UNIVERSITÄT DUISBURG ESSEN

Project 2.5

Priority substances in activated sludge: Incidence, accumulation, biodegradation, source tracking emitter identification & prevention strategies

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PEOPLE

MARIE CURIE ACTIONS

QUESTOR CENTRE

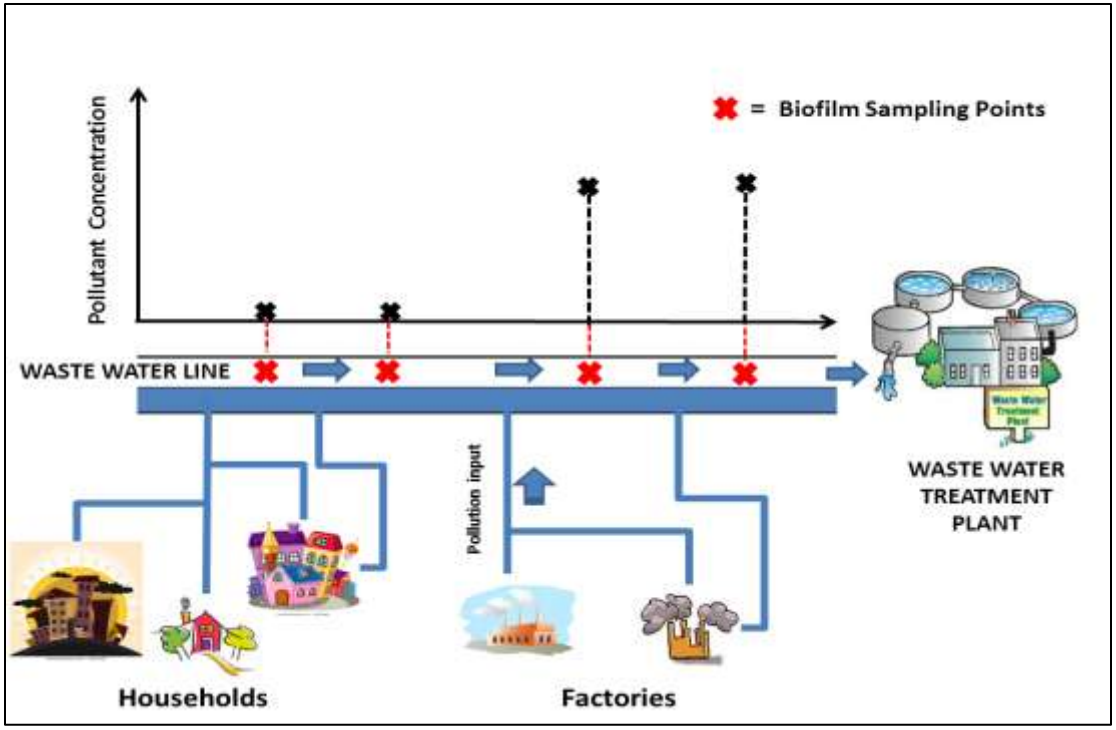
ATWARM

INTRODUCTION TO THE PROJECT

The aim of the project:

Trace the pollution in the waste waters system

Address the pollution sources along the waste water system



HOW?

Use memory effect of Biofilms as Pollution Tracers

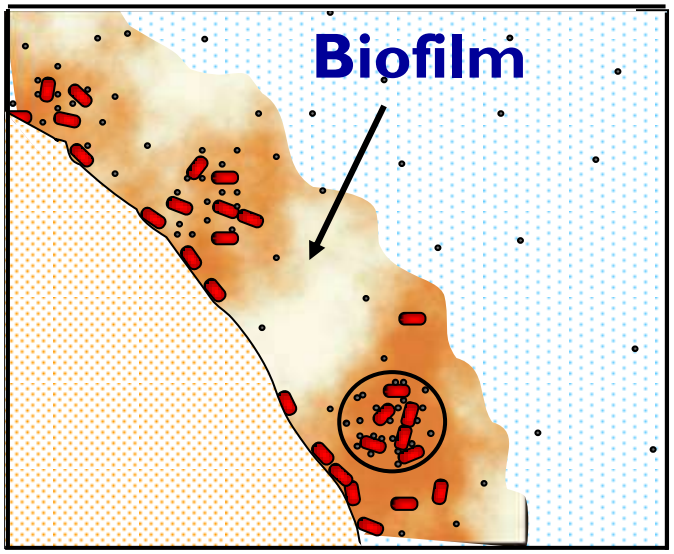
INTRODUCTION TO THE PROJECT

The General hypothesis:

Biofilms act as a memory for water components due to their sorption properties.

