SOIL-WASHING WITH REUSED FLUIDS

FOR IN-SITU REMEDIATION

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Eurosoil, Bari 2012

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FOAMS FOR IN-SITU SOIL-WASHING

Tailored Improvement of Brownfield regeneration in Europe

TIMBER Project provides an evaluation of some treatment technologies

Future treatments:

- In-situ
- Cheap intensive
- Warrant an homogeneous decontamination

The fashion is to save costs

The reagents for washing:

- Innocuous
- biodegradable, but reusable several times
- low sorption in soil

The process need :

- to reduce pollution expansion
- to be robust
- to have low variability

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FOAMS FOR IN-SITU SOIL-WASHING

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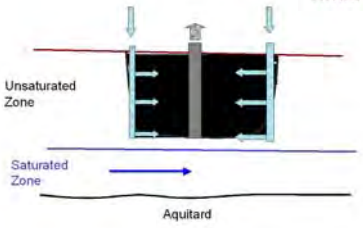
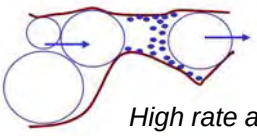
Some good reasons to use foams:

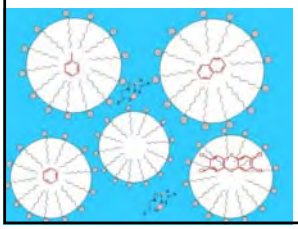
A bi-phasic fluid of low density (0,01-0,7) to prevent contaminants ' dispersion



A compromise between *Venting* and *washing with solutions*



High rate and shear-stress



A large range of micro-pollutants extracted (size, polarity)

A complicated mechanism

Mulligan and Eftekahari, 2003; Couto et al., 2009

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CHARACTERISTICS OF THE CONTAMINATED SOIL

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Solec Kujawski (Kuyavan-Pomeranian, Poland)

Old wood impregnation industrial site (Creosotes)

3m

d ~0.9 - 1.4 (NAPL)

Characteristics

Water Table ~ 3.2 m
K_{mes}~ 5.25(4)$\times 10^{-3}$ cm/s
Hydaul. Grad. 3.5 $\times 10^{-3}$

pH= 6.3-5.0
Average porosity: 0.18(7)

PAH: 5-15 g/Kg
BTEX ~ 250 ppm
Metals < LRL

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SURFACTANTS AND FOAMS

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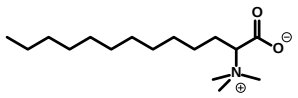
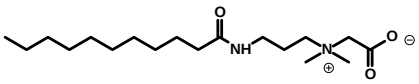
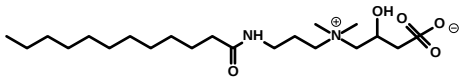
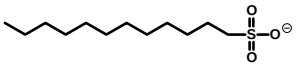
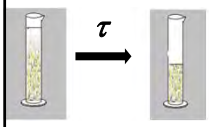
Surfactants Tested

Abbreviation	Chemical Structure	CMC (%)
LB		3.7×10^{-4}
CB		5.7×10^{-4}
CHS		2×10^{-3}
SDS		0.24

Foams Characteristics



$$F_q = \frac{V_{gas}}{V_{foam}}$$

	LB	CB	CHS	SDS
τ (h)	0.5	4.0	3.3	1.7
F_q (%)	95.5	97.8	96.5	97.2

EXPERIMENTAL SET-UP

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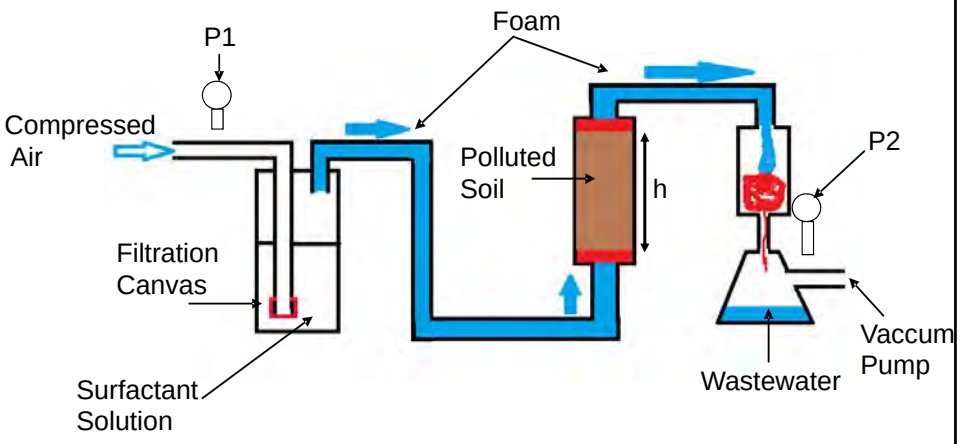

P1: 1.5-1.8 bar

P2: 0,2-0,8 bar

h: 6- 22 cm

$$V_{sol\text{-}injected} = n\,Vp = \frac{n \times m_{soil} \times 0.2}{d_{soil} \times d_{sol}}$$

