SEDNET Conference 27th-29th May 2008, Oslo, Norway

Urban Sediment Management and Port Redevelopment/
Sediment in River Basin Management Plans

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Stabilisation/Solidification of Sediments and Soils Overview of Technologies and Experience

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DEME: creating land for the future

Member of the DEME Group

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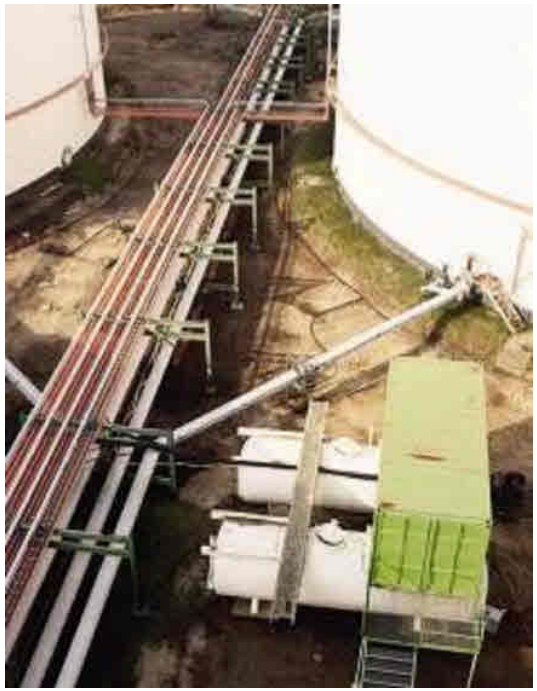





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Presentation overview

- Problems with contaminated soils and (all) sediments
- Solutions for sediments and soils
- Definition of stabilisation and solidification (S/S)
- Objectives of S/S
- Mix formulations, recipes and additives
- Ways of application
- Experiences
- Challenges

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Problems with Sediments and Soils

Objective: Re-use on land as engineered fill or better…

Sediments:

- Fine texture & high water content
- Limited geotechnical quality after dewatering
- Pollutants: heavy metals, TPH, PAH, TBT, PCB
- Depending on oxidation state: leachable metals, ammonium, chloride, sulphate (!!)

Soils:

- Varying from clayey to granular
- Natural soil versus made ground
- Treatment (= pollutant removal) not possible: soil washing (texture), bioremediation (biodegradability), thermal desorption (metals).
- Pollutants: heavy metals, cyanides, TPH, PAH,…, sulphates, ammonium,…
- Leachability strongly dependant on composition: K_D

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Solutions for Sediments and Soils

Sediments:

- Solidification: geotechnical improvement = reuse possible
- Stabilisation: reduce pollutant leachability

Soils:

- Stabilisation: reduce pollutant leachability
- Solidification: geotechnical improvement = higher reuse potential

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What is Stabilisation/Solidification ?

"Stabilisation involves the addition of reagents to a contaminated material (e.g. soil or sludge) to produce more chemically stable constituents. It may not result in improved physical material characteristics, but the toxicity or mobility of the hazardous constituents will have been reduced."

"Solidification involves the addition of reagents to a contaminated material to impart physical/dimensional stability to contain contaminants in a solid product and reduce access by external agents (e.g. air, rainfall). It may not involve chemical interaction between contaminants and the solidification agent."

Environment Agency UK: Guidance on the use of Stabilisation/Solidification for the Treatment of Contaminated Soil

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Objectives of S/S

- Major objective: risk reduction of pollutants concerned, through reduction in mobility/leachability of pollutants into water
- Chemical stabilisation: affect the pollutant, not the matrix

  → solubility or sorption equilibrium
- Solidification: affect the matrix, and encapsulate the pollutant

  → diffusion control
- Objectives of S/S:
  - Make suitable for use (pure geotechnically)
  - Re-use as soil: site specific or generic reuse leaching criteria.
  - Make suitable for landfilling (landfill criteria).

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Mix formulations, recipes, additives

Solidification:

- Classical: cement and/or lime – expensive !
- Alternative: various sorts of fly ashes, slags, puzzolanic materials,…

Stabilisation:

- Pollutant specific additives, e.g. adsorbents, phosphates, zero-valent iron,…

Stabilisation by solidification (encapsulation):

- Cement combined with additives that reduce diffusion (permeability of matrix)

Variability in the soils or sediments require a robust recipe !