Detect earlier contact with contaminants.

Contaminants = All the Priority substances mentioned in the Water Framework Directive (WFD) by European Commission.



SORPTION SITES

-Intracellular (cytoplasm or periplasmic space)

- Cell walls, cell membranes

- Extracellular: EPS

RESUMING….

We want:

- Trace pollution in waste water system.
- Use memory effect of microbial biofilm as indicators.
- Priority substances → PAH (Poly Aromatic Hydrocarbons) → phenanthrene.
- Model for absorption and desorption processes of biofilms ⇨ defined hydrogels.
- Which technique? Fluorescence spectrometry.

PROJECT WORK

- **Preliminary Experiments → modeling**
  - Artificial Biofilm, different defined hydrogels
  - Fluorescence spectrometry.
    - Partition coefficient
    - Accumulation kinetics
    - Desorption kinetics
    - Diffusivity
- **Bench scale experiments with a real biofilm matrix.**

PRELIMINARY EXPERIEMENTS (QS cuvette)

Fluorescence Spectrometer

QS (Quartz suprasil) cuvettes

Agar gel

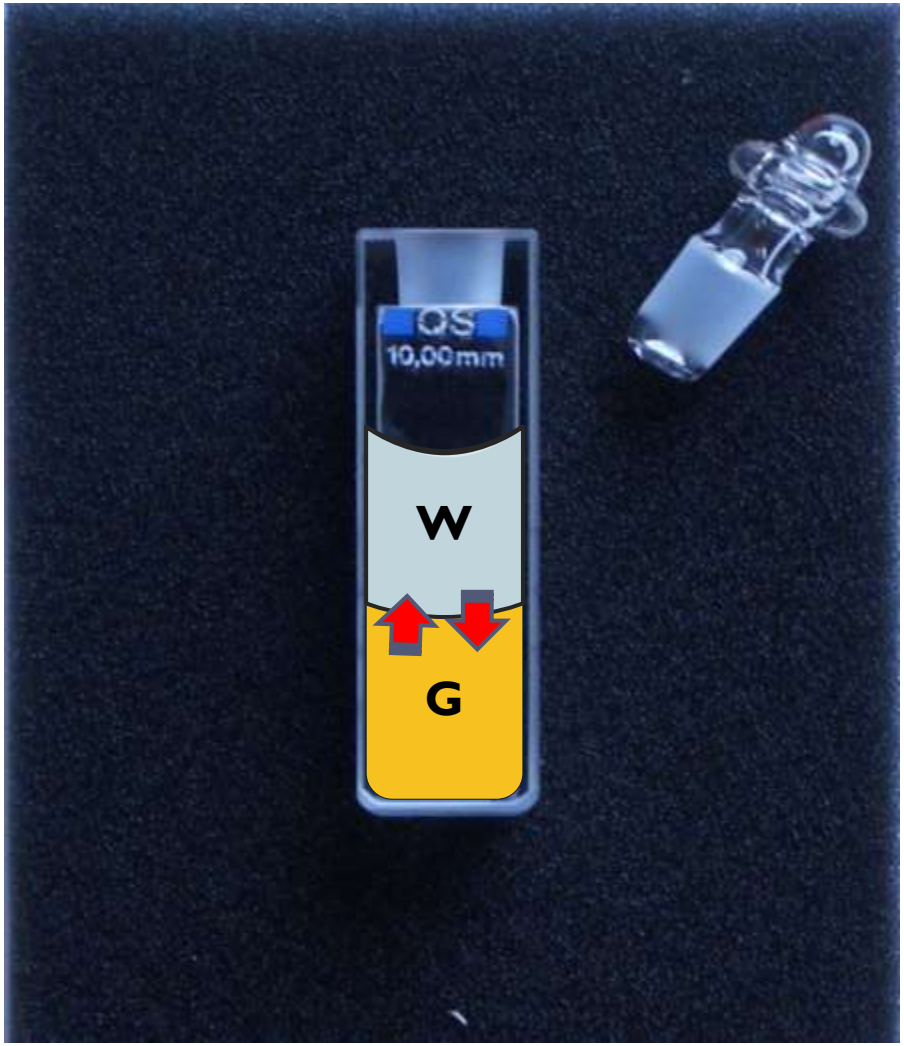
Gelatine gel

Gellan gum

VS Phe. Water solution 1.5ppm

modeling

PRELIMINARY EXPERIEMENTS (QS cuvette)



Focus

Experiments till equilibrium

1. Absorption
2. Desorption

HOW?

