Concrete achievement containing dredged sediment carried out under « Sédimatériaux » approach in Nord-Pas de Calais region

Dr. /Eng. Samira BRAKNI
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<th>Origin</th>
<th>Sédimatiériaux?</th>
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<tr>
<td>Nord Pas de Calais</td>
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S. Brakni 9th International SedNet 23-26 September 2015 Krakow POLAND – Solving with sediment

**SÉDIMATÉRIAUX APPROACH**

Meetings Ministry of Ecology in March and Dec. 2008

**Study period continued until signing a Charter**
June 2009

**Initiative of Nord-Pas de Calais stakeholders**
proposition an appropriate and dimensioned answer to the problem and to identified issues.

**1st Sediment National Days**
*In Lille 2007*
Prevention and management of port and waterways dredged sediments

**R & D**
1998 – 2009
«Sédimétraiaux» approach charter

Cooperation project on a national scale for the emergence of beneficial fields of harbors and rivers dredged sediment

«SÉDIMATERIAUX includes performing in an environmentally controlled framework, several operational structures, limited but significant scale, incorporating port and river dredged sediment”»

Signed in June 2009 by:
Ministry of Ecology, Sustainable Development, Transportation and Housing

Regional Council Nord-Pas de Calais

Prefecture of the Nord-Pas de Calais

«Création Development Eco-Entreprises»

Hight School of Mines Douai

http://www.sedilab.com/documentation/Charte_signee_MEEDDM.pdf
Charter- Context on port and river sediment

A problematic inventory:
- Huge volumes, In France:
  Ports in 50 Mm³
  Rivers 6M m³
  Dunkirk Port: 4 Mm³ (1 cm sedimentation per day)
- Dredging and dumping requirements at sea well regulated legally
- Need to clarify the regulatory framework of on land Sediment management

Therefore, sediment management currently remains problematic for contracting authorities...

Many and important issues:
- Environmental Issues: transport capacities by waterways / quality natural aquatic environments / prevention of floods / alternative materials
- Economic Issues: competitiveness of ports / development courses / activities related to transport waterways
- Social and societal challenges: Management NIMBY phenomenon / employment sectors and activities...

All issues determine an interest
1. To produce operational tools to harbor and river managers,

2. To produce data relevant to the changing regulatory framework to supply the work and investigations of Ministry,

3. To emerge and consolidate the national level of new economic fields treatment and sediment management,

4. To create conditions for sustainable sharing of experiences and the capitalization of knowledge,

5. To encourage innovation and structure the development of R&D.
Productions under Sédimatiéraux approach

1. To produce operational tools for harbor and river managers,
2. To produce data relevant to the changing regulatory framework for the enrichment of work and investigations of Ministry,
3. To emerge and consolidate the national level of new economic fields treatment and sediment management,
4. To create conditions for sustainable sharing of experiences and the capitalization of knowledge,
5. To encourage innovation and structure the development of R&D.

«Sédimatiéraux » approach charter

Cooperation project on a national scale for the emergence of beneficial fields of harbors and rivers dredged sediment

GES

METHODOLOGICAL GUIDELINES...

10 PROJECTS..

FIELDS tested...

GES LAB Ressource Center

Sédilab Ressource Center

EcoSed, THESIS...

NEW SOLUTIONS FOR SEDIMENTS
### Productions under Sédimatériaux approach

1. Methodological guideline for characterization of dredged sediment

2. Methodological guideline for beneficial reuse of dredged sediment in road construction

3. Methodological guideline for beneficial reuse of dredged sediment in concrete

4. Methodological guideline beneficial reuse of dredged sediment sediment landscaping

Summaries of these guides are available on the website in the section “guides Sédimatériaux”

Methodology used for projects

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**Stage 1**
**CHARACTERIZATION**

- Regulatory characterization
- SEDIMATERIAUX complementary analyzes
- Selecting the industry field and the possible applications

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**Stage 2**
**ON LABORATORY**

- Formulation study
  - Realization of test specimens
  - Experimental realization
  - Validation de la faisabilité mécanique et environnementale de l’usage visé en conditions contrôlées

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**Stage 3**
**ON SITE**

- Design and instrumentation an experimental structure
  - Mechanical and environmental monitoring of structure
  - Monitoring of groundwater quality at the receiving site
- Validation of the technical, mechanical and environmental in real conditions
Stage 1: Characterization (1/2)

- Elaboration of a sampling plan
- Regulatory characterization
  - Evaluation of dangerousness criteria
  - Analysis of radionuclides
- Classification dredging spoils according to the reference of Law on Waste
  - 17 05 06
  - 17 05 05*
- Possible treatment?
  - Yes: Treatment (no stabilization)
  - No: Hazardous waste storage facility (ISDD)

