SEDI.PORT.SIL Project

Recovery of dredged SEDIments of the PORT of Ravenna and SILicon extraction

waste management | recovery of waste | dradged sediments

PROJECT DESCRIPTION

The management of **dredged sediments** is somewhat complex and is one of the main problems of the port areas. According to data from the SEDNET (Sediment European Network), dredged sediments in Europe reach about **200 million cubic meters each year**. Usually these materials are transferred directly to large landfills and the related contaminated water is conducted in treatment plants, with all the problems and environmental risks related to this type of waste management. In this context, the **SEDI.PORT.SIL. project has demonstrated the possibility of sustainably managing sediments dredged from port basins through the use of consolidated treatment technologies and innovative techniques aimed at recycling and enhancing the sediments. The final product is uncontaminated material to be used as a resource for coastal nourishment or as a material in other environmental engineering activities.** The project also examined the use of polluted sediment as a raw material for the extraction of metallurgical grade silicon.

SEDI.PORT.SIL. envisaged in its first phase the development of a pilot study on some samples of dredged sediments in the Port of Ravenna, one of the most important ports in Italy for its geographical position. Subsequently, the possibility of applying the tested process on a regional scale and in a different European context, specifically the Port of Midia (Romania), was assessed. The final goal of the project was to develop guidelines for the treatment of sediments, their reuse as raw materials and perform the sustainability assessment of the construction of a treatment plant in the port of Ravenna.

PROJECT PHASES

The project was divided into 6 technical actions listed below, supported by project management and communication activities:

- **Definition of the state of the art (preparatory action)** through the acquisition of the sediments characteristics from the Port of Ravenna; analysis of the regulatory framework relating to dredging, management and reuse of sediments at regional, national and European level; and analysis of the available technologies for sediments treatment and silicon extraction.
- **Sediment treatment (demonstration action)** consisting in sediments sampling (division into three contamination classes) and (physical-chemical, microbiological, eco-toxicological and mineralogical analyzes) analysis, both before and after the treatment; treatment of the sampled sediments through laboratory processes and construction of a pilot plant.
- **Plasma treatment of the sediments and silicon extraction** using a TEKNA PL-35 35 kW RF (Radio Frequency) plasma torch to reproduce in laboratory the conditions of high temperature and heat exchange typical of this type of industrial plant. In this way it was possible to test the vitrification and inertization of the contaminated sediment and the possible extraction of metallurgical grade silicon.
- **Sediment reuse plan** aimed at identifying and characterizing possible reuses of the dredged sediment from the Port of Ravenna, after its treatment.
- **Treatment plant in the Port of Ravenna**: development of a Master Plan for the management of dredged sediments and a Business Plan for the realization of the pilot plant at the Port of Ravenna for the management of dredged sediments and

the maximization of their recovery.
- **Replicability of the project** in a different territorial-environmental and legislative context. Case study: Port of Midia.

PROJECT RESULTS

The project gave a contribution to the sustainable management of dredged port sediments. Specifically, the solution proposed by **SEDI.PORT.SIL. allows a substantial reduction in the quantities of sediments destined for landfills (efficiency of around 98%) and the recovery of secondary raw materials** which can be reused on different markets:

- **sands for nourishment of emerged and submerged sandbanks**;
- **construction of embankments and artificial banks;**
- **inert materials with fine granulometry for constructions, infrastructures and fillings;**
- **sale of silicon iron alloys** (an important element for the steel industry).

After laboratory tests and the construction of a pilot plant that made possible the validation of the applied treatments and thus their scale-up to industrial level, the project led to the construction of an industrial-scale treatment plant in the Port of Ravenna. A feasibility study on the construction of another industrial plant at the Port of Midia was also performed and validated.

The industrial-scale plant in the Port of Ravenna has shown strong **economic sustainability on a 20-year time scale**. The applied decontamination process referred to sediments of three contamination classes: highly polluted, contaminated, non-contaminated, for an amount of **30 m3 of sediments**, transferred to the plant directly by the operators of dredging activities. **Three different treatment techniques** were tested on these samples **for the recovery of sediment and/ or the creation of secondary raw materials: soil washing, landfarming and plasma melting**. The process can provide for the 3 treatments in sequence or by activating only a part of them according to the type of sediment and contamination. So the plant is flexible in terms of type and also quantity of sediments.

The following documents were produced within the project:

- **Sediment Management Report: legislative and administrative framework**. The document analyses the regulatory and administrative context of dredging, management and reuse of sediments with reference to the situation in Italy and in some European countries (Belgium, Germany, Holland, Norway, United Kingdom and Spain).
- **Report on Technologies for the treatment and decontamination of dredged sediments**. It contains a general overview of the environmental problem of contaminated sediments and an overview of pollutants with the biggest environmental impact as well as their main sources; finally an analysis of the scientific literature on research issues and perspectives in the field of sediment treatment and management techniques.
- Development of a **Business** and a **Master Plan** for the construction of the treatment plant in the Port of Ravenna: The Master Plan is divided into two parts; part A contains an overview of the possible reuses of decontaminated sediments, and a market analysis of ferro-silicon, which describes uses, demand and supply of this alloy of high market value. Part B contains an inventory and analysis of the different types of contaminated sediments, coming from different contexts of the port area of Ravenna. The Business Plan outlines the economic and managerial aspects of the treatment plant's construction, presenting the business idea, reference markets, the objectives and strategies, and giving an evaluation of the cost drivers as well as of the benefits drafting an economic-financial scenario as base for the sustainability assessment of the initiative.
- **Guidelines for sediments management**. The document summarizes the project results, and it also offers a useful work tool for sediments dredging in other ports.

Further technical documents can be downloaded from the publications section of the project's website: "The SEDI.PORT.SIL Project Reports".

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Contacts
Elisa Ulazzi

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Beneficiary headquarters

Via Pietro Zangheri n. 16
48124 Ravenna RA
Italy

Region
Emilia-Romagna