1. Selective illumination of each layer.

Priorities:

1. Prove the system.
2. Experiments till Equilibrium state.

PRELIMINARY EXPERIEMENTS (QS cuvette)

Agar gel

Gelatin gel

Gellan gum

→ **Gel 2% w/v** →

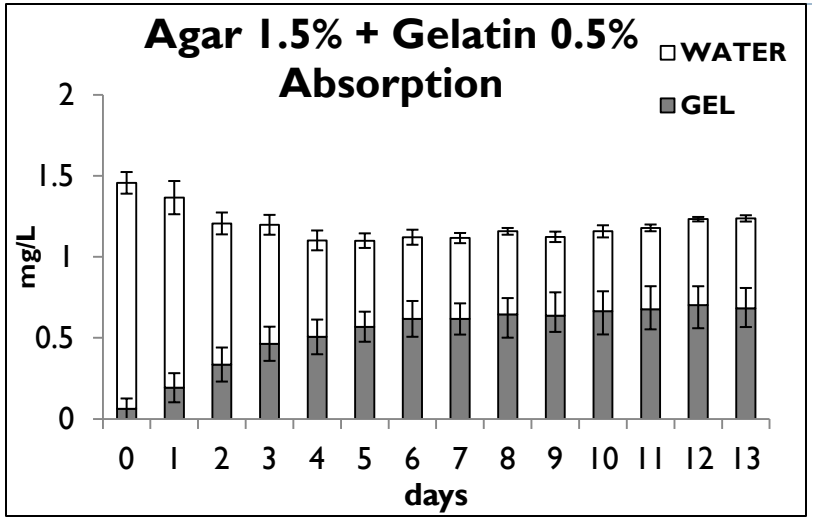
- Agar 2% w/v
- Agar 1.5% w/v + gellan 0.5% w/v
- Agar 1.5% w/v + gelatin 0.5% w/v

