination: Internal communication

- A project specific website, both containing external and internal information.
- Co-ordination committee consisting of one representative from each organization (including the co-ordinator)
- Regular telephone or internet based conferences
- Frequent use of e-mail.
- Attendance at the kick-off meeting, the all-project-workshop and the all-project-final meeting
- An additional project meeting half way through the project.
- Regular contact with the project board



Budget for PACMAN

Participating organizations, their funders and the total costs for the project



Organization	Total organization costs	Money requested	Funding organization
Umeå University (Sweden)	209 249 €	186 997 €	Swedish EPA
BRGM (France)	238 838 €	135 779 €	French ADEME-SFUSP
CNRS UMR 7566 (France)	129 812 €	46 093 €	French ADEME-SFUSP
Total	577 899 €	368 869 €	

On dissemination activities (meetings, conferences, publications etc.): 28 500 €

Thank You!

Questions?

Comments?



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