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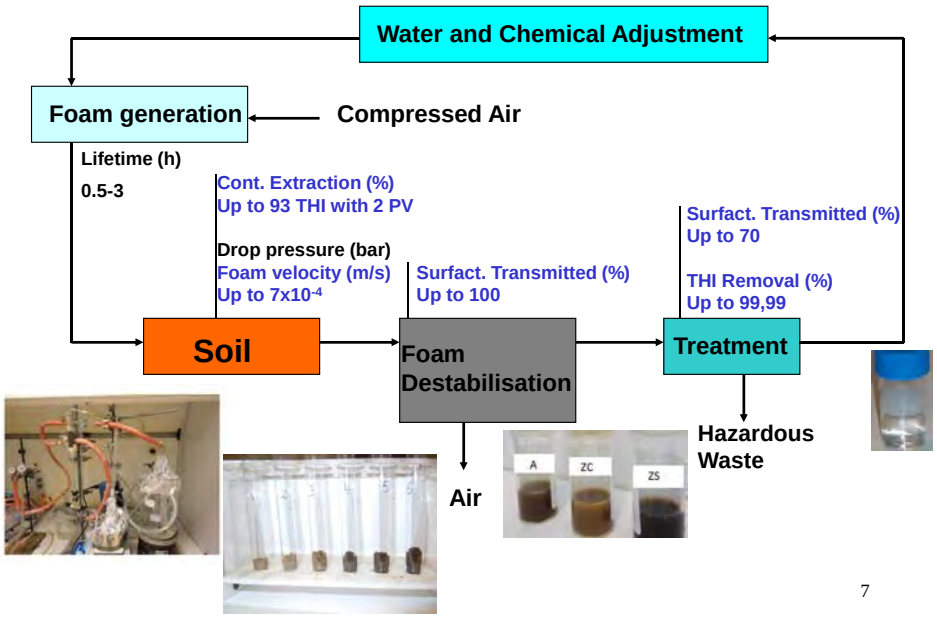
SCHEME FOR THE REPEATED USE OF FOAMS



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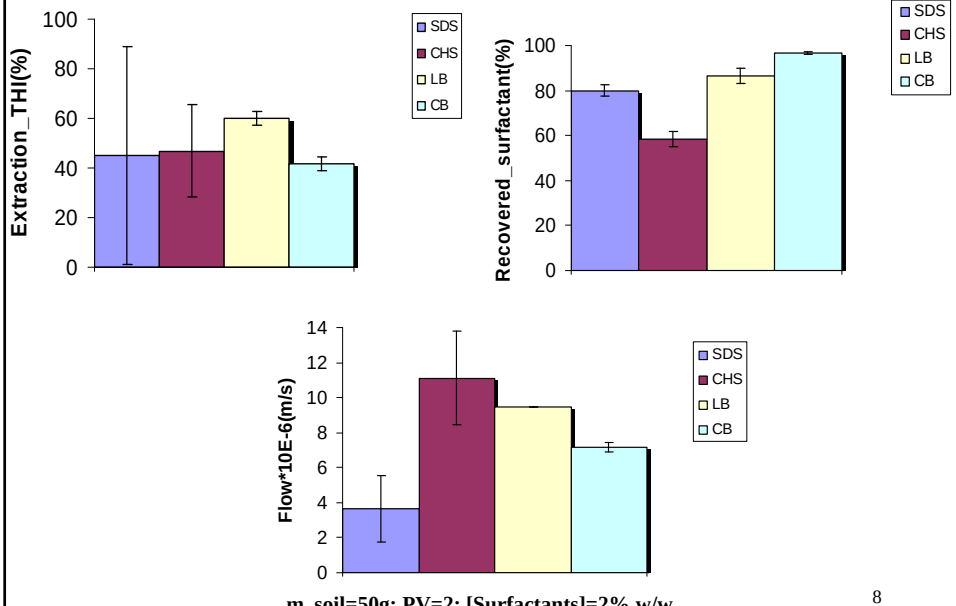
FOAMS PERFORMANCES IN THE SOIL TREATMENT



m_soil=50g; PV=2; [Surfactants]=2% w/w

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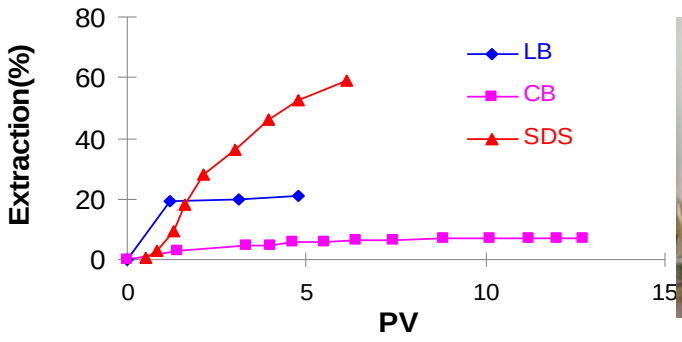
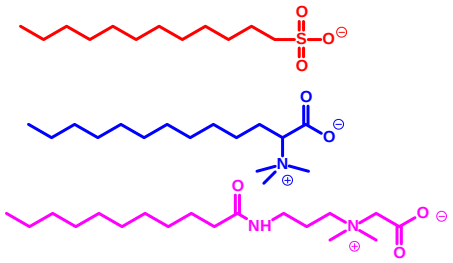
THI REMOVAL EFFICIENCY PROFILES