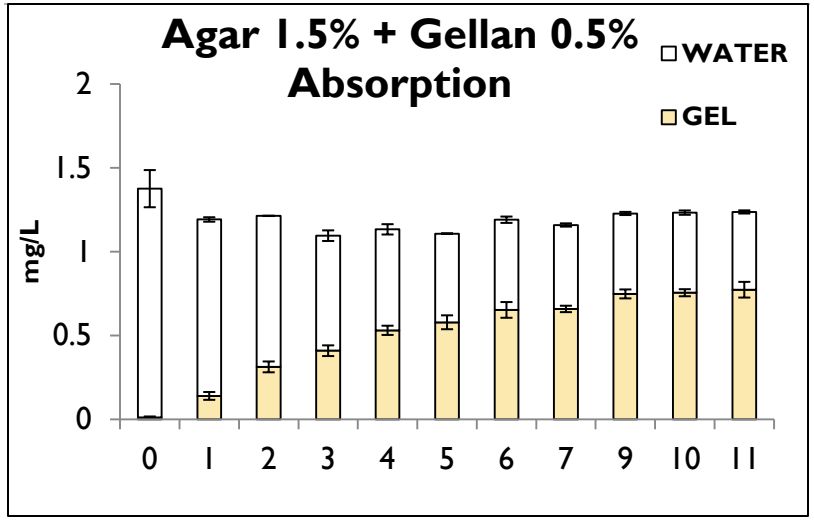
↓

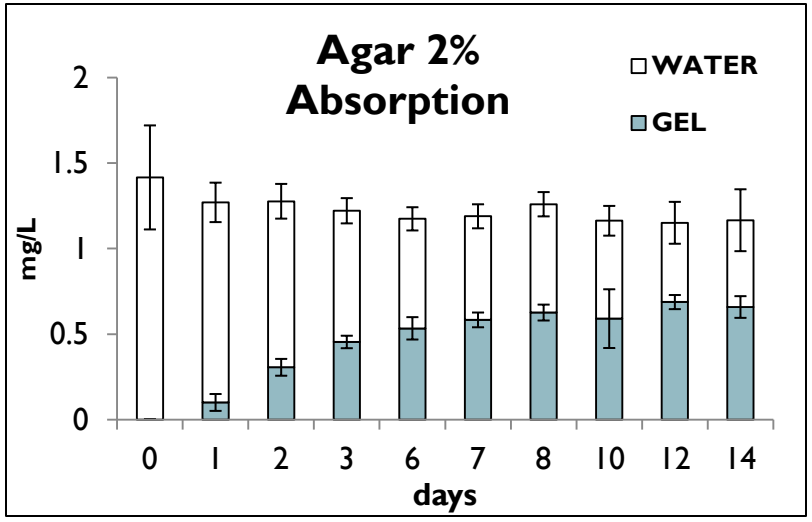
- Absorption
- Desorption

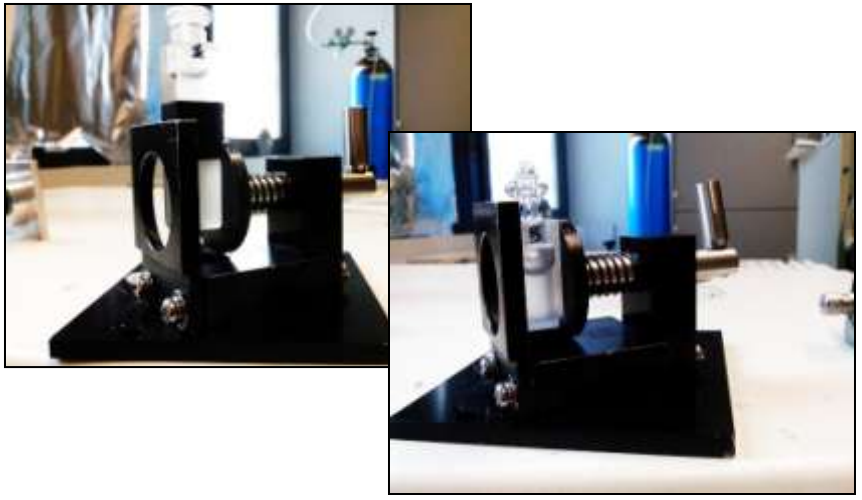
- Static conditions
- Mixing conditions

Mass balance (static conditions)

