Stabilization of Contaminated Sediment for Re-use at the Port of Helsinki, and Other Finland Sites

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Background/Objectives. Marine sediments in coastal areas often are contaminated due to historical industrial and port activities and from runoff from nearby urban areas. Modern redevelopment identifies a need to re-use these former industrial spaces in the creation of new, multi-use residential and commercial areas. Construction activities and shoreline reclamation associated with redevelopment often require dredging and management of contaminated sediments, in some cases to manage navigation and in other cases to reduce human and ecological risks associated with contaminated sediment. Under current regulations, contaminated dredged sediment can no longer be placed offshore and require alternative disposal methods. In situ stabilization presents a sustainable technology to immobilize contaminants and create usable material for modern urban construction needs. The technology also provides considerable benefit when considered in an overall circular economy evaluation because it reduces environmental impacts with alternative disposal methods while creating converting the sediment into a useful resource. This paper presents a series of case studies from Helsinki, Finland, including at the Port of Helsinki. Both technical considerations of stabilization and costs are considered.

Approach/Activities. Sediment stabilization (S/S) was performed in situ (ISS) and ex situ. ISS involves injecting pozzolanic materials into the sediment bed while blending the sediment with an auger-like mixing tool. Conventional, off-the-shelf equipment relies on the dry injection of pozzolanic materials and can mix to a depth of 8 m. Mixing both homogenizes and blends the pozzolan material, readily achieving unconfined compressive strength (UCS), hydraulic conductivity (K), and contaminant leaching goals. Binder material options and addition rates have been tested at multiple sites using Portland Cement, Lime, Cement Kiln Dust (CKD), Bottom Ash, and slag). The ideal mix is tested in Ramboll's geotechnical laboratory (Helsinki, Finland) to optimize the pozzolan mixture, costs, and performance (e.g., UCS, K, and leaching requirements). Long-term performance suggests continuous improvement due to the continuous hydrolysis of the pozzolan.

Results/Lessons Learned. We demonstrate the use of S/S and ISS to stabilize and reuse contaminated sediment. Otherwise unusable dredged sediment is transformed into a usable construction material and is applied at sites where construction fill is needed, enhancing the urban landscape and reducing total environmental impacts of dredging and contributing to urban renewal. UCS and K goals are reached in virtually all applications, and leaching tests demonstrate the protectiveness of S/S so sediment can be reused as commercial fill. We identify how the sediment is used in an environmentally protective manner that is first and foremost protective of human health.