CEAMaS project : Civil Engineering Applications for Marine Sediments

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ABSTRACT

Management of dredged sediments is an issue for many European countries. At the same time, there is a concomitant increase in demand for construction materials with regional to sub-regional deficits in suitable sources to supply the market. The use of dredged marine sediments in civil engineering applications could provide potential solutions for both issues, however existing EU legislation for handling dredged material is complex and from a policy perspective, dredged material is dealt at the intersection of EU Water, EU Waste and EU Marine Strategy Framework Directives. Procedures and contaminant thresholds to authorize relocation of these sediments at sea or in land vary considerably from one country to the other and there are no harmonized regulations at EU level.

In this context, the CEAMaS project aims to bring about a major improvement regarding the widespread uptake of practices involving the beneficial reuse of dredged marine sediments. This will be accomplished by providing new and enhanced tools, methods, services and detailed knowledge on established and innovative civil engineering applications. Key outputs will be a common European reuse methodology applicable to all ports and sediments backed

by a European Resource Centre which will provide the focal point for knowledge capitalization and raising awareness of sediment reuse options.

With the support of funding under the INTERREG IVB ERDF programme and with CD2E as Lead Partner, the Technical University of Delft, the University College of Cork, the Cork Institute of Technology, the Ecole Centrale de Lille, the University of Lille 1, the Belgium Building Research Institute and the BRGM cooperate to propose environmental, economic, technical, social and regulatory solutions to issues of the current management and reuse of dredged sediments.

Keywords: Beneficial reuse**,** Marine sediments,Civil engineering,Life cycle assessment, Decision tool, Centre of resource

1. INTRODUCTION

In many countries dredging is required to prevent siltation of ports and waterways. Management of these dredged sediments is an issue for many European countries. In North-West European (NEW) countries over 200 million m^3 of marine sediments is being dredged every year. Stricter regulations for water and environment protection have highlighted the issue even further, particularly in the case when these sediments are contaminated.

Existing European Legislation for handling dredged material is complex and from a policy perspective, dredged material is dealt with at the intersection of EU water, EU waste and EU Marine Strategy Framework directives. Procedure and contaminant thresholds to authorize relocation at sea or in land vary considerably from one country to the other and there are no harmonized regulations at EU level. Besides, raw material is not easily available in some areas, which has the consequence of a pressure on the prices. Thus, EU regions are not equal in this resource in terms of availability and cost. The use of marine sediments offers the opportunity to fill these gaps. Diagram 1 presents a synthesis view of EU regulation touching upon dredging material and disposal.

In this context, CEAMaS, a European project, was initiated with the aim to promote the beneficial reuse of marine sediments in civil engineering applications in a sustainable, economical and socially acceptable manner. This will be achieved through a multi-criteria decision analysis system for responsible end users, by capitalizing on CEAMaS outputs (and other EU projects outputs), by providing training courses and disseminating results through the ECR.

Disposal options for dredged material include relocation at sea, confined disposal facilities or placement on land. Dredged material is most commonly placed on land if it is used beneficially as a resource, if it is inert and the transport costs for relocation at sea are prohibitive, or if it is contaminated to the extent that relocation at sea is prohibited, but controlled land disposal is permitted.

