A decision-making methodology for the management of dredged sediments on the basis of chemical and toxicological data

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Introduction: Harbors and coastal areas around most cities worldwide have sediments contaminated with heavy metals and organic substances, such as hydrocarbons, polyaromatic hydrocarbons and polychlorinated biphenyls. This paper presents a methodology of evaluating management options for dredged sediments on the basis of an array of characterization tests and gives an example application for the sediments of Piraeus port.

Methods: The matrices tested are (i) collected sediment, (ii) sediment pore water and (iii) leachate produced from a standardized leaching test[1][2]. Characterization tests result in measurements of (1) total metals, PAHs and PCBs in sediment, (2a) metals in pore water, (2b) toxicity of pore water, (3a) metals in leachate, (3b) toxicity of leachate and (4) sulfides and metals in the acid phase of an extraction technique (AVS/SEM)[3]. The corresponding management options include disposal in open sea, disposal in waste land-fills and disposal in confined facilities, depending primarily on the results of tests (1), (3a) and (3b), respectively. The results from tests (2) and (4), which indicate the degree of the bioavailability of the contaminants, can be taken into account as supporting evidence for management decision in no clear-cut cases, e.g., when concentration values are between acceptable and action levels.

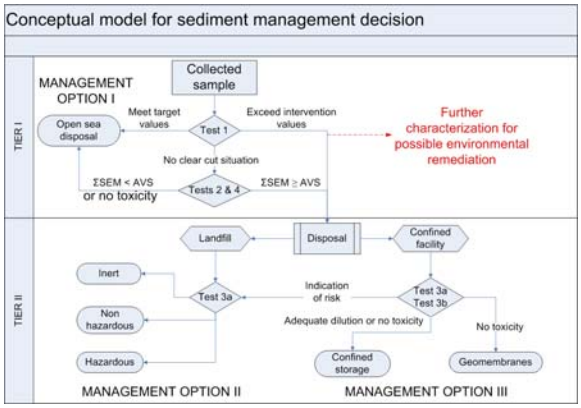

Fig. 1: Decision tree for sediment management options.

Results: The decision process is guided by a framework that provides for two tiers of assessment. In tier I, the first management option, disposal in open sea, is examined based on a sequence of characterization tests. The final decision is based on the combination of chemical and toxicological analytic results, supplemented by physical characteristics of sediments

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Although the decision-making methodology is developed primarily for dredging activities necessary to meet port and navigation requirements, tier I also evaluates whether further characterization of the sediments is warranted for restoration purposes. Tier II includes the other two options, disposal in landfills or in confined facilities. These options are examined for those sediments for which disposal to the open sea entails a high risk to the environment. Decisions in this tier are facilitated by well-established effluent criteria applied to ambient waters and wastes admitted to landfills [2][4].

Discussion: The methodology described above was used to characterize sediment samples from the port of Piraeus, Greece's main port. Disposal to open sea proved to be infeasible for the more contaminated sediments found in the areas of Piraeus port with increased shipping activities. However it was concluded that due to the very small availability of heavy metals, no additional characterization was required. for remediation purposes. Disposal in confined facilities proved a viable option for most of the sediments, whereas all sediments were characterized as non hazardous and can therefore be accepted in an ordinary landfill.

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