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Ways of Application

Ex-situ mixing plant:

- Pugmill mixer, planetary mixer, rotary bucket,…
- Advantages: process control, dosing accuracy,high production
- Disadvantages: excavation necessary

In-situ mixing:

- Rotary devices, hydraulic injection,…
- Advantages: no excavation, limited site logistics
- Disadvantages: difficult proces control, inaccurate dosing, debris sensitive

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Experiences

Cross-fertilisation of ideas and experiences between soils, sediments and waste

with respect to:

- Mixing plant (preparation, mixing, curing…)
- Additives
- Durability testing
- Legislation

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Experience : fixed plants

10 years of operation of the fixed plant in Belgium: soils, waste, sediment, sewage sludge

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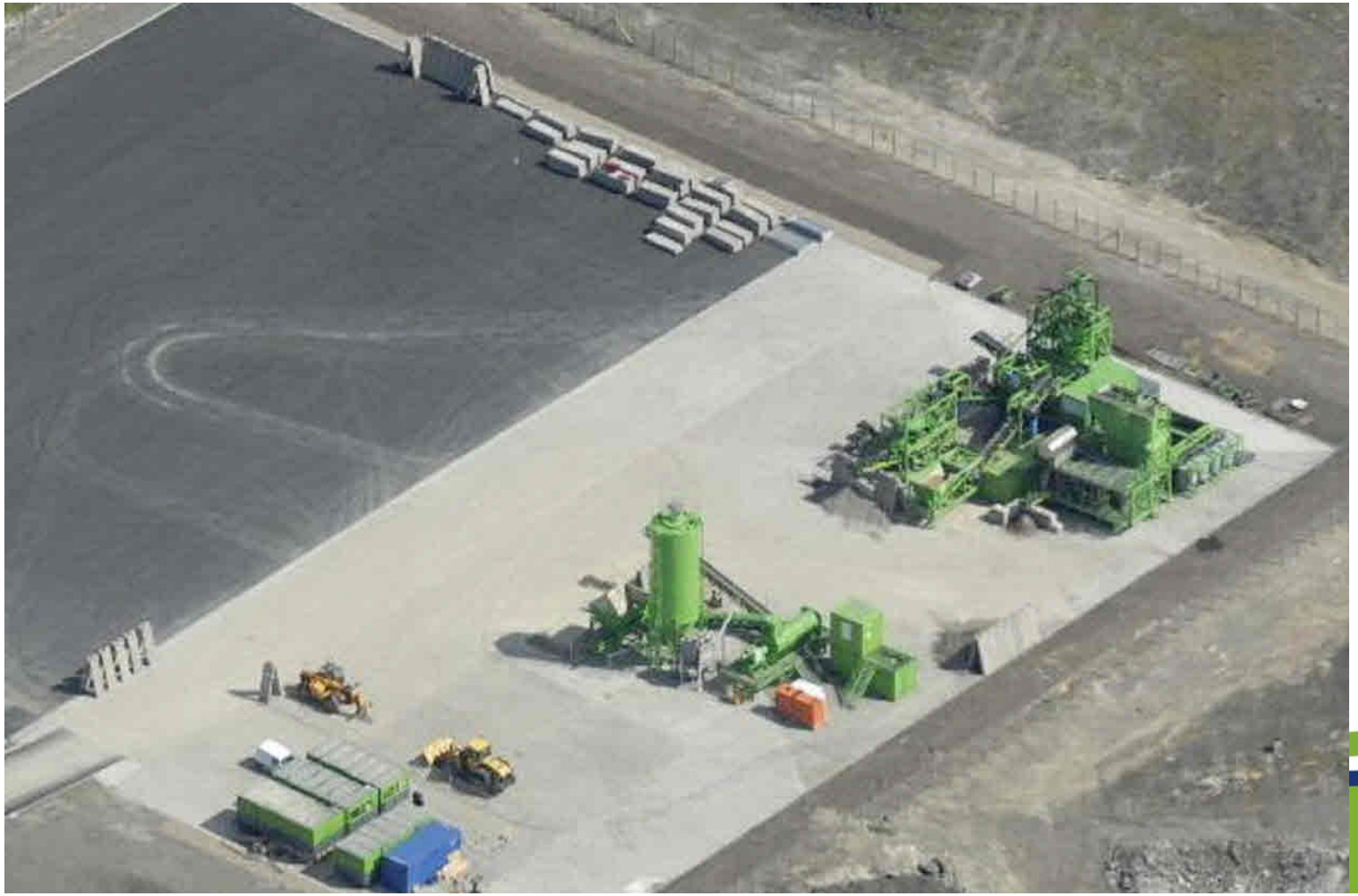
Experience : fixed plants

Terramundo UK: soil & waste treatment plant.