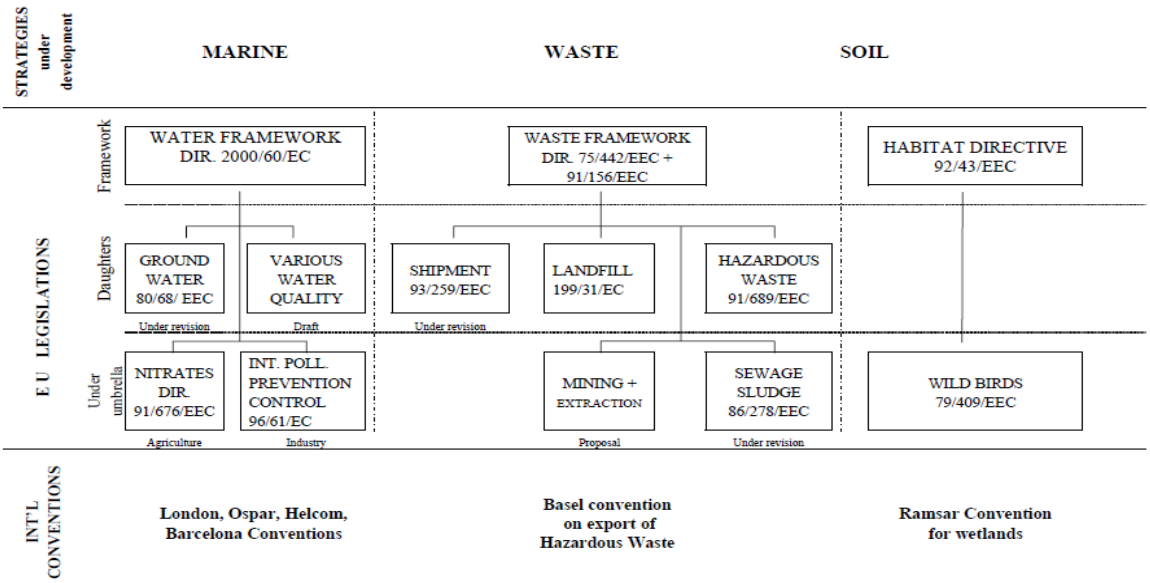

Diagram 1: Synthesis view of EU regulation touching upon dredging material anddisposal

Land disposal legislation and regulations applicable to dredged material are typically based on national systems devised for soil and other waste materials, while sea disposal regulations are based on international policies and guidelines [1]. There are three basic approaches which emerge when reviewing legislations, regulations and guidelines for dredged material disposal

- Standards whereby permitted concentrations or total loads of contaminants are stated
- Ecotoxicological whereby the toxic effects of the material are tested in a laboratory
- Case-by-case whereby each case is assessed in the context of the receiving environment (it mayinvolve both other approaches).

Standards approach

A system of standards defining the quality of the dredged material in terms of contaminants present (as either concentrations or total loads) is used in some countries. There are a number of methods available (e.g. background concentrations). The advantage of this approach is that it relies only on measurements that can be made in most analytical laboratories, chemical concentration or total loads can be easily compared to the standards. The disadvantage of this approach is that it is inflexible and may therefore impose unreasonably harsh restrictions in some cases or be too permissive in a sensitive environment. In addition, care needs to be taken that analytical methods and normalization of results, where required, have been undertaken [1].

Ecotoxicological approach

This approach addresses more directly the impact of contaminated sediments on theecology. There are various techniques which adopt this philosophy generally basedon testing samples of the dredged material in a laboratory.

Elutriate test which assesses toxicity by measuring the releasable contaminantsto evaluate potential contamination of adjacent surface and ground waters. This can be used to indicate the bioavailable fraction and potential exposure of surroundingenvironments.

Bioassay approach which observes the responses of selected test speciesto specific contaminants under laboratory conditions.

There are difficulties in selecting appropriate test species and reproducing thenatural conditions in the laboratory. However, scientific knowledge is advancing andmethods for predicting ecotoxic effects are improving.

An advantage of this method is its suitability for all classes of chemicals and mosttypes of sediments. A disadvantage of this method is that it is expensive and unableto fully reproduce the field conditions in the laboratory [1].

Case-specific approach

This approach assesses each case individually and is often regarded as a pragmaticapproach. The suitability of the dredged material for disposal may be accessed directly on its quantity and quality and on characteristics of the disposal site involved.Bioassays may also be employed if necessary, but essentially the philosophy is toassess the dredged material disposal suitability based on specific characteristics ofthe receiving site. Assessment on a case-by-case basis has the advantage of givingflexibility to adopt the best environmental option for the area. However, weaknessesof this method mean that the lack of uniform guidelines results in a lengthyconsultation process with involved authorities [1].

2. Aims and Objectives of CEAMaS project

CEAMaS, involving partners coming from 4 different countries (Belgium, Netherlands, Ireland and France) and an Advisory Committee of members coming from all NWE countries, will contribute to restore the balance between the European regions and propose sustainable and innovative methodology for reusing dredged marine sediments. Each region will benefit of the same advantage and innovation will be developed by knowledge transfer and cooperation between specialists from the partner countries. This project will promote the beneficial reuse of marine sediments in civil engineering applications, in a sustainable, economical and socially acceptable manner. It will also provide online training courses and disseminate results through a European Center of Resource towards economical, institutional and scientific stakeholders. Taking into account existing EU and national

initiatives and regulations, it aims to contribute to a more equitable and appropriate legislative framework through the provision of recommendation on this subject.

