Desalination of dredged sediments for circular reuse to raise agricultural peatlands

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Introduction: Beneficial use of dredged sediments from the Eems-Dollard estuary (Netherlands/Germany) is tested within the Eems-Dollard 2050 program. The sediments are used in pilots, such as the Raising of Agricultural Land Pilot (*Pilot Ophogen Landbouwgronden*, POL). POL uses fine sediment from Eemshaven for agricultural (peat)land elevation, contributing to reduce the CO_2 emissions from of organic matter (OM) oxidation and improving the agricultural productivity and water management. Due to the high salinity, this sediment is not directly suitable for agricultural purposes and is first rinsed with fresh surface water. One of the knowledge questions of the pilot concerns what happens to the chemical composition of the sediment as result of this rinsing process. Therefore, laboratory tests were carried out on the salty sediment, in addition to electric conductivity (EC) measurements in the field (pilot). This paper presents the results of these laboratory tests.

Methods: The rinsing with fresh water was mimicked in the laboratory: the marine dredged sediment was mixed with fresh water at a 1:6 (volume) ratio with a HOBART planet N-50 Mixer. The mixing time was 5 minutes at a constant mixing rate of 285 rpm/minute. The resulting mixture was poured in 18 glass columns where it was allowed to settle and consolidate. The settling of the sediment-water interface was monitored. Supernatant and pore water (filtrated) samples were taken from 3 replicates at each of the following times: t = 1 day, t = 3 days, t = 7 days. To check the effect of a second mixing cycle, the consolidating sediment was remixed again at t= 7 days for 9 of the 18 column replicates. The mixing was done with the supernatant water of the column (i.e. not with new fresh water) and with the same mixing procedure. For these columns, samples were also taken from 3 replicates at t = 8, 10 and 14 days. At all sampling times, the total mass of the column and the mass of the different fractions (mass of supernatant and mass sediment bed) was measured, as well as the EC of the supernatant water. For all samples, concentrations of main ions were determined using ion chromatography (Dionex). Additionally, the organic matter content from sediment samples before and after mixing was determined by thermogravimetric analysis (TGA).

Results: The results show that mixing with freshwater does reduce the concentrations of ions, and expectably the reduction of bi- and trivalent ions (Ca^{2+}, SO_4^{2-}) is lower than monovalent ions (Na^+, K^+, Cl^-). Monovalent ions such as sodium and chloride are released immediately when mixing, remaining the concentration stable during the rest of the experiment. However, ions with higher valence such as sulfate are released progressively during a longer period of time (Fig. 1). Mixing with fresh water also reduced the amount of OM. Quantification of OM for salty sediments is not straightforward because salt hinders water release, which means that temperatures higher than 105 °C are needed to remove water completely.

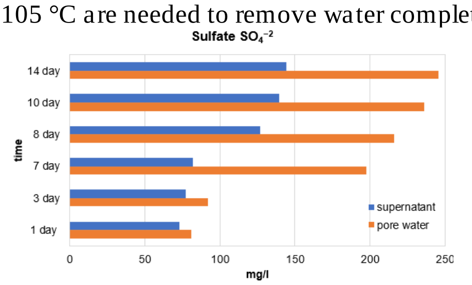

Fig. 1: Evolution of the concentration of sulfate ions (bottom panel) in the supernatant and pore water.

Discussion: More information about the optimal soil parameters is needed: it is important to maintain suitable nutrient levels and OM, but also to reduce the salt to avoid salinization of the groundwater and be suitable for more crops types. The results can be used to obtain a rough estimate of effects on other anions/cations, even if only reduction of conductivity is measured.