Natural clays of a coal tar contaminated site to stabilize hydrocarbons, reduce their ecotoxicity and make cement

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Circular economy : how to apply it in the context of EU Green Deal ?

RemTech Expo 2020 Ferrara

Context

Occurrence of coal tars contaminations

Industrial activities

> 10% (Basol)

What do they contain ?

Complex mixture of OCs → *Strong wetting ability*

Hazardous compounds : PAHs, BTEX, phenols,… → *Hazards and persistency*

Behavior

viscous

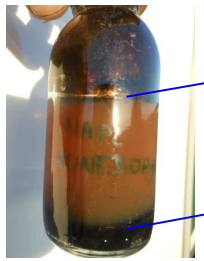
infiltration

volatilization

1 wk. later *t_0*

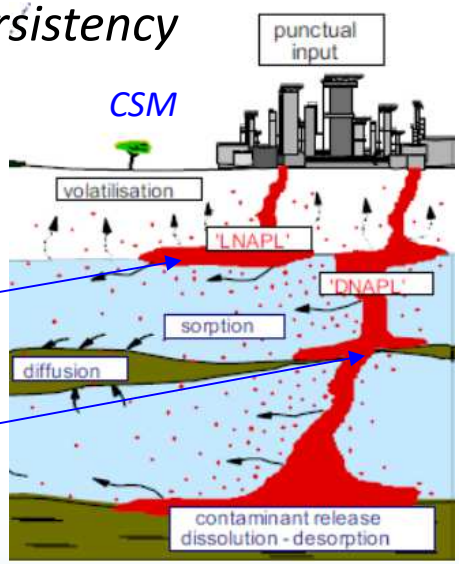
dissolution

t_0



1 wk. later

CSM



Options of management

Hindered by dissemination risks, restrictive regulation on wastes, acceptance

Incineration / disposal / confinement / stabilization-solidification

On-site and ex-situ management often require handling → *difficulties and risks*

Context

Former steelwork industry in eastern Europe

Coal tar characteristics

Parameters	Values	Parameters	Values
pH	6.0	LHV[a] ($kJ.kg^{-1}$)	37 478
Water content (%)	0.035	BTEX ($mg.kg^{-1}$)	
Petroleum indices ($mg.kg^{-1}$)		Benzene	2038 ± 864
C5-9	567 000	Toluene	2556 ± 956
C10-40	433 000	Ethylbenzene	204 ± 44
PAHs ($mg.kg^{-1}$)	84 250 ± 3278	Xylenes	3281 ± 556
Naphtalene (NAP)			
Phenanthrene (PHE)	54 513 ± 1067	Sum of BTEX	8079 ± 2297
Anthracene (ANT)	16 827 ± 3108	Metals ($\mu g.kg^{-1}$)	
Fluoranthene (FLT)	16 675 ± 2977	Al	22.7 ± 4.1
Pyrene (PYR)	12 452 ± 2103	As	< 3.4
Benzo(a)anthracene (BaANT)	8453 ± 1642	Cd	< 1.4
Chrysene (CHYChy)	9472 ± 3497	Cu	18.7 ± 3.3
Benzo(b)fluoranthene (BbFLT)	3320 ± 842	Fe	80.9 ± 15.7
Benzo(k)fluoranthene (BkFLT)	5738 ± 931	Mn	515.2 ± 98.2
Benzo(e)fluoranthene (BeFLT)	3179 ± 630	Ni	2.8 ± 1.0
Benzo(a)pyrene (BaPYR)	4262 ± 1119	Pb	7.5 ± 1.4
Indeno (1,2,3-c,d) pyrene (IcdPYR)	864 ± 145	Zn	25.3 ± 4.4
Sum of PAHs	221 000 ± 21 552	V	< 1.4

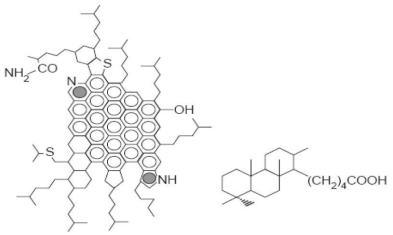
Strongly viscous, sticky and smelly

Assessing a strategy for handling and recycling

Could the use of natural local resources for S/S be a way for liquid tars management ?

