GARCÍA-CERVILLA, RAÚL

PhD

Universidad Complutense de Madrid

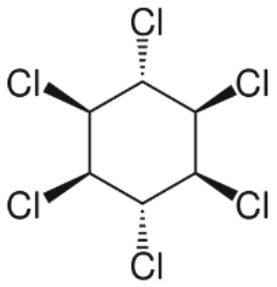
Departamento de Ingeniería Química y de Materiales

ISCO AND S-ISCO EVALUATION IN THE REMEDIATION OF SARDAS ALLUVIUM

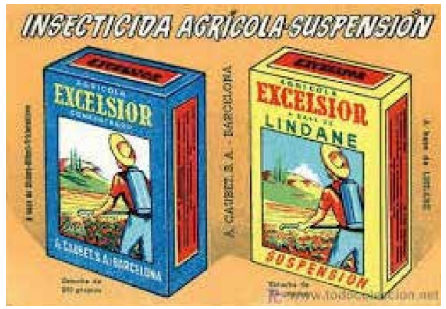
Lorenzo, D., Domínguez, C. M., García-Cervilla, R., Santos, A., Checa-Fernández, A., Fernández, J., Guadaño, J., Gómez, J.

Obsolete pesticide: Lindane

- **Lindane** (**γ**-isomer of **H**exachloro**C**yclo**H**exane) is an obsolete pesticide heavily used as a wide-spectrum insecticide in public health programs and as a wood preservative.
- **Banned by Stockholm Convenia (POP).**
- Hughe amounts of toxic wastes were generated and dumped in the nearby production sites without environmental concern.