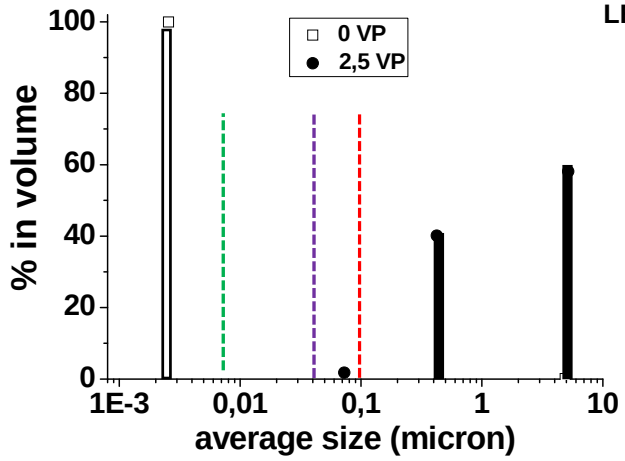




R (8PV, SDS)= 60% but :

- high variability
- low flow rate
- adsorbs in soil

SIZE OF PARTICLES IN WASTEWATER

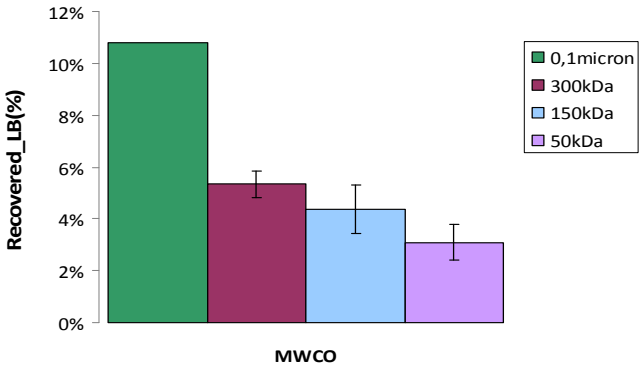


MWCO= 50 kDa

MWCO= 300 kDa

MWCO= 0,1 µm

SURFACTANT RECOVERY BY FILTRATION: MF vs. UF



- 5-10% surfactant recovered by UF
- MF increases twice surfactant recovery **but THI in permeate is 10%**
- Neither effect of tangential rate nor pH in the range 4 - 8

UF OFFERS:

- RETENTION OF FOAMING PROPERTIES
- COMPLETE REMOVAL OF THI
- DESINFECTION FOR BETTER REUSE

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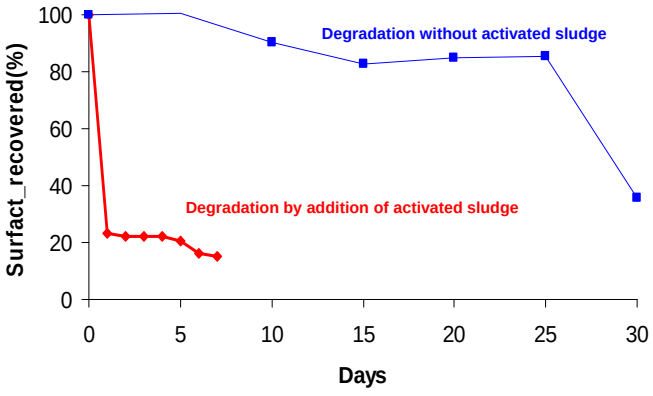
TREATMENT OF FILTRATION CONCENTRATES: activated sludge



- THI REDUCTION ~80% after a week
- ~ 20% surfactant recovered by addition of activated sludge

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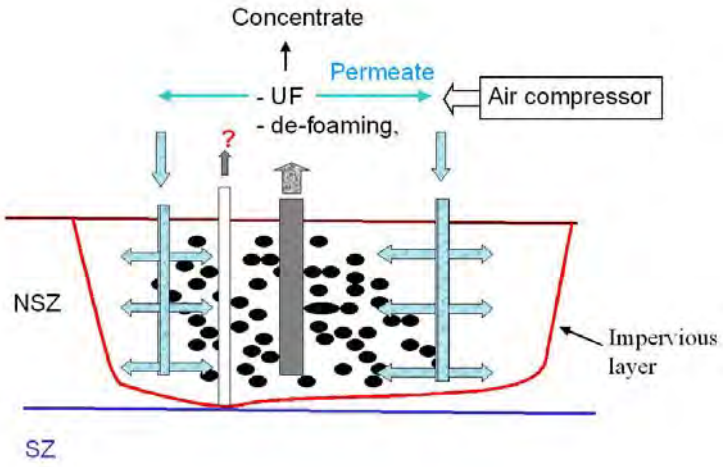
SCHEME FOR THE TEST

Lauryl Betaine (LB) will be used
(innocuous, T_{soil} ~ 90-100%, high flow rate, low variability)



1-month test next september

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