SedNet WP 4

An overview of sediment and dredged material treatment

Giuseppe Bortone
Emilia-Romagna Region
Bologna - Italy
<table>
<thead>
<tr>
<th>Core-group</th>
<th>Name</th>
<th>Participant</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Giuseppe Bortone</td>
<td>6</td>
<td>Frank Elskens</td>
</tr>
<tr>
<td>2</td>
<td>Pol Hakstege</td>
<td>7</td>
<td>Didier Grosdemange</td>
</tr>
<tr>
<td>3</td>
<td>Kay Hamer</td>
<td>8</td>
<td>Johan Van Veen</td>
</tr>
<tr>
<td>4</td>
<td>Ivo Pallemans</td>
<td>9</td>
<td>Maya Soerjoesing</td>
</tr>
<tr>
<td>5</td>
<td>Audun Hauge</td>
<td>10</td>
<td>Petra Scanferla</td>
</tr>
<tr>
<td>6</td>
<td>Luciano De Propris</td>
<td>11</td>
<td>Wouter De Weirdt</td>
</tr>
<tr>
<td>7</td>
<td>Leonardo Palumbo</td>
<td>12</td>
<td>Wolfgang Calmano</td>
</tr>
<tr>
<td>8</td>
<td>Joop Harmsen</td>
<td>13</td>
<td>Carmela Cellamare</td>
</tr>
<tr>
<td>9</td>
<td>Andrea Giordano</td>
<td>14</td>
<td>Eric Stern</td>
</tr>
<tr>
<td>10</td>
<td>I.K. Deibel</td>
<td>15</td>
<td>Emanuele Zanotto</td>
</tr>
<tr>
<td>11</td>
<td>Heinz-Dieter Detzner</td>
<td>16</td>
<td>Marialuisa Cremonesi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>17</td>
<td>Carola Lampe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
<td>Pieter Vervaeke</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
<td>Eduardo Arevalo</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>Jan Peter Ulbricht</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21</td>
<td>Raffaele Cesaro</td>
</tr>
</tbody>
</table>

Book: Dredged material treatment
Dredged material treatment

Chapter 1: General Introduction

Chapter 2: National situation

Chapter 3: Overview on treatment and disposal options

Chapter 4: Description of available technology

Chapter 5: Beneficial use

Chapter 6: Assessment of treatment and disposal options

Chapter 7: Life Cycle Assessment and case studies

Chapter 8: Costs and economical issues

Chapter 9: Case studies and fact sheets

Chapter 10: Conclusions and recommendations
Introduction

- Sediments are an essential, integral and dynamic part of river ecosystems.
- Due to human activities during the last decades, sediments have been contaminated, and it's likely that they will be contaminated also for the near future.
Dredging is necessary to keep Europe’s ports vital

- Inland shipping
- Prevent flooding
- Urban watermanagement
- Ecology
- Fishery
- Agriculture
Uses of watersystems (2)

- drinking water
- yachting
- sportfisheery
- recreation
Dredging in Europe

- In Europe very large amounts of sediments are being dredged

- **Amount/year**
  - 30 – 50 Million m³ in Netherlands, Germany, France, Flanders
  - 5-6 million m³ in Italy
  - 100,000 m³ in Norway

- **Expenditure/year**
  - > 150 M€ in Germany, 130 M€ in NL

- Management costs for EU estimation at least 1 billion €/yr
Situation in Europe

- On the basis of a SedNet estimation, it can be assumed that around 100 and 200 million cubic meters of contaminated sediment might be produced yearly in Europe.
- Increasing pressure for new solutions for contaminated dredged material, because of decreasing space & public acceptance and increasing costs.
- Existing national legislation are very complex, borderline of water, soil and waste.
- EU regulations do not adequately deal with dredged material / sediments (WFD, Waste Catalogue, Landfill Habitats, Marine and Soil Strategy).
Perception of dredged material
(by Pol Hakstege)