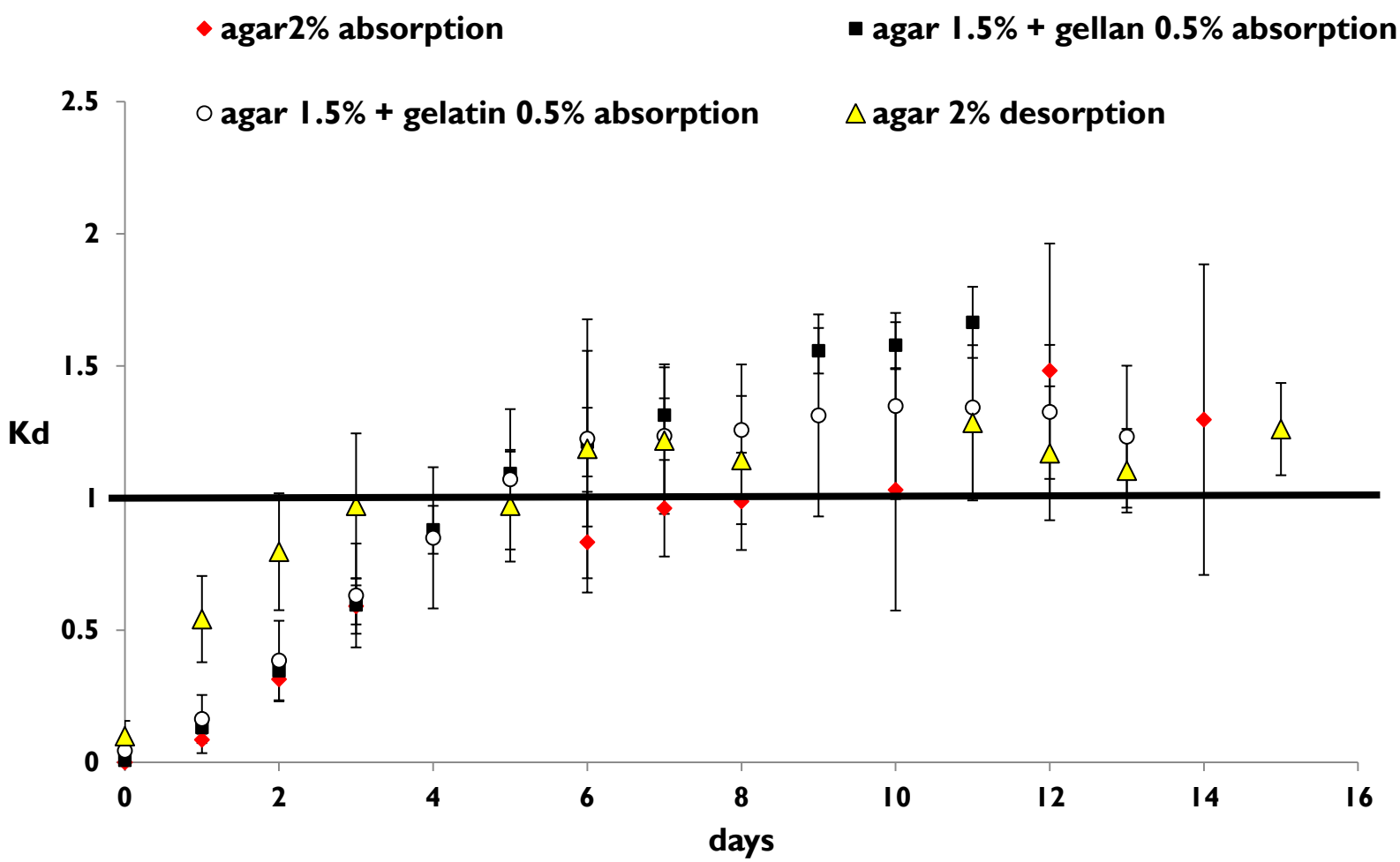








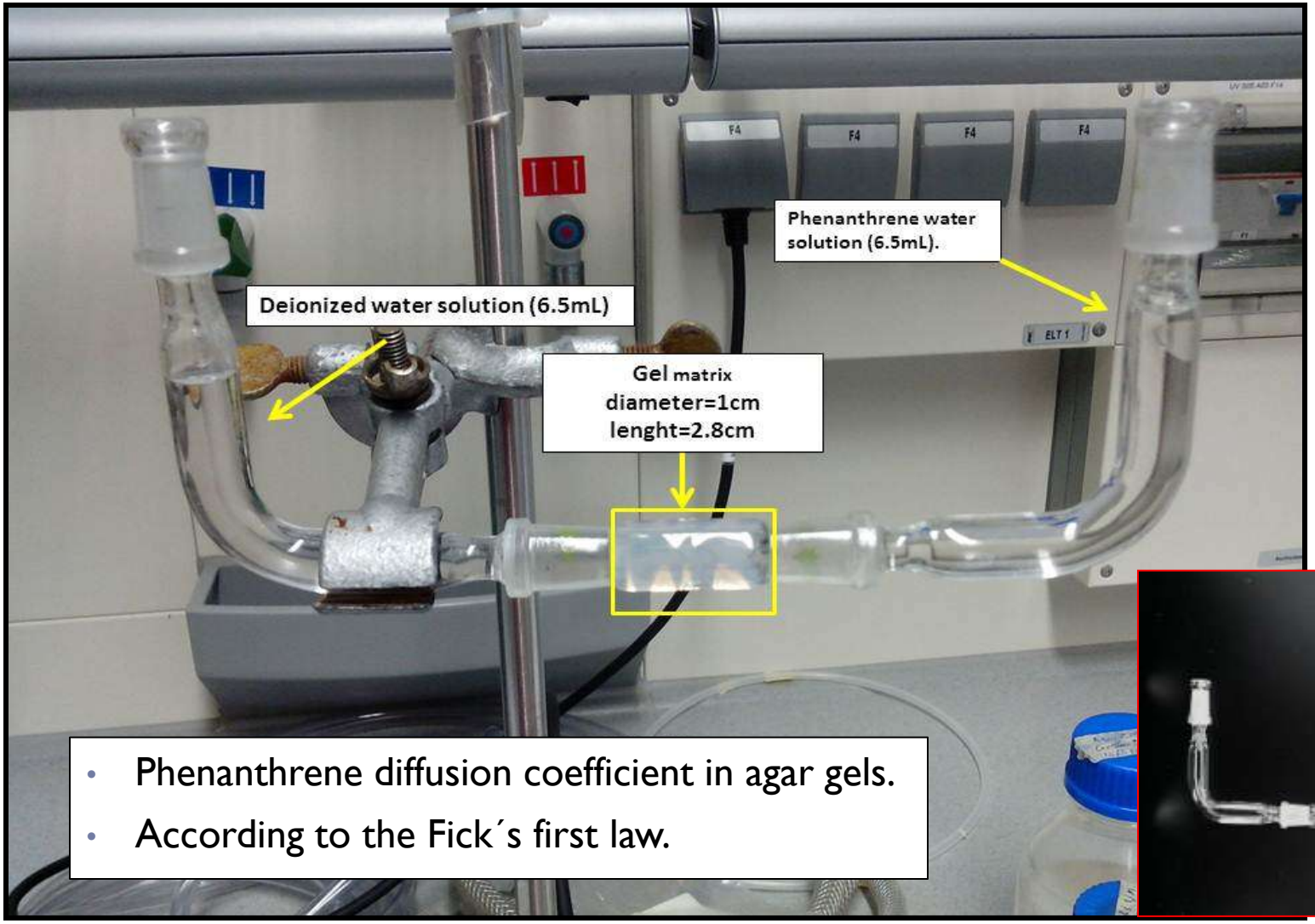
Distribution of Phenanthrene (ongoing)



