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**Publication date**

2023

**Document Version**

Final published version

**Citation (APA)**

Kirichek, A., Bampatzeliou, A., Gebert, J., Chassagne, C., Ohle, N., & Schmekel, U. (2023). *Testing Conditioning Methods for Maintenance Dredging in Ports*. Abstract from 13th International SedNet Conference 2023, Lisbon, Portugal. <https://sednet.org/wp-content/uploads/2023/08/5.6-Testing-Conditioning-Methods-for-Maintenance-Dredging-in-Ports.pdf>

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# Testing Conditioning Methods for Maintenance Dredging in Ports

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Conference theme number(s): 3

**Introduction:** There are several maintenance methods that are typically used for sediment conditioning in ports. For instance, the sediment re-circulation is used by the Port of Emden (Germany) for reducing the strength of the sediment [1]. Another example of sediment conditioning is applying Water Injection Dredging (WID) in port areas with low energy regions. The Port of Rotterdam (the Netherlands) tested WID for conditioning the sediment in the Calandkanaal [2]. The WID-induced fluid mud layer can be then used by vessel for navigation in the Calandkanaal by adapting the density of 1.2 t/m<sup>3</sup> as the critical criterion for navigation. Finally, sediment conditioning can be done by, for instance, hydro jet at the suction head, bed leveller and underwater plough. These methods has been also considered for reducing the strength of the sediment and thus increasing the under keel clearance (UKC) in the port area by adapting the nautical bottom approach.

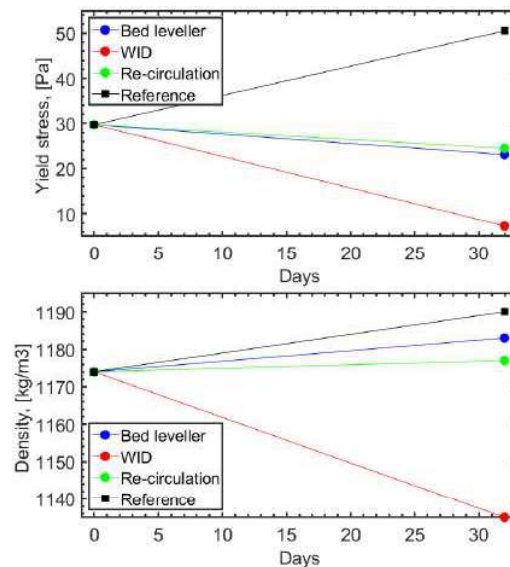
This laboratory study compares the effect of different maintenance methods and frequencies on sediment properties as a basis for possible future adaptation of maintenance strategies in the Port of Hamburg (Germany).

**Methods:** First, sediment conditioning by WID, bed leveller and re-circulation was conducted using a field sediment sample collected from the Port of Hamburg in the laboratory. The sediment properties, namely rheology (yield stress), structural recovery, settling, oxygen saturation and redox potential were measured before and after conditioning to study the effect of these methods on mud properties. The rheological protocols developed by [3] were applied in this study. Conditioning was conducted with different frequency (once a week and 3 times a week) in order to investigate the frequency of maintenance for keeping mud fluid. Secondly, the results of the laboratory experiments were compared to the results of field trials, were WID, bed levelling and re-circulation were tested for port maintenance dredging.

**Results:** The effect of all conditioning methods can be replicated in the laboratory. Both laboratory and field

tests showed that WID has the most pronounced impact on mud properties. Bed levelling and re-circulation had similar impact on rheology and density of mud. The effect of all methods was influenced by the frequency of conditioning, but differences were smaller than differences resulting from the different methods. The results also showed that WID is the most oxygen consuming condition method.

Future investigations will optimise lab replication of dredging techniques and further investigate the effect of dredging frequency on mud properties.



**Fig. 1:** Effect of conditioning methods on (fluidic) yield stress (shear strength) and on density of mud.

This study is funded by Hamburg Port Authority. The research is carried out within the framework of the MUDNET academic network. <https://www.tudelft.nl/mudnet/>. The authors would like to acknowledge Deltares for the use of FCL.

**References:** [1] Wurpts et al. (2005) Terra et Aqua 99:22-32; [2] Kirichek & Rutgers (2020) Terra et Aqua 160:16-26; [3] Shakeel (2022) PhD thesis, TU Delft.