Complementary characterization
Stage 1: Characterization (2/2)

Complementary characterization

- Physical and geotechnical analysis:
  - Water content
  - Dry material
  - Grain size
  - Density
  - Organic matter content
  - Value methylene blue
  - Atterberg limits

- Mineralogical analysis:
  - DRX microscopy
  - XRF

- Mechanical analysis:
  - Proctor test
  - IPI test
  - Oedometer test
  - Triaxial test
  - Permeability test

- Chemical analyses:
  - Total content
  - Inorganic pollutants
  - BTEX, PAHs, HCT
  - PCB, TBT

- Selection of reusable deposits

- Characteristics compatible with the targeted use?
  - Yes
  - No

- Acceptable environmental characteristics?
  - Yes
  - No

- Elimination

- Treatment installation

- Phase 2: Laboratory study
Stage: Laboratory (1/1)

Laboratory Feasibility Study

Formulation study

Preparation of the material

Acceptable mechanical performance?

Acceptable environmental characteristics?

Design and monitoring of experimental planks?

Mechanical and environmental characteristics consistent with expectations?

Phase 3: On site

No

Abandonment

No

Yes

Yes

Yes
Stage 3: On site (1/2)

Preliminary inquiries and studies

- Identified pretreatment platform?
  - Yes
  - No

  - Using a mobile platform receptor site (ICPE regime)

  - Obtaining a material pelletable
  - Passing through a existing transit facility /grouping

  - Identified receptor site?
    - Yes
    - No

Impact study of the project reusing sediment

- Characterization of the initial state of the receptor site
- Characterization of the environmental impact
- Health Risk Characterization

- Acceptable health and environmental risks?
  - Yes
  - No

On site structure

- Abandonment Project
- Securing the structure
Stage 3: On site (2/2)

- Feasibility study on site
- Structure conception
- Instrumentation
- Mechanical and environmental monitoring over 12 months

  No
  Acceptable mechanical performance?
  Yes
  Acceptable environmental impact?
  No
  ABANDONMENT
  Yes

Validation of the technical, mechanical and environmental project in real conditions
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<thead>
<tr>
<th>Expert</th>
<th>Skills</th>
<th>Institution</th>
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<tbody>
<tr>
<td>Nor Edine ABRIAK</td>
<td>Méthodologie de caractérisations et de traitements des sédiments</td>
<td>Mines Douai</td>
</tr>
<tr>
<td>Rémi BARBIER</td>
<td>Aspects sociétaux, sociologie</td>
<td>ENGEES Strasbourg</td>
</tr>
<tr>
<td>Christelle BONNEMASON-CARRERE</td>
<td>Contaminations, ultra-traces, environnement</td>
<td>Université de Pau</td>
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<tr>
<td>Jean-Pierre GOURC</td>
<td>Sciences des déchets, géotechnique</td>
<td>Université de Grenoble</td>
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<tr>
<td>Pascal GREGOIRE</td>
<td>Expérimentation opérationnelle, environnement maritime</td>
<td>GMP Dunkerque</td>
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<tr>
<td>Bernard HUSSON</td>
<td>Durabilité, valorisation, environnement</td>
<td>Université de Toulouse 3</td>
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<tr>
<td>Isabelle CHARLES</td>
<td>Matériaux routiers- Essais vraie grandeur</td>
<td>CEREMA Rouen</td>
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<tr>
<td>Daniel LEVACHER (Chair)</td>
<td>Aspects matériaux, unités techniques, valorisation</td>
<td>Université de Caen</td>
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<tr>
<td>Muriel MAILLEFERT</td>
<td>Sciences humaines et sociales, économie de l’environnement, risques, politiques publiques</td>
<td>Université de Lille 3</td>
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<td>Françoise QUINIOU</td>
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<td>CEREMA Brest</td>
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<tr>
<td>François GARRIDO</td>
<td>Bio-géochimie, risques, dangerosité, contamination</td>
<td>BRGM Orléans</td>
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</table>

The Scientific Experts Group, called GES, is constituted for scientific questions, technical, socio-economic and legal under the Sédimatériaux approach.
### Projects reusing dredged sediment

- **First thesis supported under SEDIMATERIAUX Raouf ACHOUR**
- **Length:** 700 m  
  **Width:** 7 m  
  **Thickness:** = 41 cm (including 30cm treated sediment)
- **Sub-base:** harbor sediments + dredged sand + hydraulic lime binder
- **Environmental monitoring with piezometer**
- **15 years**
- **Constructed in 2012 by: Colas**
- **100 trucks per day**
**Projects reusing dredged sediment**

**Blocks to strengthen dikes**

- Raouf ACHOUR thesis (2013)
- Manufacture of a hundred blocks of 10 tons (12 to 20% of sediment)
Projects reusing dredged sediment

