Active Nautical Depth: a promising method to manage harbour sediment with the potential of tributyltin bioremediation

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Introduction: Active Nautical Depth (AND) is a promising sustainable method to replace or reduce dredging need and mitigate the problems associated with siltation in ports and harbours. It is applied by mixing and aerating the sediment *in situ*, turning it into a navigable fluid mud (fig. 1) [1]. Aerating the sediment promotes the growth of aerobic microorganisms, which subsequently produce a large quantity of extracellular polymeric substance (EPS). The presence of EPS affects the fluid viscosity, which helps delay fluid mud consolidation. In certain port conditions, the fluid mud cloud can even prevent additional siltation by constituting a physical barrier, as for the case of the port of Emden [2]. Therefore, in ports with fluid mud problems, this process can reduce the reliance on dredging through the creation of navigable fluid mud. Furthermore, the process has the potential for other benefits such as the reduction of carbon emissions (released during the transport of dredged sediment) and cost involved in sediment management.

A further benefit of AND is the potential for *in situ* bioremediation. The process of aeration acts to stimulate an aerobic microbial community which previous studies [3] have shown to be active in the biodegradation of harmful contaminants commonly found in ports and harbours, such as the previously widely used antifouling compound called tributyltin (TBT). Aerobic biodegradation is known to be the major process for TBT degradation in sediment but it remains poorly understood in coastal and marine waters [4].

This study thereby aims to understand the environmental factors controlling TBT biodegradation in sediment in order to optimize the implementation of AND.

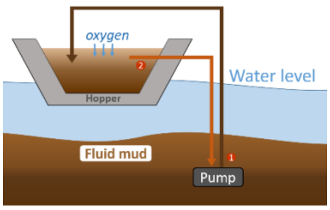

Fig. 1: Active Nautical Depth principle.

Methods: Microcosms will be set up under different environmental scenario. The three main varying parameters will be temperature, aeration and agitation.

A first phase (10/18 – 03/19) will include 250 mL microcosms while a further experiment will be designed using pumps, aerobic and anaerobic tanks to model AND field conditions.

In each condition, samples will be taken regularly and analyzed for organotin compounds through GCMS to calculate a degradation rate.

Results: We hypothesize an increase of TBT degradation rate with increasing agitation, oxygenation and temperature, with a threshold to be determined for temperature above 25°C.

Discussion: We expect higher rates of degradation when sediment is incubated in aerobic conditions and at higher temperatures as microbial degraders of TBT are known to be aerobic and microbial activity is higher at high temperature.

Depending on the extent to which the parameters will influence TBT biodegradation, the results can be considered by applying AND during warmer seasons or warm locations around the world, changing the duration of sediment exposure to the air before its pumping back to sea bottom, or even adapting the pumping system.

The implications of the potential of the AND process to revolutionize the way the port industry approaches intrinsic mud problems will be discussed.

Acknowledgements:

Thank you to SEMASO and LJMU for funding this project.

Reference: [1] Polrot *et al.* (2019) *Towards coastal resilience and sustainability* (16):262-275; [2] Kirby *et al.* (2008) *Proceedings in Marine Science* 9:1–15; [3] Cruz *et al.* (2015) *Critical Reviews in Environmental Science and Technology 45(9):970-1006* ; [4] Sakultantimetha *et al.* (2010) *International Biodeterioration & Biodegradation 64(6):467-473*