Invisible
Toxic
Difficult
Waste
Nimby
Not sexy
Sediment as resource

- Sediments are not a waste, but a valuable, natural resource that can allow protection, conservation or even restoration of water bodies.
River basin scale

- In any case, dredging and sediment treatment/disposal need to be integrated in the river basin management.
- They should not result in unwanted impacts elsewhere or any time in the river system.
- Joint effort of authorities to meet the national and EU policy targets and comply with legislation along a river system.
- Integrated approach from inland to coastal waters.
Sediment treatment strategy

- It is clear that an effective sediment treatment strategy could never only implement the so-called 'end of pipe' approach,
- **source control** is the prerequisite to reach a sediment quality in the future, which does not pose a risk to aquatic systems or upland use (source: urban, industrial, agricultural areas).
- Investments in source control upstream are **often more economical** than treatment downstream.
• Treatment of dredged material is part of sediment management.
• Management options for dredging and/or treatment

Sedimentation and sources

Decision

No Dredging

In-situ Treatment

Dredging

Ex-situ Treatment

Dewatering

Disposal

Reuse

Treatment + use

Treatment + disposal

Relocation

Maintenance

Capital

Remediation
Site specific solutions

- Several aspects have to be always taken into consideration when a treatment technology has to be chosen.
- Therefore, it would never be a unique solution (it’s not like to buy a washing machine!)
- Different solutions have to be assessed every time case by case
- That means: treatment technology choice is very much site specific.
Preferred order of destinations of DM

1. Supply of DM
2. Sustainable relocation
3. Beneficial use (directly or after treatment)
4. Confined disposal
Relocation to the same watersystem

- Environmental restraints for environmental protection of marine and inland watersystems

- London, Ospar, Helcom

- Points of debate: quality criteria, WFD

*Sediments are an essential part of watersystems and no waste so relocation should be first option*
Alternative options

- If relocation is undesirable or impossible for environmental, morphological or spatial reasons, alternative options are applied:
  - beneficial use
  - treatment
  - confined disposal.

- The term 'Beneficial use' is used for treated and untreated dredged material.

- It’s questionable if dredged material should be treated before one can speak of beneficial use.

- Surely disposal can not be considered as beneficial use.
Treatment and disposal

- Different treatment and disposal technologies are well known world wide
- In many cases, the experiences of soil remediation technologies as well as mining tech can be useful adapted
- All types of treatment options are technically available
- Treatment and disposal are complementary options
## Treatment Technologies

<table>
<thead>
<tr>
<th>Processing Principle</th>
<th>1. Open water disposal</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relocation</td>
<td>2. Injection dredging</td>
</tr>
<tr>
<td>2. Mechanical separation</td>
<td>1. Classification</td>
</tr>
<tr>
<td>3. Dewatering</td>
<td>2. Sorting</td>
</tr>
<tr>
<td>4. Contaminant separation</td>
<td>1. Evaporation</td>
</tr>
<tr>
<td>5. Contaminant destruction</td>
<td>2. Mechanical dewatering</td>
</tr>
<tr>
<td>6. Contaminant immobilisation</td>
<td>1. Chemical extraction</td>
</tr>
<tr>
<td>7. Disposal</td>
<td>2. Thermal desorption</td>
</tr>
<tr>
<td></td>
<td>1. Biological reduction</td>
</tr>
<tr>
<td></td>
<td>2. Chemical oxidation</td>
</tr>
<tr>
<td></td>
<td>3. Thermal oxidation</td>
</tr>
<tr>
<td></td>
<td>1. Chemical immobilisation</td>
</tr>
<tr>
<td></td>
<td>2. Thermal immobilisation</td>
</tr>
<tr>
<td></td>
<td>1. Sub-aquatic confined disposal</td>
</tr>
<tr>
<td></td>
<td>2. Upland disposal</td>
</tr>
</tbody>
</table>
Applicability