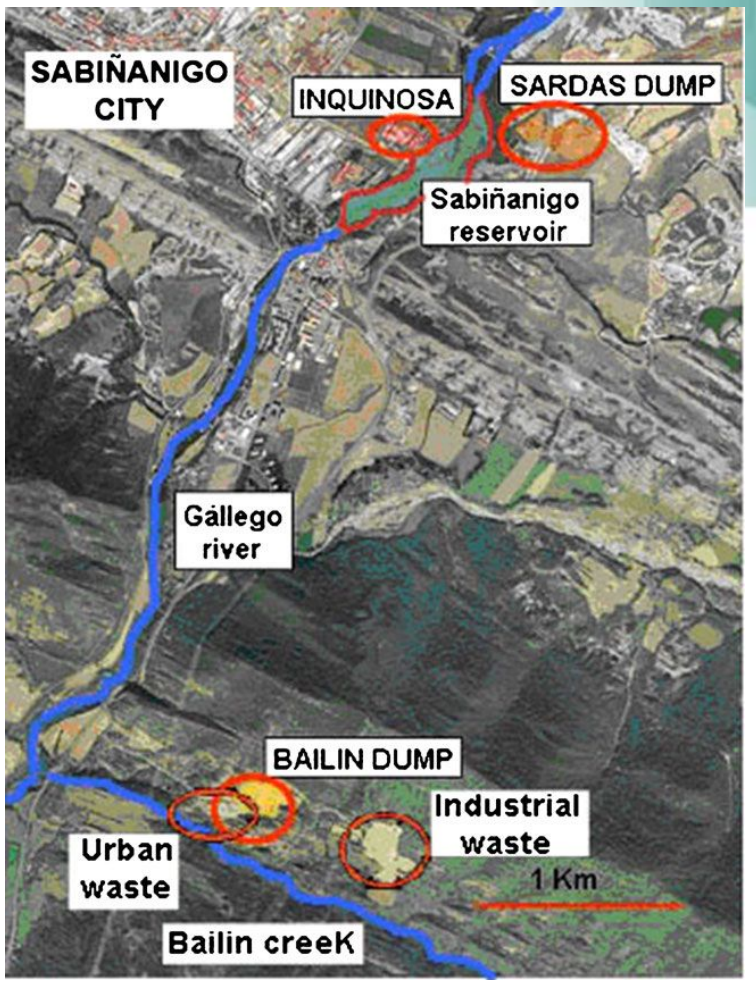


63% of HCH wastes were produced in Europe

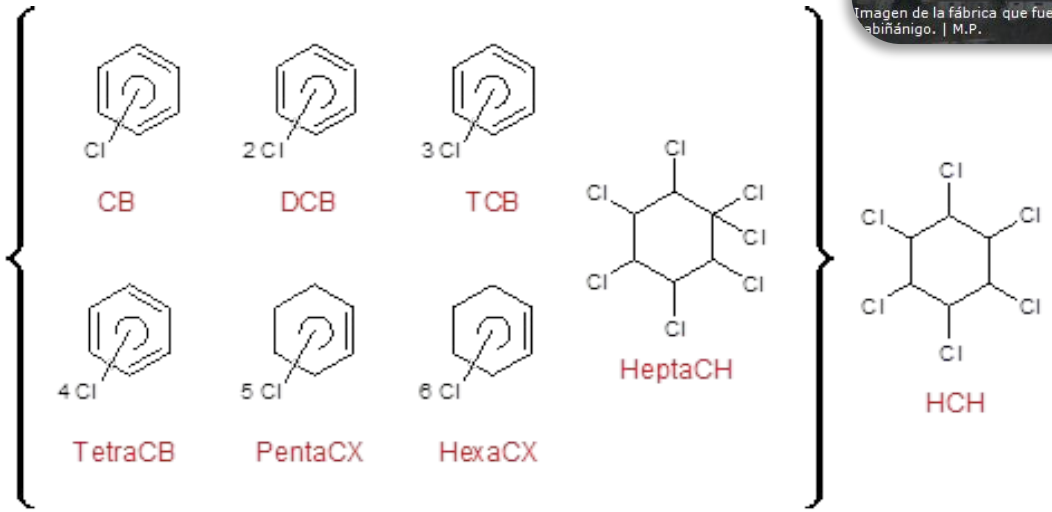


Lindane wastes in Sabiñánigo (Spain)

- ✔ The Company INQUINOSA operated from 1975 to 1988 in Sabiñánigo, Spain.