On site illite material

Coal tar spillage



Collab. ATILH Group

S/S treatment

Xtar

Cement Factory ?

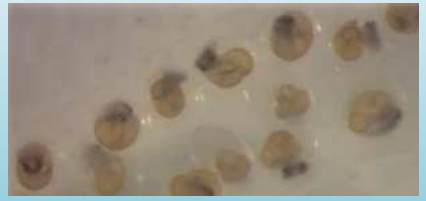
Contaminant mobility ? ⟷ Ecotoxicity ?

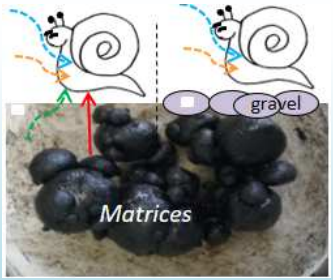
- *leakage potential*

- *mobilization tests and mass balances*

- *solid matrices and gas phase*

- *leachates*



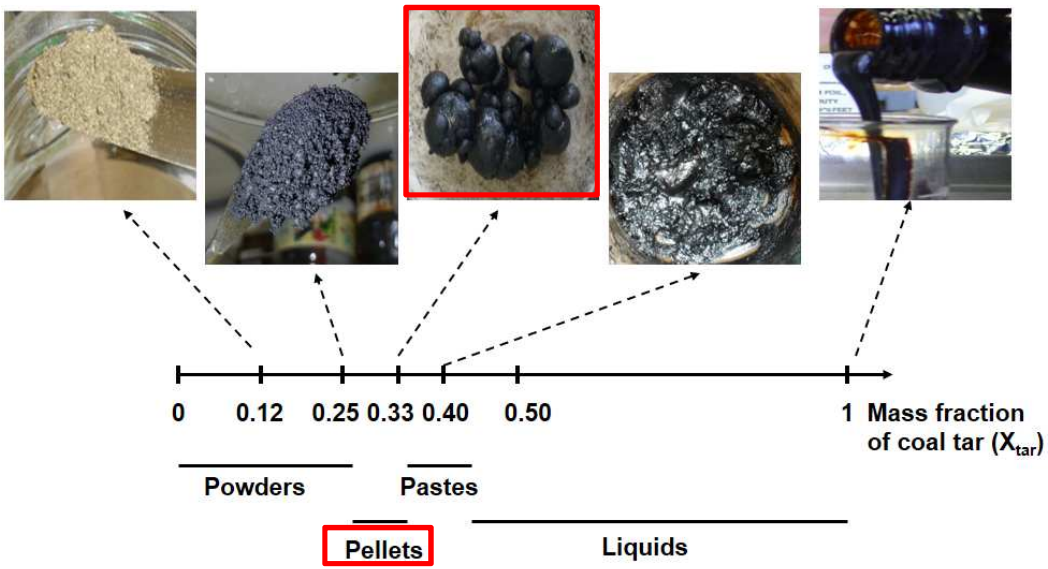


Snails (survival and growth)

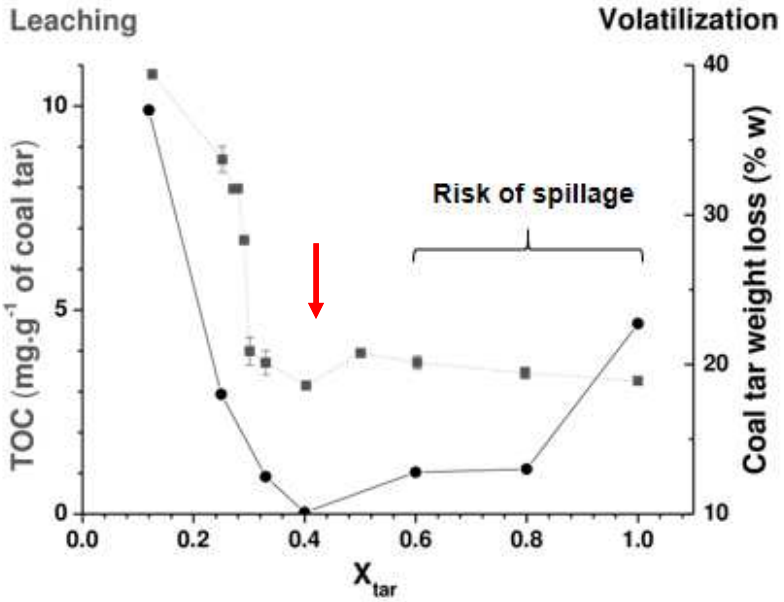
Freshwater snails (hatching rate after 25d.)

