SEDNET CONFERENCE
25th September 2015

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Ecole Centrale de Lille, FRANCE

Faculty of Geology, Geophysics and Environmental Protection, AGH University of Science and Technology, Krakow, Poland
SUMMARY

• CEAMaS PRESENTATION

• LEGISLATIVE ISSUES

• TECHNICAL ISSUES

• APPLICATIONS
PARTNERS

- France:
  - Cd2e
  - BRGM
  - Ecole Centrale de Lille
  - Université de Lille 1
- Ireland:
  - University College of Cork
  - Cork Institute of Technology
- Belgium
  - BBRI
- Netherlands
  - TUDelft / Deltas
SWOT analysis and benchmarking on dredged sediments management and reuse in Europe

Development of new solutions/new formulations of sediments reuse

Environmental, social and economical acceptability

Methodology to reuse marine sediments

Communication / Centre of Resources on sediments management and reuse
CEAMaS PRESENTATION

WP2 VISION

Polluted sediments

Non Polluted sediments

Raw sediments

Characterization

Legislation ????

List of treatment process

List of civil engineering applications

List of Raw materials

Treated sediments

Formulations

Reuse in civil engineering
LEGISLATIVE ISSUES FOR REUSE

MAJOR CONVENTIONS RELATED TO SEDIMENTS

• OSPAR CONVENTION
• LONDON CONVENTION
• BARCELONA CONVENTION
• HELSINKI CONVENTION
## LEGISLATIVE ISSUES FOR REUSE

**LEACHING TOOL ACCORDING TO NEN 7373 (2004)**

<table>
<thead>
<tr>
<th>L/S 10</th>
<th>Flemish</th>
<th>VLAREA</th>
<th>Dutch</th>
<th>NV building material</th>
<th>Dutch</th>
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<tbody>
<tr>
<td></td>
<td>Example 1</td>
<td>Example 2</td>
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**Classification**

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**Detailed Analysis**

- **Low**
  - Irish Lower Level
  - Flemish free us excavated
  - French Level 1 (N1)
  - Dutch (*) Bbk, living/cla

- **High**
  - Irish Upper Level
  - Flemish secondary soil
  - French Level 2 (N2)
  - Dutch (*) Bbk, industry/cla
TECHNICAL ISSUES FOR REUSE

ACIONS IN WP2

WP2 - Development of new solutions /new formulations of sediments reuse

A6
Definition of common characterization methods

A7
Characterization of different sludge types and compositions

A8
Requirements for sediment-based civil engineering formulations

A9
Best practice exchange through field experiment studies

Technical Report: Characterization techniques of sediments

Synoptic files + Tools

Formulation for the sediments reuse

Flow sheets: Criteria for reuse

Site visits and technical exchange + Best practice

Marine sediments

Dunkirk, FR

Lowlands, NL

Amoras, BE

Cork, IE
TECHNICAL ISSUES FOR REUSE

SEDIMENT CHARACTERISATION TECHNICS FOR REUSE

METHODOLOGY

A6 - PHYSICAL, GEOTECHNICAL, AND CHEMICAL CHARACTERIZATION TECHNIQUES OF SEDIMENTS

- Netherlands
- France
- Ireland

Site Description and sampling Methods

A7- CHARACTERIZATION OF SEDIMENTS

Synoptic file for each studied sediment + Classification

A8- Requirements for sediment-based civil engineering formulations
Marine Sediments

Physical Characterization
- Appearance
- Water content
- Solid grain density
- Specific surface area
- Grain size distribution

Geotechnical Characterization
- Atterberg limits
- Organic content
- Calcium carbonate content
- Proctor compaction test
- Oedometer test
- Permeability test
- California bearing ratio test
- Shear box test

Chemical Characterization
- Sulphur
- Chloride total
- pH
- Leaching
  - Concentration of heavy metals
  - Concentration of organic pollutants
  - Bio available fraction of organic pollutants
  - Mineral composition XRF
  - TUD specific tests (Zeta potential, ...)

Complementary Characterization
- TGA
  - Sorption and desorption
  - Thermal conductivity
  - Unsaturated hydraulic conductivity
  - In situ field equipment
TECHNICAL ISSUES FOR REUSE

- Sediments in place
- Contaminated
  - Selective dredging
  - Non contaminated
    - Bulk dredging
      - Dehydration
      - Separation
      - Treatment
      - Temporary storage
      - Final disposal site
      - Reuse
TECHNICAL ISSUES FOR REUSE

EC LILLE

Physical, Geotechnical and Complementary characterization

- Density
- Water content
- Grain Size Distribution
- Atterberg limits
- Methylene blue adsorption
- Specific surface area
- Calcium carbonate content

- Organic content
- Proctor Compaction test
- Consolidation test
- Permeability
- TGA
- Sorption & Desorption
- Thermal Conductivity
TECHNICAL ISSUES FOR REUSE

EC LILLE

PHYSICAL TESTS RESULTS

Water content in the raw sediments (NF P 94-050)

<table>
<thead>
<tr>
<th>Location</th>
<th>40°C</th>
<th>60°C</th>
<th>105°C</th>
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<td>Dunkirk</td>
<td>92,58</td>
<td>93,78</td>
<td>95,5</td>
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<tr>
<td>Amoras</td>
<td>132,84</td>
<td>134,54</td>
<td>136,5</td>
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<tr>
<td>Cork</td>
<td>44,15</td>
<td>44,5</td>
<td>45,05</td>
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<tr>
<td>Lowlands</td>
<td>1555,4</td>
<td>1606,86</td>
<td>1683,35</td>
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**PHYSICAL TESTS RESULTS**