- ✔ HCH production generated approximately 150000 tonnes of waste, mainly dumped in **two unlined landfills**: **Sardas** and **Bailin**, close to the river Gallego and the Sabiñanigo Reservoir.



DNAPL



Treatment train for NAPL removal

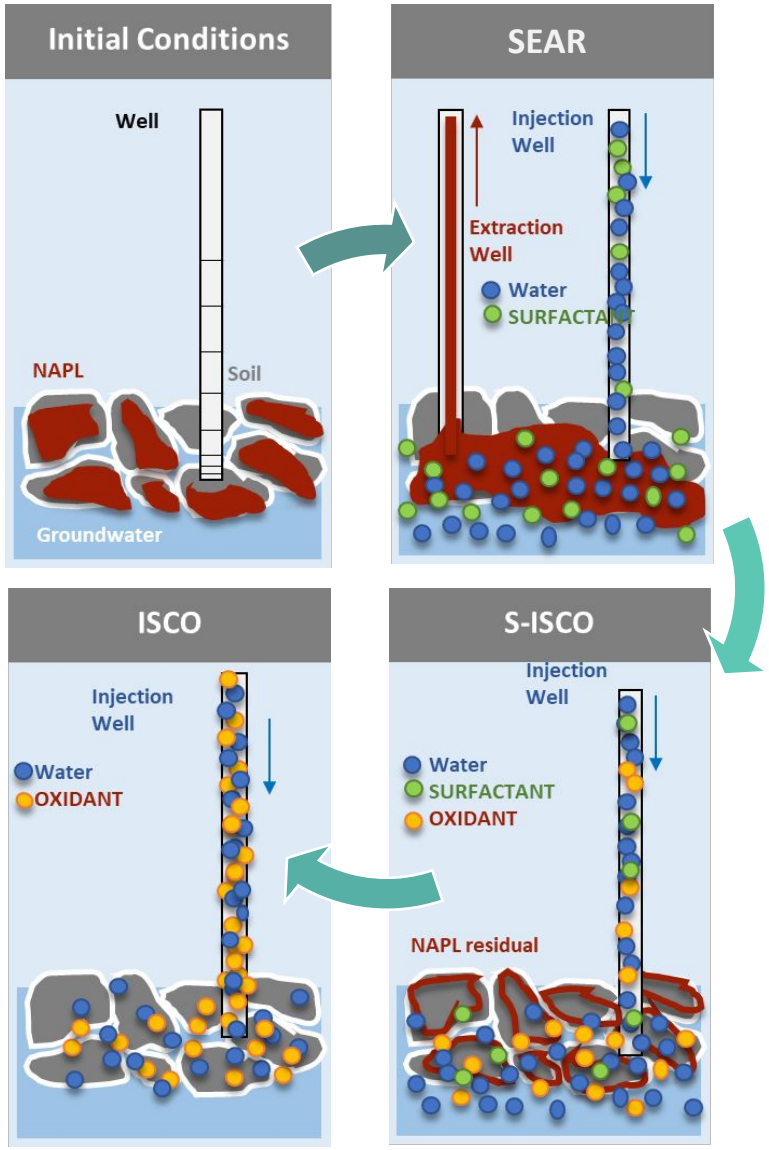
Pump (no surfactant)