Results

Mass fraction of tar is critical for handling and contaminants mobility

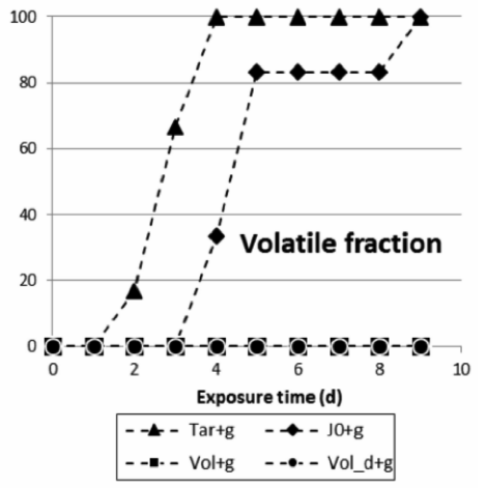


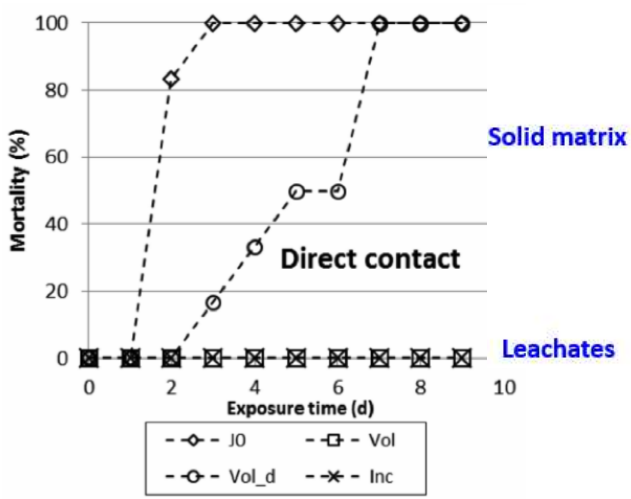
Contaminants mobility of freshly prepared matrices

