

Environmental characterization addressed to port sediment management: two case studies in the central Tyrrhenian sea (Italy)

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Introduction: Sediment dredging is necessary and vital to preserve maritime activities and prevent floods and the management of sediments represents an environmental challenge for many countries worldwide. It is estimated that the amount of sediments annually dredged in Europe is approximately 200 million m³ [1]. In this context, a proper characterization plays a fundamental role in considering dredged sediments as a resource and, where possible, promoting their reuse in the marine-coastal and port environment.

In Italy, the management options for dredged sediments are defined on the basis of their quality obtained through a multiple line-of-evidence approach, according to the Ministry Decree (M.D.) 173/2016. It is known that the combination of chemical and biological analyses represents an added value for monitoring and management purposes [2]. This study summarizes the results of the environmental characterization carried out before capital and maintenance dredging in two areas, "Darsena Servizi" of the port of Civitavecchia and the canal port of Fiumicino (central Tyrrhenian sea). In particular the marine area outside the port of Civitavecchia is characterized by the presence of protected habitat (Habitats Directive) [3].

The aim of this work is to assess the environmental quality and to suggest the proper management options minimizing the adverse effects on marine ecosystems.

Methods: Sediment samples were collected in both ports according to the strategy defined by M.D. 173/2016: a total of 11 samples in the dock of Civitavecchia port and 16 samples in the canal port of Fiumicino. For each sample granulometric, chemical and ecotoxicological analysis were carried out. Data were elaborated using SediquaSoft 109.0® software to identify the overall quality classes for management.

Results: In the port of Civitavecchia, results showed a sediment quality classified as A and B, with a limited amount of C class. For class A and B it is possible to manage sediment directly in the marine environment and for C to dispose them into a confined disposal facility (CDF) without isolation, i.e. any exchanges with the marine environment do not generate adverse effects.

As far as the sediments of the Fiumicino port canal are concerned, results showed a worse quality which includes classes D, suitable for disposal in a waterproofed CDF and, to a limited extent and class E for sediments that have to be safely removed from the marine environment.

Discussion: The characterization of the sediments to be dredged confirmed, in both cases, the management options preliminarily identified by the Port Authority. The environmental quality of canal port of Fiumicino is probably influenced by the contamination coming from the mainland and by the activities historically present in the area [4]. The "Darsena Servizi" of Civitavecchia, not affected by direct discharges and far away from main maritime traffic, shows a quite good environmental quality. In both cases, chosen management options were considered in Harbour Master Plan to increase the port efficiency. Finally, the application of the integrated assessment proposed by M.D. 173/2016 has proved to be a valid support tool for verifying the adequacy of the management options proposed by the competent Authorities in their master plans, favoring a sustainable use of sediments. In line with the principles of the circular economy that consider sediment as a resource it promotes the reuse of dredged sediments with adequate precautions, such as impact mitigation measures and monitoring plans, focusing the attention on protected and sensitive habitats and species.

References: [1] Svenson et al. (2022). *Waste Management* 138, 30-40; [2] Regoli et al. (2019). *Front. Mar. Sci.*, 08, 6 art 377: 16 pp; [3] Marcelli et al. (2021). *EGU General Assembly 2021, online*, 19-30; [4] Onorati et al. (2013) *J. Soils Sediments* 13:474-487.