SEAR

S-ISCO

ISCO

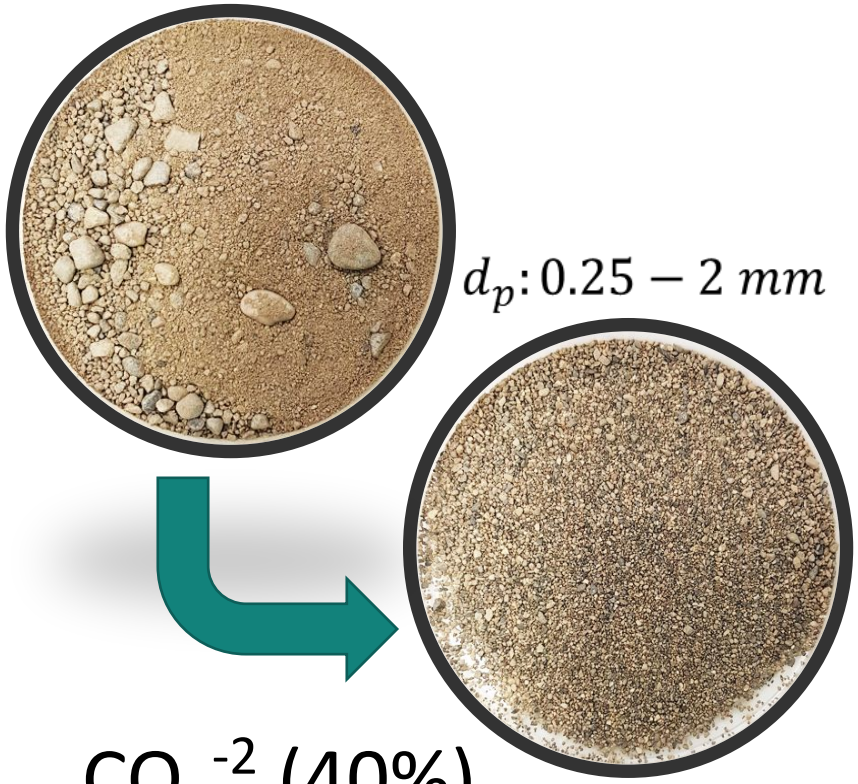
Acute toxicity
Microtox®



Soil samples

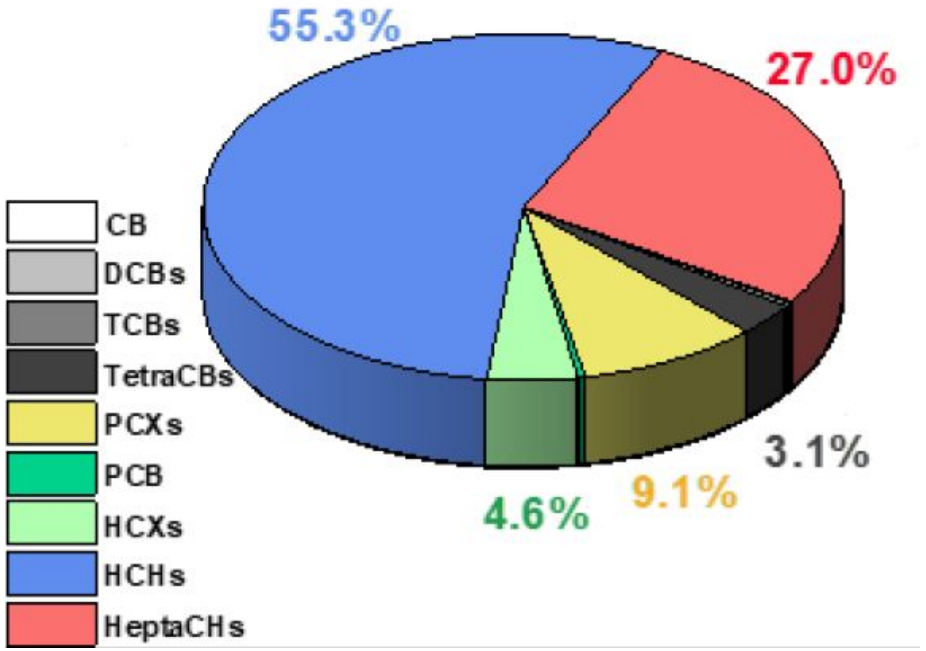
Soil B1 : Unpolluted

Soil B2 : 3680 $mg \cdot kg^{-1}$ of COCs



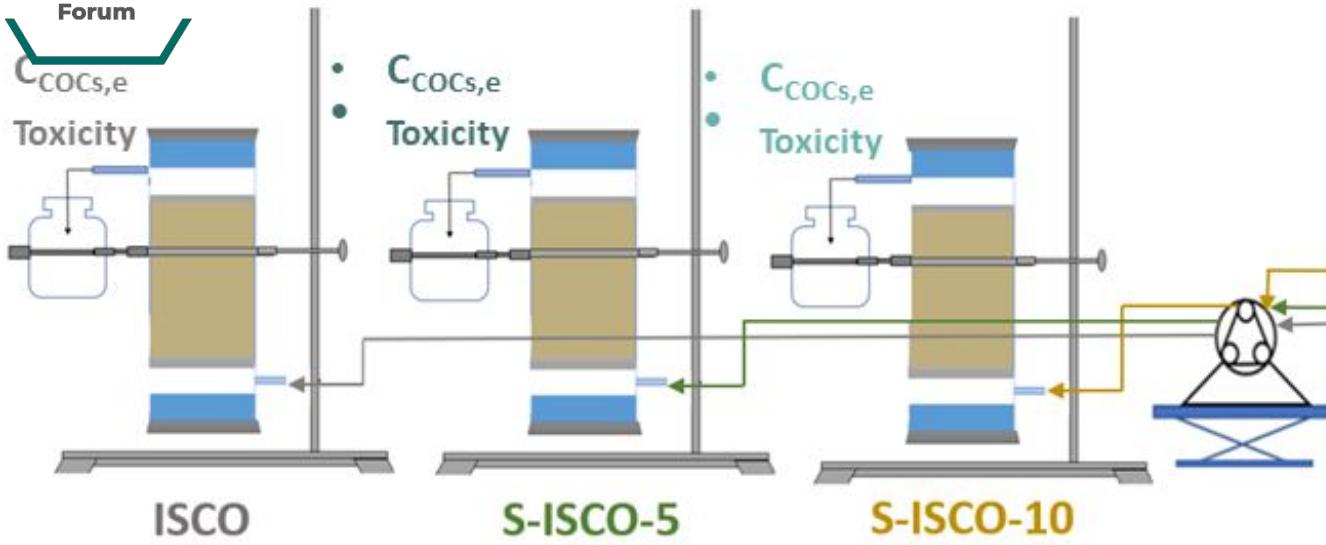
$d_p: 0.25 - 2\ mm$

CO_3^{-2} (40%)