Particle size distribution (by laser granulometry: Malvern Mastersizer 2000)

<table>
<thead>
<tr>
<th>Granular fractions (NF EN ISO 14688-1)</th>
<th>Clay (&lt; 2 µm)</th>
<th>Silt (between 2 µm and 63 µm)</th>
<th>Sand (between 63 µm and 2000 µm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dunkirk</td>
<td>6,03</td>
<td>65,53</td>
<td>28,43</td>
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<td>Amoras</td>
<td>5,48</td>
<td>67,41</td>
<td>27,11</td>
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<td>Cork</td>
<td>1,89</td>
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<td>61,79</td>
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<td>0,85</td>
<td>13,29</td>
<td>85,86</td>
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**TECHNICAL ISSUES FOR REUSE**
EC LILLE

GEOTECHNICAL TESTS RESULTS

Atterberg Limits (NF P 94-051)

<table>
<thead>
<tr>
<th></th>
<th>Liquid limit (LL)</th>
<th>Plastic limit (PL)</th>
<th>Plasticity index (PI)</th>
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<td>65,15</td>
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<td>31,88</td>
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TECHNICAL ISSUES FOR REUSE

SEDIMENT CHARACTERISATION TECHNICS FOR REUSE

WP2 - Development of new solutions of sediments reuse

A6 - Definition of common characterization methods
A7 - Characterization of different sludge types and compositions

Properties
- Physical
- Chemical and mineralogical
- Geotechnical
- Others

Properties
- Water Content

Standards / Methods
- NF P 94-050
- NF P 94-050
- NEN 15834-2012

Methods
Results

www.ceamas.eu
## APPLICATIONS

### Road construction
- Road embankment, fines
- Road embankment, sand
- Road embankment, self clear
- Road sub base
- Parking lot road surface

### Soils
- Soil elevation (meadow deposit)
- Lift up of Lowlands
- Wet storage (deposit)
- Filter cake press

### Soils
- Nature development, on land
- Nature development, wetland
- Sand separation
- Hydrocyclone for sand separation
- Natural Ripening

### Soils
- Enhanced ripening with geotextiles
- Landfarming
- Energy crops
- Sound walls
- Capping of deposits
### APPLICATIONS

**Dikes and safety against flooding**
- Trench shoring
- River Embankment
- Dike, river site scouring protection
- Dike, land site terrace
- Lake, erosion protection

**Dikes and safety against flooding**
- Shallow lakes, ecological embankment
- Reallocation at sea
- Sediment store (baggerbuffer)
- Sediment settler (trapping)
- Terp (local ground elevation)

**Building industry**
- Brick production
- Artificial gravel production
- Artificial basalt
- Concrete for roads/coastal defence
- Cement mortar production

**Building industry**
- Cement granulate production
- Stabilisation/Solidification

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**Innovating in Opportunities**

**CEAMaS**
Civil Engineering Applications for Marine Sediments
Thank you!

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A WHAT-IF TOOL

- A « what-if » decision support environment:
  - to simulate the various consequences of available management options
  - to take into account possible options in Belgium, France, Ireland and the Netherlands
  - Indirect benefits for options that would not be retained in a local tendering process (widened system boundaries)

- Exchange and sharing for return on experience between each country
TARGET AUDIENCE

• Goals of the CEAMaS decision tool:
  - to allow various users to explore sediment management options in a port situation, and discuss them within the same framework
  - to act as a hub for the other more detailed tools or studies of the CEAMaS project, and beyond them, in the European Centre for Resources

• Targeted users:
  - students and communities, not necessarily with a high technical background
  - port decision makers and territorial authorities
  • The tool includes specific points of view for civil engineering companies that can reuse sediment.
100% reference scale = « worst » scenario

Decision risk level note
- Regional economic development
- Social acceptance
- Human health
- Ecosystem quality
- Climate change
- Positive effects
- Negative effects

Cost assessment k€
- Damage due to sediment management

Compared to the « nothing done » option
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<thead>
<tr>
<th></th>
<th>Convention OSPAR</th>
<th>Convention de Londres</th>
<th>Convention de Barcelone</th>
<th>Convention de Helsinki</th>
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<tr>
<td><strong>Échelle géographique</strong></td>
<td>Atlantique nord-est</td>
<td>Pays contractants</td>
<td>Mer Méditerranée</td>
<td>Mer Baltique</td>
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<td>Protection du milieu marin</td>
<td>Protection du milieu marin</td>
<td>Protection de l’environnement marin</td>
</tr>
<tr>
<td><strong>Gestion des sédiments</strong></td>
<td>Possibilité d’immerger les sédiments de dragage.</td>
<td>Caractérisation du sédiment en vue de l’immersion.</td>
<td>Pas de solution lorsque les sédiments ne peuvent pas être immersés.</td>
<td></td>
</tr>
<tr>
<td><strong>Guides et ouvrages de référence</strong></td>
<td>· Guide pour la caractérisation des sédiments de dragage.</td>
<td>· Instructions pour l’évaluation des sédiments de dragage</td>
<td>· Protocole « immersions »</td>
<td></td>
</tr>
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