

Sustainable Sediment Management at the City of Helsinki – From Low-Quality Soils into Construction Materials

**Noora Lindroos¹, Juha Forsman¹, Emma Niemeläinen², Kata Kreft-Burman¹, Juha Sorvali²
Veli-Pekka Perttinen², Mikko Suominen², Hannu Halkola², Satu-Pia Reinikainen³, Eeva Jernström³**

¹Ramboll Finland Oy, PL 25, 02601 Espoo, Finland

Phone: +358 (20) 755 6758

²City of Helsinki, STARA/HKR, PL 1572, Helsingin kaupunki, Finland

E-mail: noora.lindroos@ramboll.fi

³LUT Lappeenranta University of Technology, PL 20, 53851 Lappeenranta, Finland

Introduction: The maintenance of ports and seaways require dredging and handling of contaminated sediments since the level of contamination inhibit dumping of dredged sediments into the sea. Based on their technical properties, most of these dredged sediments are regarded as too poor quality material for earth construction purposes. In the City of Helsinki in Finland, mass stabilization technology has been applied to improve the technical properties of the dredged sediment in order to utilize the material in construction. Owing to stabilization/solidification, also the contamination is encapsulated in a monolithic solid of a high structural integrity. Thus, contaminants migration is restricted by the decreased surface area exposed to leaching. The treatment site presented in this article is placed in West Harbour, in Helsinki where the dredged sediments are disposed to stabilization pools, mixed with binders by mass stabilization and then transported to final utilization sites. The overall volume of the four stabilization pools is about 90 000 m³.

Methods: The stabilisation technology requires technical and environmental material tests in the laboratory before the launch of construction works and follow-up studies afterward. Technical properties of the materials are determined by laboratory studies including compression strength tests after a specified curing time. Several different binders and their amounts are tested in order to determine a suitable binder mixture for a given application. The most commonly applied binder in stabilization has been cement. However, its high price and considerably high carbon footprint encourage searching for alternative solutions. The replacement of cement with binders based on fly ash from coal combustion in the stabilization of dredged sediments has been studied both in the laboratory and on site. Also hydraulic conductivity of solidified mixture is commonly tested. The environmental acceptability is evaluated by testing leaching of contaminants from stabilised material in the laboratory. In addition, leaching of contaminants from stabilised sediments is simulated in the lysimeter field, in the real weather conditions.

Results: The results of the tests provide good reasons for the use fly ash based binders in the process of stabilization of dredged sediments. Due to considerable variations in quality of the mass stabilized sediments, the need for an active quality control in all stages of work is indispensable. The quality control methods embrace e.g. water and organic matter content tests, XRF-measurements, pocket Vane Shear test, Fall cone test, Column and Cone penetrometers, settlement plates.

Discussion: The use of mass stabilization method allows for the processing of low quality and polluted sediments into construction materials. One of the challenges is the high water content in the dredged sediments which requires big amounts of cement. For instance, the West Harbour application (in 2012) demanded ~6200 t of cement for the stabilization of ~88000 m³ of dredged sediments. This application has also allowed for piloting stabilization with the use of fly ash. Based on the results obtained, it is possible to conclude that at least half of the amount of cement used could have been replaced with fly ash.

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References:

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