- The decision if a given technology is applicable depends on different factors.
- For instance, the chemical-physical characteristics of the sediment itself defines whether a process principle is applicable or not.
- There will be in many cases a relation between the grain size distribution and the contamination of the sediment.
- The finer the particles and the higher the content of organic matter in the sediment, the higher will be the content of contamination.
## Decision frame

<table>
<thead>
<tr>
<th>Processing principle</th>
<th>Type of contamination</th>
<th>Type of contamination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Silty</td>
<td>Silty / sandy</td>
</tr>
<tr>
<td>2.1. Classification</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>2.2. Sorting</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3.1. Evaporation</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>3.2. Mechanical dewatering</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.1. Chemical extraction</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4.2. Thermal desorption</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>5.1. Biological reduction</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>5.2. Chemical oxidation</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>5.3. Thermal oxidation</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.1. Chemical immobilisation</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>6.2. Thermal immobilisation</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

- + indicates that the process complies with environmental standards.
- - indicates that the process does not comply with environmental standards.
COSTS

- Of great importance are the costs of different treatment options.
- They depend very much on the specific circumstances: large variations in costs occur.
- Simple technologies such as sand separation and land farming/ripening are generally slightly more expensive than disposal.
- While costs for stabilisation and thermal immobilisation technologies are significantly higher.
Treatment choice

- Nowadays, the costs of the treatment is often that high that the funds for continuous financial support for dredging activities might be not sufficient.
- This is true for the treatment as well as for the confined disposal, with the only difference that treatment is more expensive than disposal (except if landfilling is forbidden, limited or taxed),
- and therefore more treatment means that more budget is needed
- unless the treated product for beneficial use is marketable.
Choosing treatment options

- Since each treatment option processes the dredged material into a product, and the latter might be clean sediment, sand, bricks etc,
- the first consideration in the treatment choice should be, "are these products accepted by private or public users?".
- If the products are not accepted, the options are not feasible
Treatment costs

- all benefits (economical and societal) should be included!
Social cost benefit analysis

Economic sectors
- Navigation
- Fishery
- Agriculture
- Recreation

Social sectors
- Ecology
- Urban environment
- Drinking water
- Flood protection

All benefits expressed in € for each sector and compared with management costs dredging. Tool for policy-making to set priorities for investments
Beyond cost/benefit analysis

- How to apply sustainability
- **No general definition of treatment sustainability assessment**
- Site-specific approach for the treatment choice based on a long perspective integrated environmental, economic and social assessment
- **OBJECTIVE**: Interventions should not result in unwanted impacts elsewhere in the river basin (up- or downstream) and/or should not have an adverse impact tomorrow
Assessment

- An assessment approach accounting for the complete range of effects associated to a process remains a complex problem.
- An example of this new way of process assessment is the development of the methodology of the life-cycle assessment (LCA) and its progressive introduction to decision making schemes and even strategies for policy making in the public sector.
Assessment recommendation

- It must be recommended that a combination of tools (costs, LCA, costs benefit analyses, risk assessment studies) should become assessment routine for decision-makers.

- Indeed, the present structures for decision-making are mostly at local level with a very short timeframe (usually a political mandate).

- However, decisions have often consequences on a larger scale: the river basin, and might show long-term-effects.

- Decisions have to be based on a new spatial and time scale.
Final recommendation

- Experience has still to be gained for the large-scale application of technologies, logistics and the market potential of the products.
- For beneficial use at a larger scale it is imperative to develop markets for the application of dredged material and products from treatment of dredged material.
- Additional financial tools and markets for beneficial use are strongly required.
- Smart and innovative tendering, large-scale contracting of dredging projects.
- Public procurement.
Final recommendation

- It is of crucial importance to involve the public and other stakeholders in the decision-making process of treatment and disposal options.
- Public support is a critical factor, not only for the location of disposal sites, but also for the location of treatment plants and the beneficial use of the products.
THANK YOU VERY MUCH!