Ex-situ Projects Soils

- Cyanide and arsenic waste

  La Floridienne Belgium (*stabilisation)*

- Viscose sludge

  Fasiver, Belgium (*solidification)*

Ex-situ projects Soils

Contaminated soil
Proviron, Belgium
(stabilisation)

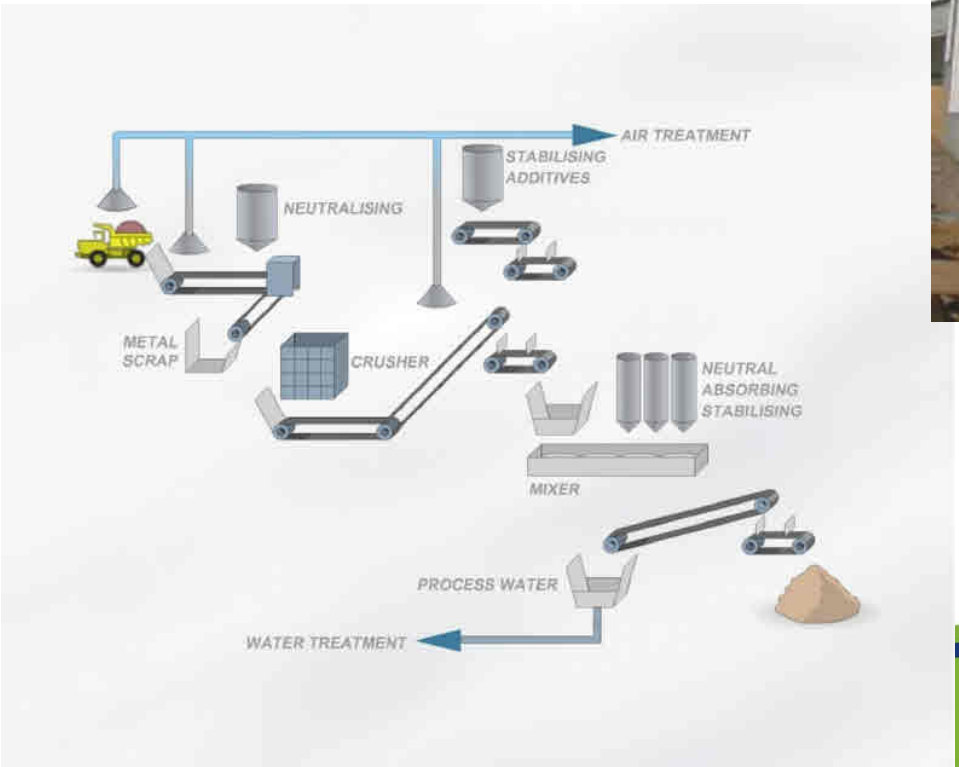
Contaminated soils
Bekaert, Belgium
(stabilisation)

Ex-situ Projects Acid Tar

Acid tars: Rieme Belgium

TOTAL

(*solidification/stabilisation)*



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Ex-situ projects Minerals

<u>Stabilisation Soil washing residues</u>

- Tranemo, Sweden, CCA
- Dublin gasworks, cyanide
- Terra Cotta, sulphates

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Ex-situ: Sediments

- TBT contaminated sediment Guernsey, UK (*stabilisation)*

- Contaminated Sediments Dublin / Castletownbere (*stabilisation)*

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Ex-situ: Sediments

- Crude oil sediments, Shell Nigeria (*stabilisation)*
- Sediment with heavy metals Belgian Railway *(stabilisation)*
- Viscose sludges Fasiver Belgium (*solidification/stabilisation)*