$$\sum COCs = 3680\ mg \cdot kg^{-1}$$

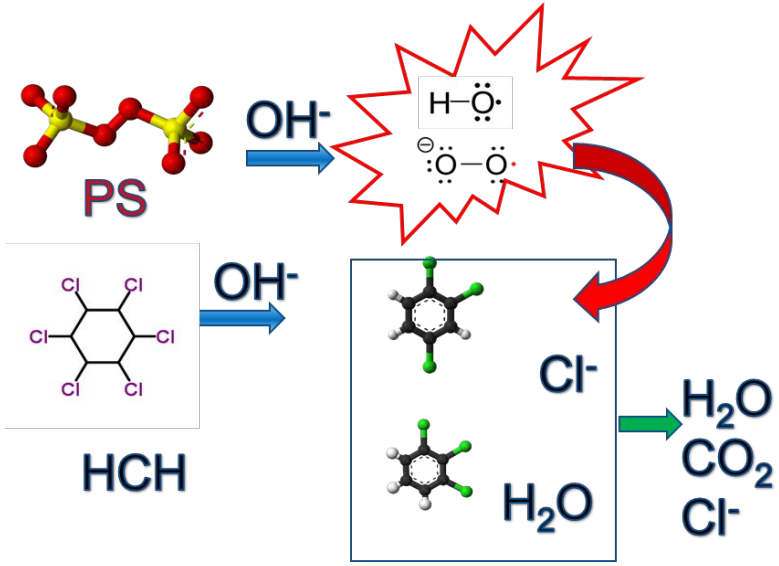
ISCO and S-ISCO experiments



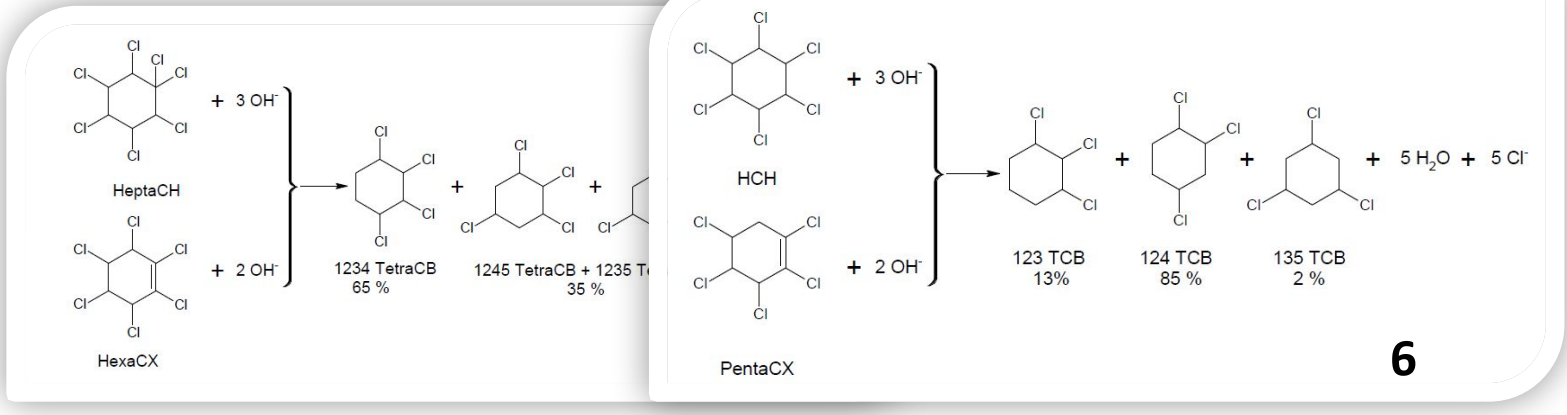
nº Pvs = 4 and 8

Time resting = 96h

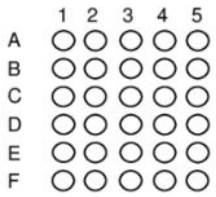
0	5	10	C_{surf}(g/L)
210	210	210	C_{PS}(mM)
210	210	210	C_{NaOH}(mM)

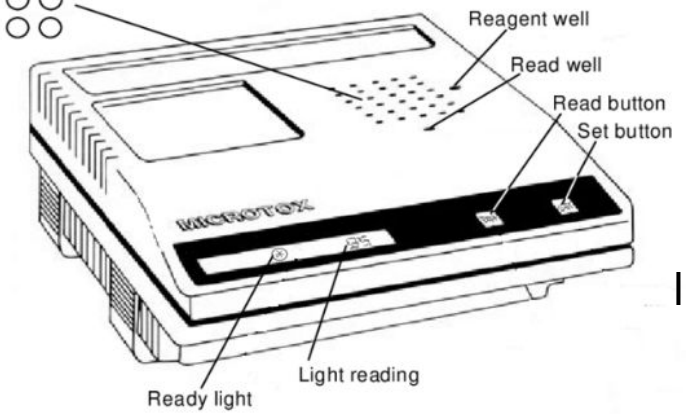


Alkali transformations:



Toxicity analysis (Microtox®)

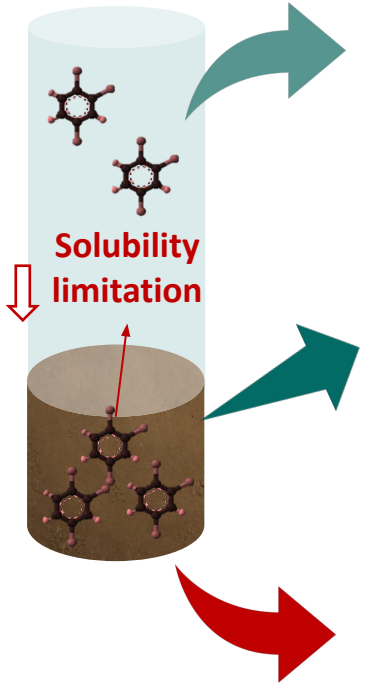




Measuring natural luminescence from marine bacteria: *Vibrio fischeri*

⚠ **pH setting = 6 - 8**

Comparing and adapting different methods



2. Aqueous extract:
Basic Test

1. Soil phase:
Basic Solid-Phase Test

3. Organic extract:
Organic Solvent Sample Solubilization Test
Solvent: Methanol

EC_{50}:
Concentration of the sample resulting in a 50% reduction of the initial luminescence of the bacteria.

Results:

Polluted samples: **EC_{50} (%)**

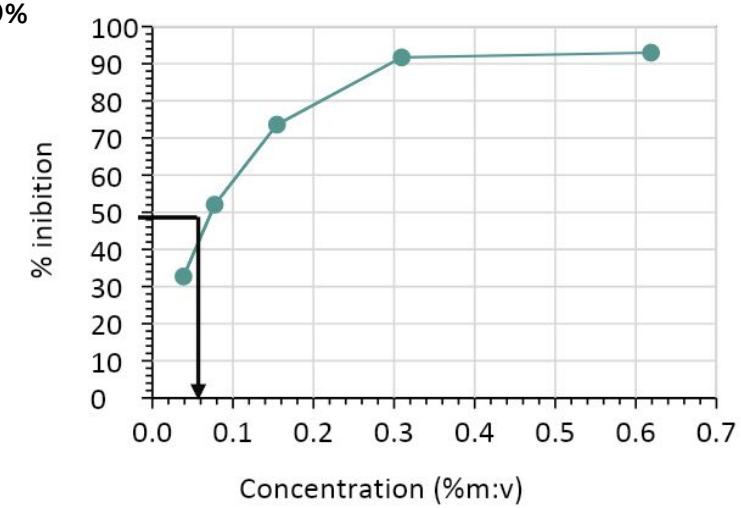
EC_{50} (%) ⇩ **toxicity** ⇧

- Compare: **UT_{50}**

⇩

Direct relation between the toxic effect and the numerical toxicity value:

$$UT_{50} = \frac{1}{EC_{50}}$$



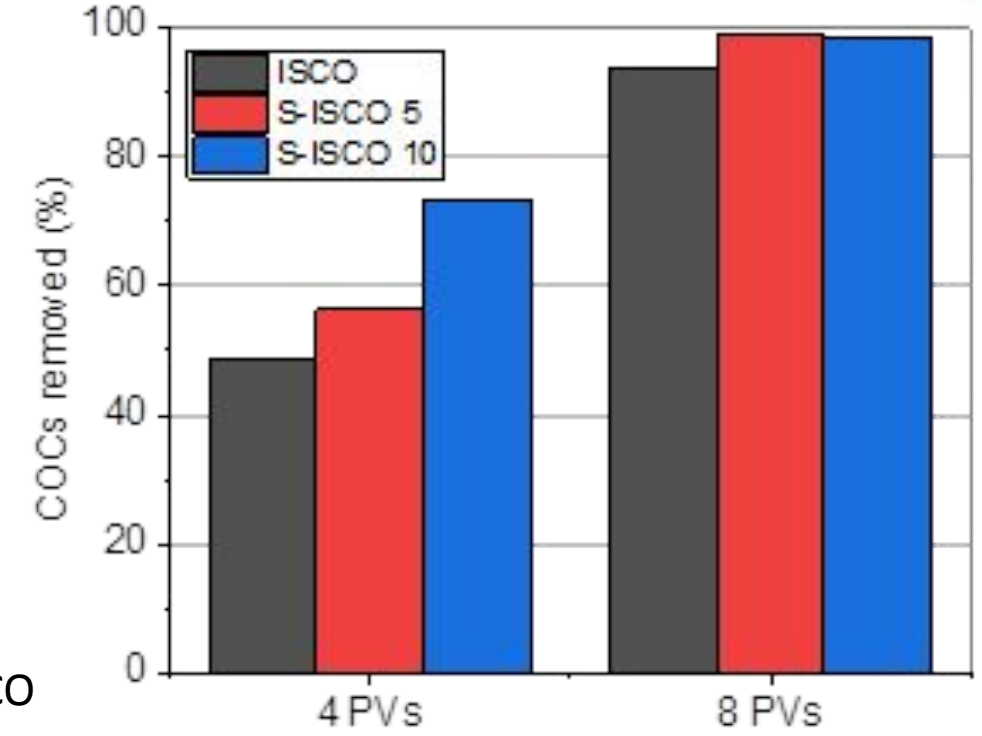
ISCO and S-ISCO treatments

Surfactant **improve** the COCs desorption

Radicals **oxidize** the pollutant (TCBs, TetraCBs)

Also E-Mulse 3

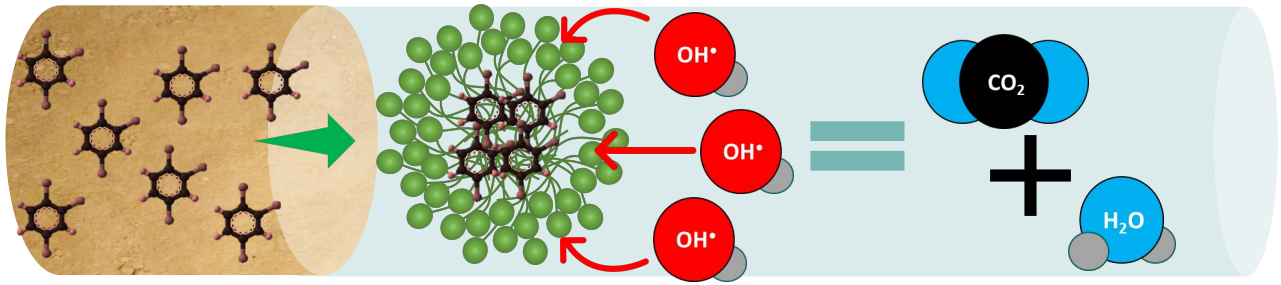
The higher the concentration of COCs in the aqueous phase, the higher the elimination rate