CEAMaS' aim is to mainstream sustainable re-use of dredged marine sediments by providing new and enhanced tools for the development of innovative civil engineering applications, by developing a European reuse methodology applicable to all ports and sediments types and by enhancing knowledge capitalization and awareness of sediment reuse options through a European Centre of Resource (ECR).

CEAMaS project is a North-West European project to which 8 expert partners will bring their contribution, experience and know-how in order to strengthen the emergence of marine sediments valorization and to bring about a major improvement regarding the widespread beneficial re-use of dredged marine sediments to end users.

Partnership includes scientific partners (University of Cork and University Lille 1, Delft University of Technology and Ecole Central de Lille), Cork Technical Institute (CIT), environmental triple-helix cluster (CD2E), public sector organization (BRGM) and industrial organization (BBRI) from 4 NEW countries. These organizations will develop a common approach taking into account their different points of view and interests based on their national experiences.

The Objectives of CEAMaS are

1. Compare EU regulations and perspectives for the reuse of marine sediments through a SWOT analysis on civil engineering applications and benchmarking on dredged sediments management and reuse in NWE (WP1).
2. Search and study new solutions and formulations of sediment reuse by analyzing the characterization of dredged sediments and by conducting parallel developments of new formulations based on dredged marine sediments (WP2).
3. Organize field studies and observations for best practice exchange (WP2).
4. Secure the reuse of dredged sediments by looking at environmental, social and economical impacts of studied experiments (WP2) and by monitoring results of impacts with a Life-Cycle Assessment approach as well as by consulting environmental NGOs regarding the impact on biodiversity (WP3).
5. Develop and propose a sustainable European methodology of reuse of sediments (multi-criteria decision tool) applicable to all ports in order to foresee the possible reuse of sediments and propose alternative solutions to the EU Water Directive regarding the "status of waste" of sediments once out of the sea (WP4).
6. Sustain knowledge capitalization, encourage innovation and disseminate findings of CEAMAS by the creation of an online EC (WP5).
7. Develop an online training program on sediments management and reuse in civil engineering applications (WP5).

8. Propose recommendations for an integrated legislation regarding the reuse of dredged sediments in Civil Engineering industry and inputs for a non-waste status of some categories of sediments.

3. CEAMaS, an innovative and a unique project

The project is innovative because of its focus on finding sustainable solutions of reuse of sediments in Civil Engineering applications, taking into account the environmental, economic and social aspects but also thanks to its objective to create a European methodology to help ports' managers to foresee how they can reuse their dredged sediments in civil engineering applications in their own ports.

The project is also innovative because it addresses directly a lack in the legal national and European framework regarding sediment management and reuse. Another innovative aspect of the project is to address the sediment issue globally regarding environmental, economical, social and regulatory aspects and to monitor results of new applications of sediments in field observations in the ports of Waterford, Dunkirk and Antwerp and in the Netherlands through a Life Cycle Assessment approach and consultation of NGOs (regarding the impact on biodiversity).

Environmentally, by providing long-term solutions for the depth of water near coasts, the quality of natural aquatic environments and the biodiversity reinforcement, helping flood prevention and proposing alternative materials, a European methodology to ports managers regarding the management of dredged sediments and their reuse.

Economically, by providing long-term benefits by increasing ports' competitiveness by (1) reducing the cost of treating some sediment; (2) proposing a global management of sediment reuse; (3) developing new sectors and materials; (4) reinforcing innovation in this sector and (5) increasing the activities of maritime transport.

Socially, by providing practical information and dissemination through mainly the European Centre of Resource about the project's advantages and its benefits for the citizens living near the dredged areas and thereby avoid conflicts among citizens and port's managers.

CEAMaS will provide them with information about the good management of aquatic systems, and so will encourage local jobs with the creation of a new sector of industrial reuse of sediments and activities. The ECR will also propose to end users an interactive online educational training program on sediment management and reuse in civil engineering applications.

And for the *Regulatory and Politic sides*, by providing alternative solutions to be included in the EU directives and influence national legal framework and norms especially regarding the "waste status" of sediments once out of the sea and will also propose guidelines towards a

harmonized European level of acceptability of (contaminated) sediments regarding their reuse applications.