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In-situ: Sediments

- Sediment heavy metals
  Cargovil, Belgium
  solidification/stabilisation

- Sediment stabilisation
  Doeldok, Belgium

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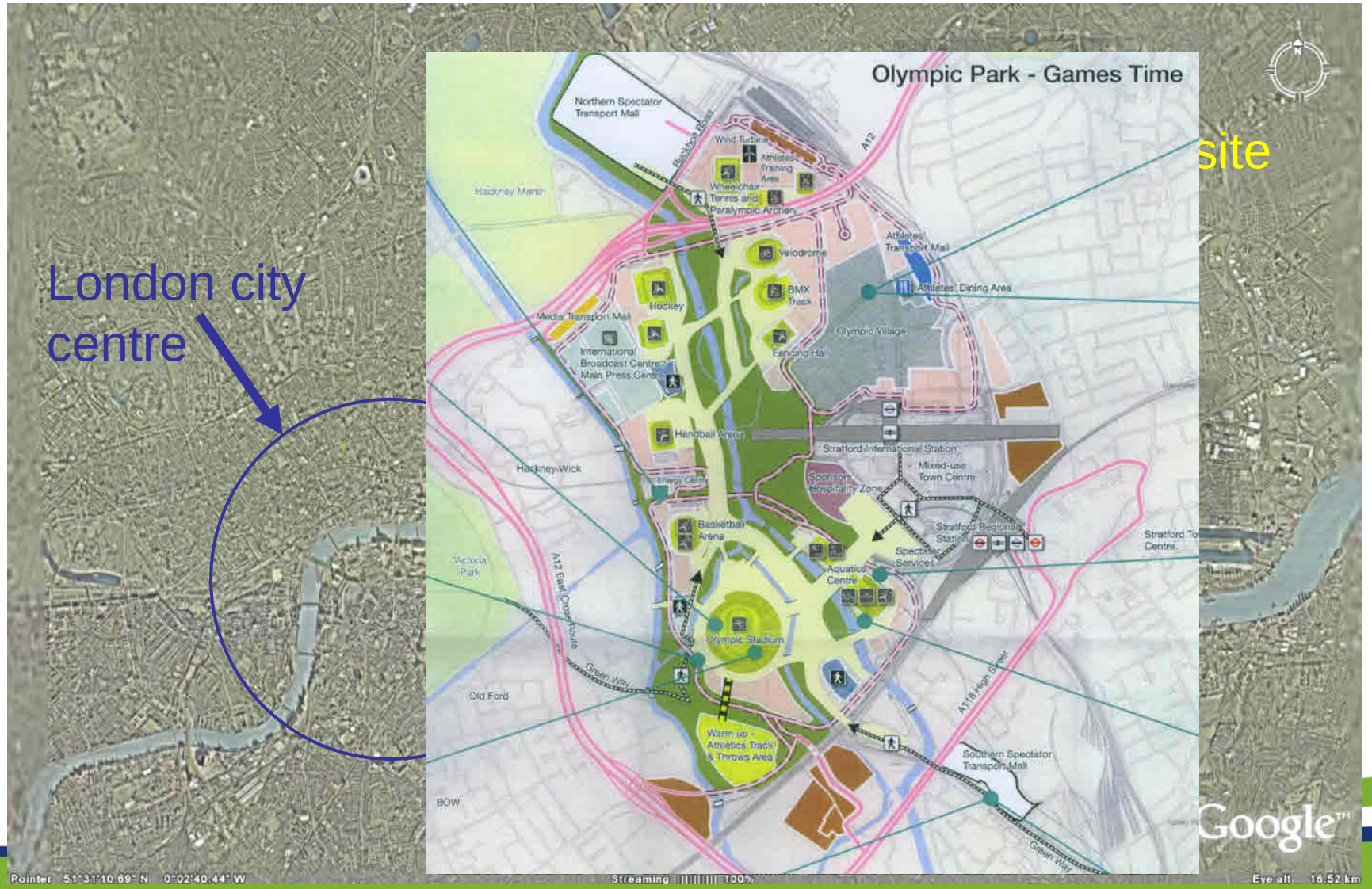
Ex-situ: Soils

LONDON 2012

Location of the Olympics site



Stabilisation at the Olympics

- 80000 tons of soils contaminated with heavy metals (As, Pb), organics, cyanides,…
- 10000 tons of sediments to come
- Very strict leachability reuse criteria
- DEC developed proprietary additives for the stabilisation of the contaminants.

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View on the Stadium Area

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Challenges

- Development of appropriate mix formulations for various sediments, soils and pollutant cocktails.
- Look at boundary conditions for other re-use possibilities of stabilised/solidified material: e.g. under water → erosion ?
- Establish confidence to all stakeholders by:
  - Gain confidence by showing succesful projects
  - Evaluate various S/S projects that have been carried out last 20 years.
  - Establishing decent and validated protocols for durability testing of stabilised/solidified materials in function of application.
  - Adapt legislation towards the stimulation of S/S if durability is proven.

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Thanks for your attention