Desalination of dredged sediments for circular reuse: two Eems-Dollard cases

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Introduction: Large amounts of sand are used in infrastructure projects and industry. Sandy sediments are therefore becoming scarce [1] while billions of cubic meters of fine cohesive sediments are dredged worldwide to maintain navigation channels. Consequently, more and more of these fines will have to be used in infrastructure development [2]. However, dredged sediments are more complex to use because they consist of a heterogeneous mixture of water, fines, sand, organic matter and gas, among other components. Sediments from marine areas also contain salt, which influences the physical and (bio)chemical behavior of the mixture.

Promoting circular economy to achieve sustainability goals is a worldwide trend among policymakers. In this line, the Netherlands has committed to be completely "circular" by 2050 (e.g. [3]). Simultaneously, around 1900 km of the Dutch dikes must be reinforced before 2050 to comply with new safety requirements. This implies the need to develop re-use scenarios and sustainable sediment sources for infrastructure projects and industry [4], [5].

The ecological quality in the Eems-Dollard estuary (Netherlands/Germany) has been decreasing because of high turbidity caused by resuspended sediment. To improve its ecology, and comply with the demand for local sustainable raw materials, beneficial use of dredged sediments from the estuary is tested as part of the Eems-Dollard 2050 program. The dredged sediments are used in pilots, such as the Clay Ripening Pilot and the Raising of Agricultural Land Pilot (POL). The Clay Ripening Pilot was built in 2018 [6] to investigate various ways of converting dredged sediments into ripened clay soil to use as erosion resistant top layer for embankments. Here, the relatively large amount of organic matter and salt turned out to be a limiting factor that hinders compliance with existing dike reinforcement material standards. The POL project starts in early 2021 in order to gain knowledge and experience to sustainably reuse dredged sediments to raise agricultural land in the Groningen peat area, following earlier Dutch experiments to "Lift up Lowlands" [7]. This would make the sediment usable on a larger scale and improve water management, while also reducing the CO_2 emissions from peat oxidation.

Methods: In early spring 2021, marine dredged sediments will be mechanically dredged in the Zeehavenkanaal of Delfzijl harbour, flushed with fresh water and transported to a 4 hectare-plot for the POL. This sediment will be dredged at the same location as for the Clay Ripening Pilot in 2018 [6]. However, the process is different: in this pilot, the sediment will be dredged mechanically and flushed with fresh water before placement. This is therefore an opportunity to compare the differences in these two pilots in terms of evolution of water-content , salt and organic content. Monitoring of water, salt and organic content is performed during the preparation and filling process and once the sediment is placed in the plots. Furthermore, a mass balance is performed. Simultaneously, small scale "mixing and flushing" lab experiments are carried out to gain insights into the influence of different treatment techniques on water, salt and organic content.

Results and conclusion: This presentation will show the preliminary results from the field campaigns from spring 2021 and compare the differences in properties after placement between the Clay Ripening and the POL pilots. The new future climate and policy goals combined with the scarcity of sandy sediment offers opportunities for circular (re)use of these normally dumped slurries worldwide. However, strategies are needed to treat the slurries so that they can comply with standards and be suitable for the desired use and location.

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