**Landscaped bund**

Second under Sédimatériaux thesis of Issamedine KHEZAMI (2014)
Length: 500m
50,000 m$^3$ of dredged sediments
Specialized vegetation: Salix repens, Sambucus nigra, Hippophae rhamnoides, Acer campestre
Cover with topsoil of 25 cm
Environmental monitoring: 5 piezometers
Mechanical monitoring
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**Projects reusing dredged sediment**

**SEDICYCLE**

- Realisation of concrete bike path formulated with harbour sediment from Dunkirk port
- Development project with a strong territorial dimension
### Projects reusing dredged sediment

**SEDICYCLE**

- What properties of studied sediment compared to granular materials usually used in concrete?
- What compatibility for concrete formulation?

**Fundamental objectives:**

Find a compatible formulation (economic and sustainable) + Durability + Physical/Mechanical/Environmental monitoring on site

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<td>Normal concrete</td>
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<td>Concrete with sediment</td>
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</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
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</table>

- Normal concrete
- Concrete with sediment
- **Surface**
- **Subbase**
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Projects reusing dredged sediment

**SEDICYCLE**

3 experimental pilot of cycle path Containing the sediment

SEDICYCLE project
Reuse of dredged sediment on coastal engineering

Coastal engineering application will be studied in the project
### Projects reusing dredged sediment

**Concrete rockfill for riverbank stabilization**

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- Ghent Dredging
- Vnf
- Neo-eco Recycling

![Concrete rockfill for riverbank stabilization](image)
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Projects reusing dredged sediment

- Selfcompacting grout
- Non structural concrete for roadway reservoir
Projects reusing dredged sediment

Urban furniture- C’URBAN

https://www.youtube.com/watch?v=6SPXB2U4iic
Projects reusing dredged sediment

Feasibility study of reuse lake sediment of Parc Barbieux

- No dredging for 100 years
- Total sediment volume: 10,760 m³
- Very humic sediments
### Projects reusing dredged sediment

**CO-VAlorization of SEDiments**

- Eco-innovation program: ECOTECH
- Accredited by the Ministry of Industry and productive recovery
- Future recycling platform of sediments in France:
  - Dehydrated
  - Valorization of uncontaminated sediments
Projects reusing dredged sediment

SEDIMENT DREDGED

PRE-TREATMENT:
- Sorting size
- Dewatering (by NEMEAU®)

VALORIZATION

SAND

WATER

SLUDGE

WATER TREATMENT
Projects reusing dredged sediment

- Findings and achievements of Sédimatériaux approach at the origin of project
- The interest of cross-border cooperation

Introduction to CEAMaS and the European Resources Center
**SEDILAB**

**SEDiment LABoratory (Resource Center)**

**SEDILAB**? resource center in Europe for the management and beneficial use of sediment.

- Created in the Nord-Pas de Calais region.
- Relies on field actions and concrete achievements made over the last ten years in the Nord-Pas de Calais region.
- Intensifies the work done by the SEDIMATERIAUX approach during 4 years.
- It will function as a laboratory of ideas, research and practical achievements. It will make its resources available to all managers in France and Europe.

### 5 missions:

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<th>Description</th>
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<td>1.</td>
<td>Monitoring and economic intelligence</td>
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<td>2.</td>
<td>Support for research and development</td>
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<td>3.</td>
<td>Development and diffusion of the work of Sédimatériaux approach</td>
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<tr>
<td>4.</td>
<td>Training and awareness of institutional and economic actor</td>
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<tr>
<td>5.</td>
<td>Communication through web: methodologies and results in France and Europe</td>
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EcoSed (Economie circulaire Sediment)

This industrial chair is based on work carried out under SEDIMATERIAUX

- On April 2nd 2014, School of Mines Douai signed the founding act of a research chair with 6 partners
- The aim this chair is to create a dynamic scientific, technological and partnership around the management of port and river sediments for recycling in road construction or concrete products.
A regional dynamic around sediment management ...

- A cluster TEAM² (2010), one of the 3 (specific area of activity) is specifically dedicated to sediment.

- A Euro-regional and national resource center on beneficial use and land sediment management referred SEDILAB (2013), carried by CD2E and one of the 5 main missions concerns the national coordination of SEDIMATERIAUX approach.

- An Industrial Research Chair dedicated to the valuation of sediment, called EcoSed (2014) and leaded by the Ecole des Mines of Douai.

- European and international dimension of the regional dynamic through many Interreg projects (€ 15.7 million to € 7.7 million operations for European aid) GedSet (2009), PRISMA (2011) and CEAMaS (2013).
s.brakni@cd2e.com

www.sedilab.com