However

Oxidation in soil phase Significant conversions with ISCO

Soil phase **Aqueous phase**



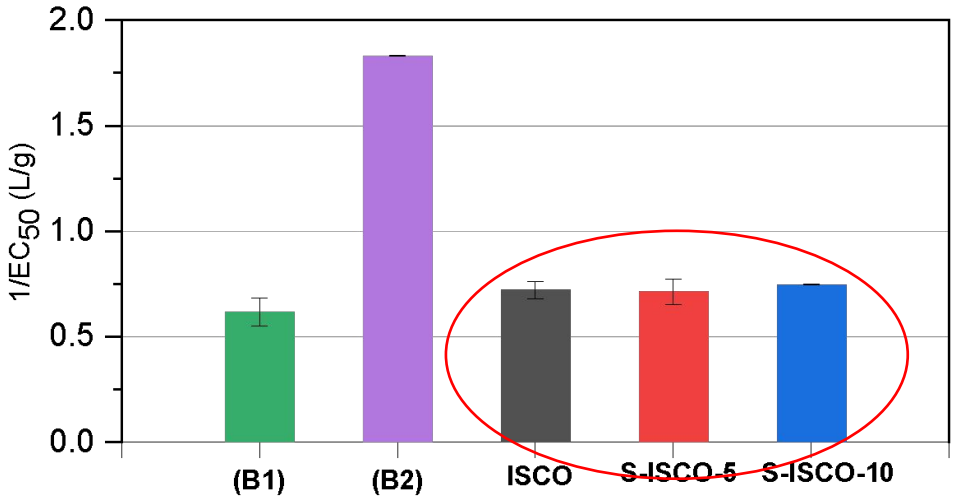
Toxicity evaluation

Clasification

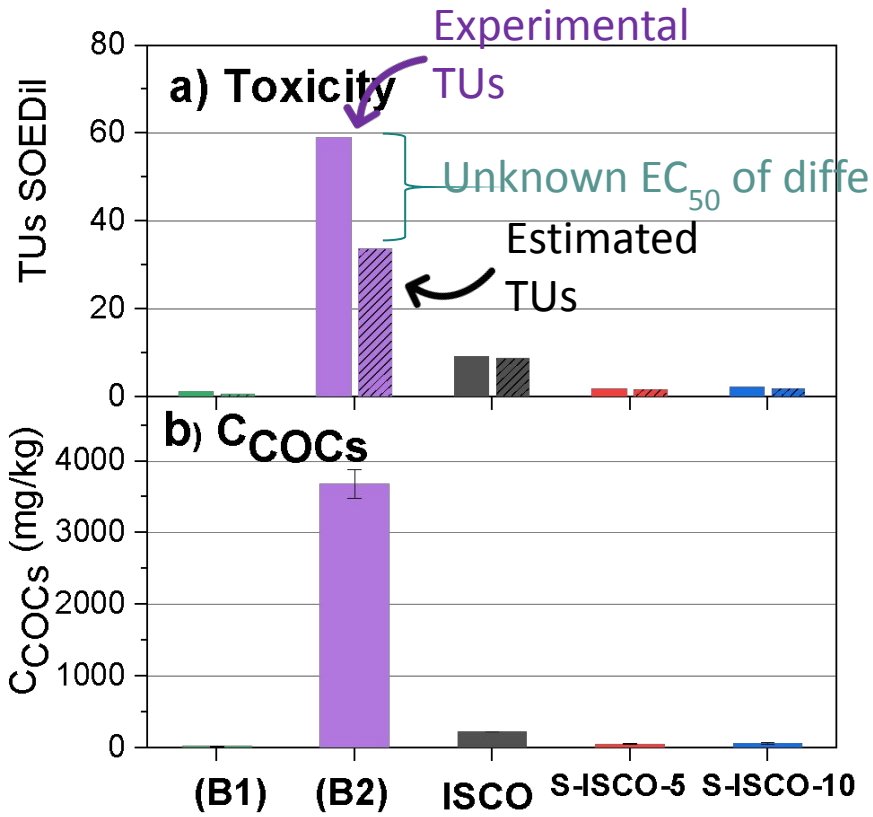
EC_{50} > 10%: non-toxic
EC_{50} = 1% - 10%: moderate toxicity
EC_{50} < 1%: high toxicity

Kwan, K. K. et al. 1990. *Toxicity Assessment*. 5, 4, 395-404

Basic Solid-Phase Test (mBSPT)



Organic Solvent Sample Solubilization Test (aOSSST)



14th International HCH and Pesticides Forum

Conclusions

The initial polluted soil showed high acute toxicity, and the toxicity of the soils treated by ISCO and S-ISCO decreased significantly. Comparable to the high COC elimination achieved with these treatments.

The application of E3 as a surfactant did not show an increase in soil toxicity after the oxidation treatments.

ISCO and S-ISCO, with alkaline activation of PS can be proposed for real aplication, as they lead to a high COCs reduction and restore the soil to its original toxicity value.

14th International HCH and Pesticides Forum

Acknowledgments

- This work was supported by the EU LIFE Program (LIFE17 ENV/ES/000260), the Regional Government of Madrid, through the CARESOIL project (S2018/EMT-4317), and the Spanish Ministry of Economy, Industry, and Competitiveness, through project PID2019-105934RB-I00-R. The authors thank the Department of Agriculture, Livestock and the Environment, Government of Aragon, Spain, as well as EMGRISA and SARGA, for kindly supplying the samples

Life surfing

CareSoil_CM

emgrisa

GOBIERNO DE ARAGON
Departamento de Agricultura, Ganadería y Medio Ambiente

GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

14th International HCH and Pesticides Forum

THANK YOU FOR YOUR ATTENTION

raugar05@ucm.es

UNIVERSIDAD COMPLUTENSE MADRID