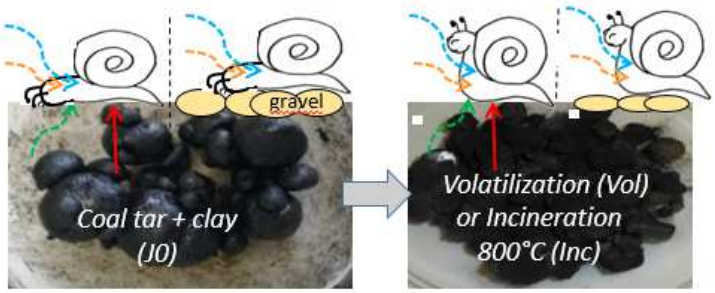


Results

Ecotox.: *tar > S/S > S/S + aeration > S/S + incineration = no effect detected*





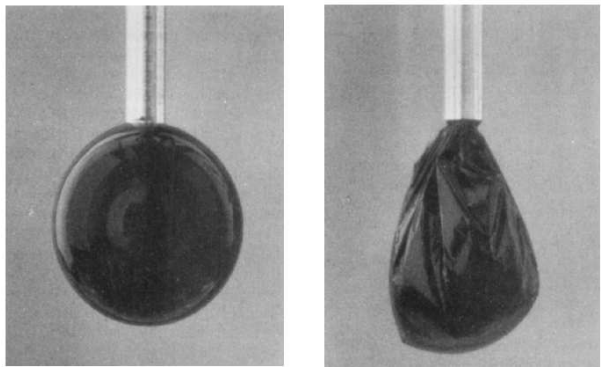


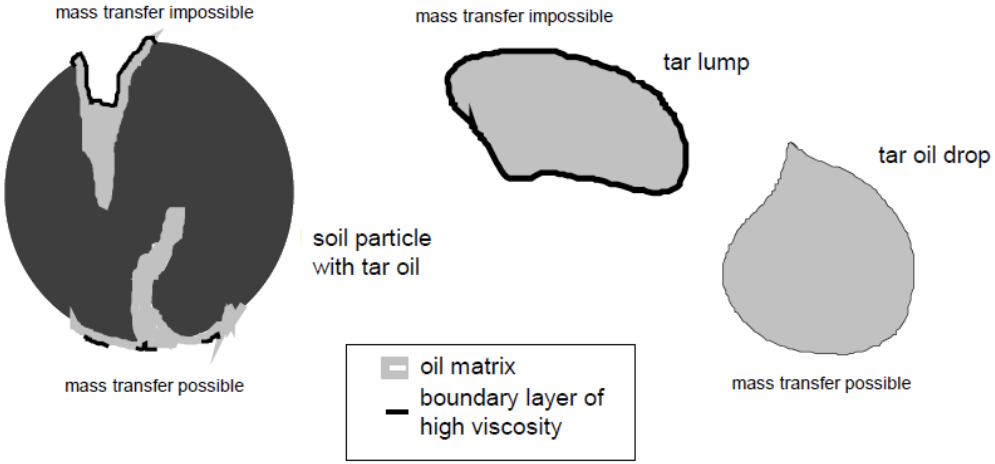
Eggs of Lymnaea stagnalis : J0 > Vol > Inc

Ageing with contaminant release → SVOCs precipitation at the interface

Tar oil drop in water
(fresh and after deposition for 48 h)

Luthy, 1993





Results

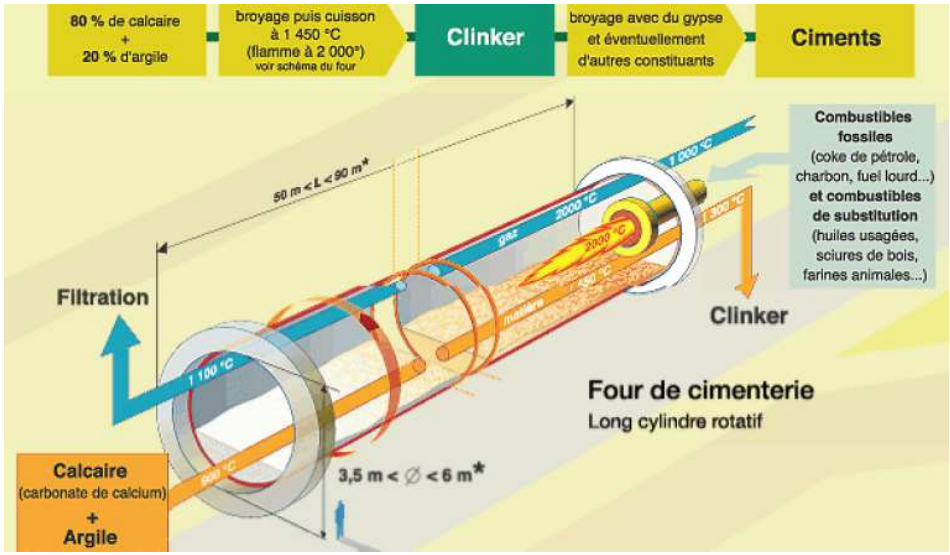
Feasibility of recycling the stabilized tar in cement production ?

Ecological and economical strategy

LHV of the coal tar

Short delay of treatment

But…



Low contaminants conc. thresholds ex: THCs and PAHs (~1 g/kg), metals

No smelly material

Dark color of produced cement

Learnt lesson: importance of early partnership and accurate knowledge of rules

Related article

Bamze Attoumani et al., 2019. Ecotox. & Environ. Safety

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