Partition coefficients (ongoing)

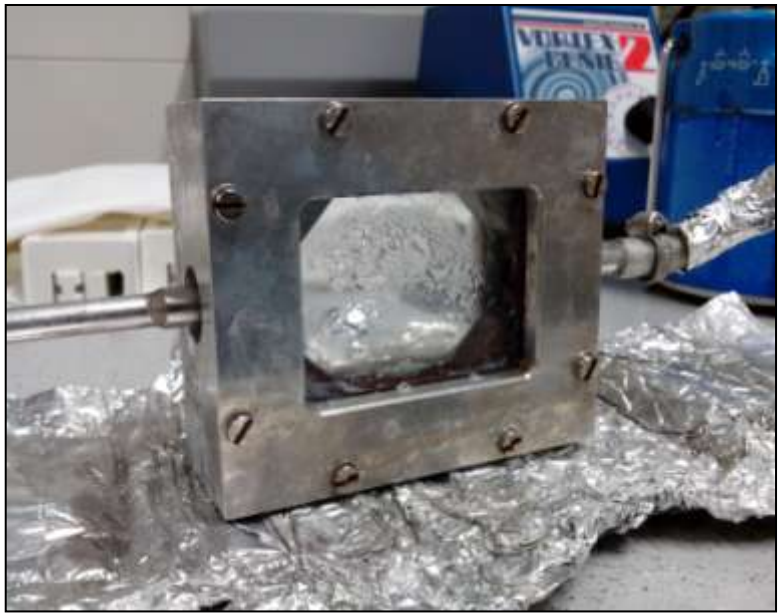
Log Kow= 4.7	Koc (L/Kg) **Log Koc**
This study (preliminary experiments): • **Agar 2% w/v** (absorption, static) • **Agar 2% w/v** (desorption,static) • **Agar 2% w/v** (absorption, mixing 900rpm) • **Agar 2% w/v** (desorption, mixing 900rpm) • **Agar 1.5% w/v+Gellan 0.5% w/v** (absorption,static) • **Agar 1.5% w/v+Gelatin 0.5% w/v**(absorption,static)	 **5.2** **4.6** **4.7** **4.6** **5.2** **5.1**
Wicke et al.2007 **Biofilm (Sinorhizobium sp.)**	**4.1**
Jonassen et al.2003 **Humic acid**	**4.2**
Gauthier et al.1986 **Humic materials**	**4.7**
Krauss and Wilcke 2001a **Soils and sediments**	**4.1-6.7**
Patryk Oleszczuk 2008 **Sewage sludges**	**4.1-4.7**

