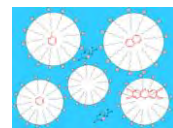
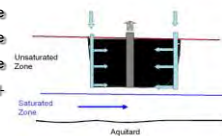


Removal of contaminants from soil with reused foams for in-situ remediation

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Introduction

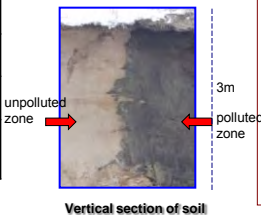
The in-situ extraction of contaminants by foam technology is a recent, suggested at the end of 90s and begins to emerge from the laboratory. Surfactants are usually used as the foaming agent to lower the surface tension of the liquid therefore to create or stabilize foams. They have many advantages over the solutions in this case. However as with all washing fluid, re-use is required to reduce the costs of treatments and impacts of environments. Our work, at laboratory scale, is to develop a treatment based on extraction liquid-solid, liquid-liquid, and by ultrafiltration after destabilize foam in order to reuse washing fluid.



Experimental

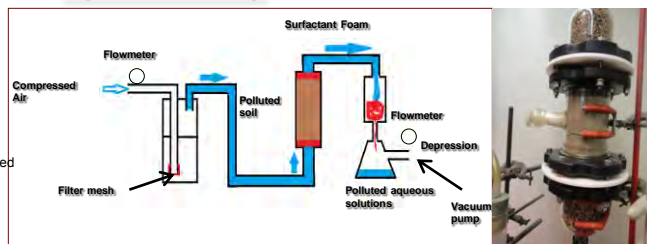
Surfactants	Usual name	Molecular structure	CMC(%w/w)
Betadet SHR	Cocamidopropyl Hydroxysulfate		2 ^F -3
EMAL 10P-HD	Sodium lauryl sulfate		0.24
Euroquat CF	Lauryl Betaine		3.7 ^F -4
Euroquat HC47VG	Cocamidopropyl Betaine		5.7 ^F -4

Tablet. Data of surfactants studied



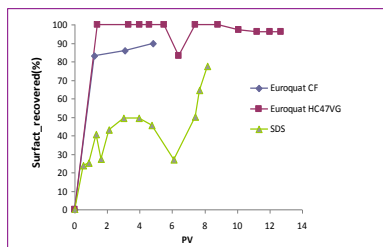
Vertical section of soil

Experimental set-up



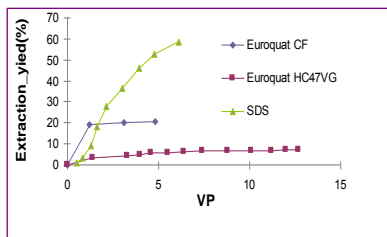
Results and Discussion

Recovery rate of surfactant on pilot test



Euroquat surfactants are recovered well throughout foam injection and soil wash, except SDS. This ensure in case of Euroquat a cost reduction of uses and waste treatment.

Extraction profile of pilot test



- Excellent extraction profile for SDS with $Y(8Vp) = 60\%$ but 1) High variability, 2) Low Flow 3) adsorption on soil

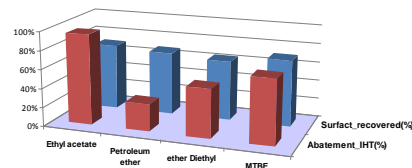
- The low extraction of CF indicate the presence of preferential pathways on the Pilot

- The presence of an amide functional group on EHC47VG can reduce its ability to extract more than CF.

$m_{soil} = 650g$; $T = 17^{\circ}C$; $pH_{solutions} = 6.5-7$; $[IHT]_0_{soil} = 8340 \text{ ppm}$; $Conc_{surfact}(\%) = 2\% w/w$

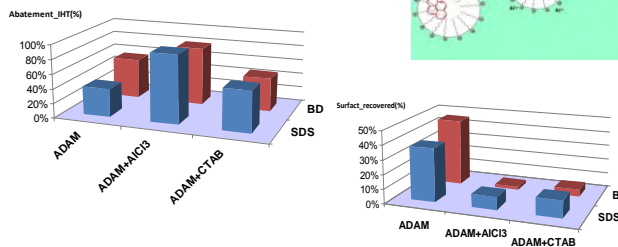
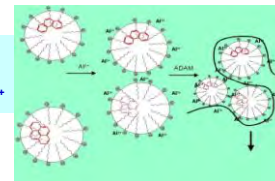
Liq-liq extraction process:

Good abatement of hydrocarbons but impossible to re-foam the surfactant solution after regeneration



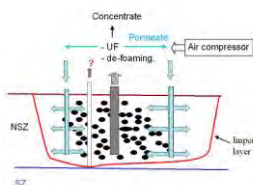
Coagulation-Flocculation process:

Very promising way but risk to reinjection Al^{3+}



Conclusion

Among the surfactant studied, CF was characterized by its regular extraction of pollutants and its high flow trough soil, which can help to the uniform, substantial and fast remediation. In addition, CF has low adsorption on soil and its rapidly biodegradable, not toxic which is reduce the risk of mobilization by leaching of pollutants after treatment. Finally, CF can be measured at the field by colorimetric measurement. The physical treatment (Ultra-filtration), than chemical (coagulation-flocculation), provide a safe about treated effluent, that it's the key to provide a good operation of the in-situ extraction technology at full scale.



Field test configuration at Solec, in Poland

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