The project is also unique in its capacity to bring together different stakeholders such as ports' managers, local authorities' project officers, scientists from universities, industrials, clusters, environmental NGOs… to work together to find collaborative long-term solutions to the current issues of sediment management and reuse which are both innovative and operational.

Finally the unique European Centre of Resource (ECR) that will be created (legally as a European Association) will capitalize and disseminate via a web-based platform all the findings of CEAMaS and as well from other European projects and initiatives regarding sediments' management and reusing applications in civil engineering industry.

4. Project Management Structure

4.1. Management structure of the project and organization of decision-making, partnership cooperation/coordination, sharing of responsibility

This project is managed by CD2E, which assumes and hosts the project global management along with the financial and communication management. The role and responsibilities are equally split among partners with different partners leading different work packages: University College Cork, UCC in Ireland for WP1, Ecole Central de Lille in France for WP2, Cork Institute Technology, CIT in Ireland for WP3and CD2E in France for WP4 and WP5.

The choice of these WP managers was done during a transnational meeting and they have been accepted by all partners. The lead partner will encourage the contribution of external experts brought by the partners and especially a transnational Advisory Committee set up at the beginning of the project and composed of European key stakeholders on sediments (managers of ports, industrial federations, civil engineering companies, research Institutions, public and government bodies, territorial authorities, environmental NGOs) and European networks such as SEDNET, representatives of other European projects. This Advisory Committee will advise and analyze the findings of CEAMaS ensuring representativeness and dissemination of findings at the European level.

4.2. Internal reporting of the project with particular emphasis on the audit trail and the way the accounts will be handled between partners

A steering committee is set up at the project level and involves the contact point of each partner organization. Formal meetings with all partners are held twice a year, one month prior to the introduction of a payment claim. Once a year, the steering committee will approve the annual activity report. This monitoring committee has the responsibility, under lead partner supervision which chairs this committee of project achievement (i.e. making sure that

the outputs and deliverables are delivered in due time, with the adequate quality, at the expected cost). Minutes are drafted and sent to all partners, and are part of the official documentation related to the project. A progress report is realized every 6 months with the financial claim. In case of major problems, this monitoring committee will held an extraordinary session and find ways to solve the problems before asking the support from the JTS.

5. Importance of transnational cooperation to achieve the aim of the project

Partners will cooperate together to

1. Compile, analyze and disseminate a comprehensive bibliography and mapping coverage for sediment re-use and management in NEW countries
2. Propose a common characterization for dredged sediments
3. Analyze the environmental, social and economical acceptability of new civil engineering applications studied
4. Create a common European methodology to re-use sediments based on a multi-criteria decision analysis for entities responsible for sediment management
5. Sustain knowledge capitalization and dissemination of options and methods for sediment re-use through the creation of a European Centre of Resource
6. Organize regional workshops and international conferences on project findings

These issues concern the whole NWE area, whilst sediment management differs in each country due to local regulations and standards. Therefore, there is a need to clarify and foster convergence between these legal frameworks and CEAMaS aims to bring economically viable solutions.

In this context, transnational cooperation is important in order to exchange knowledge and methodology to set recommendations for an integrated legislation regarding the reuse of dredged sediments in civil engineering applications. There is also an EU transnational economical challenge to be addressed arising from the dislocation between increasing levels of local/regional raw material supply deficit and the parallel increases in demand, particularly for materials used in civil engineering works.

This project proposes to bring together knowledge and skills from partners in France, Belgium, Netherlands and Ireland together with input from a transitional Advisory Group. This group will focus on creating a European common methodology for sediment re-use as well as a unique European Centre of Resource on sediments' reuse and management which will promote new innovation, best practice and online training educational programs.

This cooperation is essential in (1) the establishment of a Europe-wide methodology for reusing marine sediments based on a multi-criteria decision analysis for entities with responsibility for sediment management; (2) to capitalize and disseminate information at

European level through the creation of a European Centre of Resource; (3) to create an online database and mapping coverage of sediments' reuse needs and opportunities in civil engineering; (4) to create an interactive online training program on sediment management and reuse in civil engineering applications and (5) to set recommendations for an integrated legislation regarding the reuse of dredged sediments in civil engineering industry and inputs for a non-waste status of some categories of sediments.

Acknowledgement

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References

[1] Fletcher C.A., Burt N.T., Paipai E. (1997)."International Legislation and Standards Governing the Disposal of Dredged Material"*International Conference on ContaminatedSediments.*