Nature-based geotextile tubes: a new circular and nature-friendly solution for the dewatering of dredged material

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Introduction:
The Dutch water boards have set an ambitious target to become 50% circular by 2030 and 100% circular by 2050.The main resource flow within the water boards consists of locally dredged sediments. The beneficial reuse of these dredged materials fits within the philosophy of a circular economy[1]. Dredged sediments, often seen as waste, therefore offer a natural resource that can be applied in many sustainable infrastructural and ecological applications.

One of these sustainable applications is geotextile dewatering tubes. Woven geotextile is commonly applied in geo-engineering for reinforcing soil and erosion/scour protection[2], but also for dewatering soft sediment. Instead of using sand as filling material, NETICS has been performing intensive studies on the large-scale dewatering and reuse of soft waste sediments in dewatering tubes[3].

Geotextile tubes are often made from synthetic polypropylene, which after exposure to degradation, can release harmful microplastics into the environment[4]. In Europe, this problem is increasingly relevant, since geotextiles are also commonly used in vulnerable and protected natural areas. Therefore, there is urgent need for a nature-based replacement that can degrade biologically.

Methods:
The usage of biodegradable and natural geotextiles is not new. Natural textiles such as jute and coir are abundantly used as for example scour protection[2]. In case of geotextile tubes however, it is commonly believed that the larger tensile forces released during the filling of geotextiles tubes can only be absorbed by synthetic materials.

NETICS collaborated in a consortium with the municipality of Rotterdam, geotextiles suppliers and dredging contractors, to tackle the societal challenge of geotextile plastics. The goal of this consortium was to prove that nature-based textiles are suitable for dewatering tubes in day-to-day dredging works.

For this study the most commonly used woven natural textiles: jute, hemp, flax and ramie/nettle have been investigated. These textiles have been tested on density, O^{95}, sediment dewatering speed and tensile strength. Continuing on these findings, together with the consortium, multiple full-scale jute geotextile tubes have been produced and used for dewatering two types of soft sediments in a full-size practical experiment.

Results and discussion:
This study has yielded insights into the possibilities for applying nature-based geotextiles as a sustainable replacement for synthetic dewatering tubes in a full-scale dewatering plant. In fact, all but one of the chosen natural materials were deemed technically suitable for upscaling into a real-world application. Moreover, the natural materials even offer various co-benefits for this type of application, such as increased evaporation, wet stiffness, being a substrate for vegetation and most importantly its (controlled) biodegradability.

This study found that, large-scale application of biodegradable tubes is limited by the readiness of the local textile markets. Large scale production of nature-based textiles is considered by modernized industries as ancient craftmanship and is only available in emerging economy countries. However, due to the increasing awareness on the damaging effects of synthetic materials produced from non-renewable oil, there is growing demand for bio-based materials.

This presentation will give insight in the potential of natural textiles for beneficial use of dredged materials, and the challenges we face now and, in the future, to integrate these eco-friendly materials in large scale industry practices.

References:
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