Sustainable sediment solutions: Stabilization of contaminated sediment

Tim Olean[1], Dusty Tazelaar[1], Michael Mengelt[2], Juha Forsman[2], Mark Nielsen[3], Victor Magar[4]

[1]O'Brien & Gere, Wrentham, Massachusetts, US

E-mail: Tim.Olean@OBG.com

[2] Ramboll, Säterinkatu 6, 02601 Espoo, Finlandat

[3] Ramboll, 101 Carnegie Center, Suite 200, Princeton, NJ 08540

[4] Ramboll, 333 W. Wacker Drive #2700, Chicago, Illinois 60606, US

Introduction: Marine sediment in coastal areas often is 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 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 sediment contaminants. Under current regulations, off-shore placement of contaminated dredged sediment us increasingly difficult and requires creative alternatives. Stabilization (Fig. 1) is a sustainable technology that can be used to immobilize contaminants and leave the stabilized sediment in place (i.e., in situ stabilization, or ISS) or to stabilize contaminants ex situ to create a usable material for modern urban construction needs.

The technology 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.

Methods: Solidification/stabilization S/S is a process of blending treatment reagents (e.g., pozzolanic materials) into contaminated material to impart physical and chemical changes that result in reduced environmental impact of the contaminated material [1]. 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 can be 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.

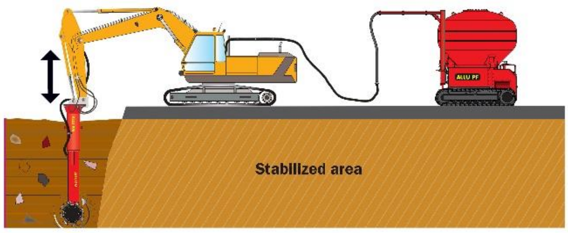

Fig. 1: Sediment Stabilization Process.

Results: We will present multiple case studies showing how the application and evaluation of ISS performance. We include post-ISS results from a former manufactured gas plant (MGP; Wisconsin, USA), including surface water, surface sediment, and benthic community measurements to evaluate how ISS impacts the ecological community. For ex situ applications, we will discuss the use of sediment stabilization to find a beneficial use for contaminated sediment at the Port of Helsinki, Finland. We will consider both technical considerations of stabilization and costs.

Discussion: Stabilization and ISS are increasingly considered viable remedies for impacted sediment [2,3]. Technology advances have greatly reduced technology costs while improving implement ability and reliability. ISS leads to reduced dredging needs, while stabilization and reuse leads to reduced waste. Effective use of this technology can reduce energy requirements and contribute positively to the circular economy.

References: [1] ITRC (2011) *Development of Performance Specifications for Solidification / Stabilization*. www.itrcweb.org. [2] EPA (2009) Technology Performance Review: Selecting and Using Solidification/Stabilization Treatment for Site Remediation. EPA/600/R-09/148. [3] Tajudin, SAA et al. 2016. *Stabilization/Solidification Remediation Method for Contaminated Soil: A Review.* IOP Conf. Series: Materials Science and Engineering.