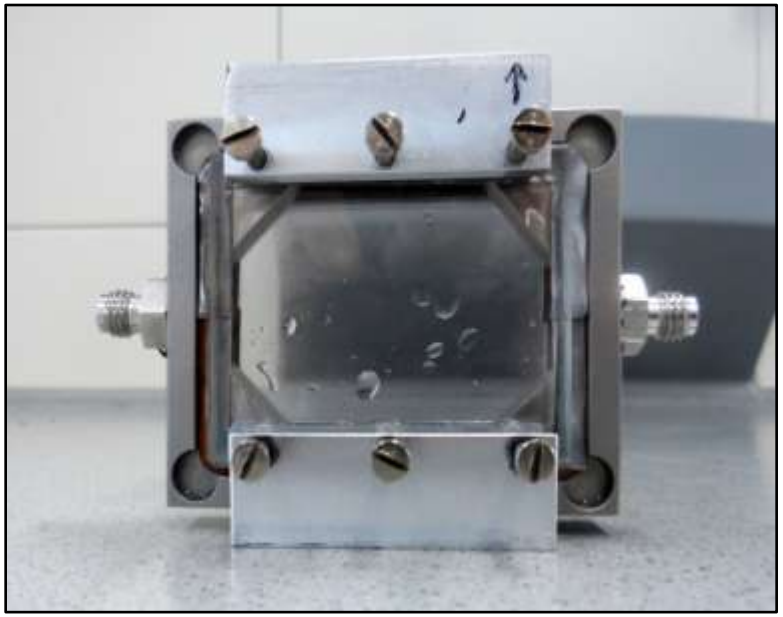
Diffusivity (ongoing)

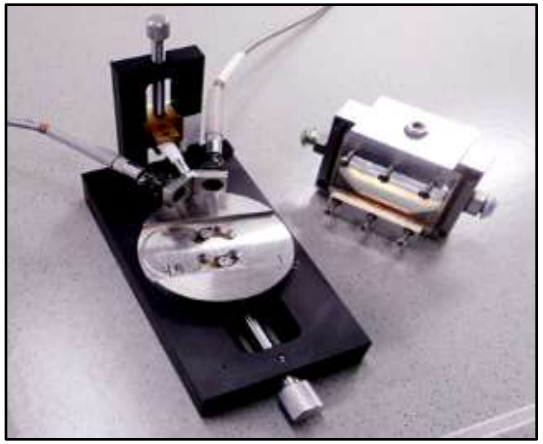


- Phenanthrene diffusion coefficient in agar gels.
- According to the Fick´s first law.

Lab-scales flow cell for biofilm (ongoing)







- Grow drinking water biofilms.
- Spike the biofilm with phenanthrene.
- Detect the phenanthrene into the biofilm by front face fluorescence spectroscopy.

Growing biofilm on glass (ongoing)

- Glass : chemically inert material.
- Glass slides (2.5cm x 7.6cm) sand etched.
- Static conditions (previous exps).
- NB medium inoculated with drinking water preculture (2.2E^10 cells/mL).
- <u>3 different systems:</u>
  - 50mL glass vial (A)
  - 275mL glass bottle (B)
  - 80mL stainless steel chamber (C,D)

Summary

- Agar as biofilm model.
- The Fluorescence Spectroscopy (front face mode) is a suitable technique.
- Agar 2% w/v matrix does not show significant accumulation.
- Microbial biofilms might not accumulate significantly phenanthrene from deionized water solutions.
- But retention of phenanthrene can be long enough to detect concentrations elevated compared to water.
- Glass tube experiments for diffusivity of Phenanthrene.
- Flow cell: sampling and analysis device
- Growing biofilms on glass → front face fluorescence

Further work

- Repeat cuvette exps.
- Study the desorption time of phenanthrene from the agar gel matrices.
- Change phenathrene solution:
  - pH
  - Salinity
  - Humic substances
  - Temperature
  - Surfactants (anionic)
- Compare diffusivity results with literature data.
- Sorption experiments with real biofilm matrix and phenanthrene water solutions.

Workgroup

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THANK YOU FOR YOUR ATTENTION

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