

# Application of GEOWALL® dike revetment elements made from dredged materials

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## Introduction

With the acceleration of sea level rising, flood protection is becoming increasingly predominant worldwide. In this perspective 300 km of dike is being strengthened in the Netherlands every year<sup>1</sup>. Still a significant number of concrete elements are used, for example in dike revetments. Therefore, to contribute to ambitious global climate goals such as emission or circularity, there is a growing need for applying sustainable concrete replacement in the dike sector.

On the other hand, siltation of waterways is worldwide an environmental and economic problem. Almost 200 million cubic metres of sediment is dredged every year only accounting for the European waterway system. The management of dredged sediment is an increasing issue for harbours and local authorities. At this moment most of the dredged sediment is transported to depots as waste. This is a missed opportunity, since 90% of the sediment in Europe is expected to be clean enough to be reused in high value applications.

## GEOWALL® technology

NETICS has developed a novel recycling solution wherein dredged sediments are reused in high quality solid building blocks. This unique innovation, patented by NETICS, is called GEOWALL®. One example of GEOWALL® blocks are concrete-like elements consisting of compressed locally available dredged sediment. The blocks are made by mixing the sediment with some (natural) stabilising binders such as eco cement, lime, zeolites (according to a designed recipe with the NETICS recipe model) and by pressing it directly into the right shape. This is done with a unique built GEOWALL® Press. This method of mechanical stabilisation prevents high percentages of binders and a long curing period like concrete blocks.



## Methods

In close collaboration with the Dutch flood protection program (HWBP) and the Scheldestromen Water board, NETICS performed a full-scale study on the applicability of dike revetments made from dredged materials using the GEOWALL®-technology. The main goals of this study were to prove the feasibility of the product under laboratory conditions, develop practical production equipment and techniques, control the production and apply this material in real.

## Results and discussion

Results have shown that dredged material can be added in a significant quantity up to >35% (m/m) in the production of dike revetment elements. The product, compressed with a mechanical pressing device, had similar mechanical properties as regular concrete: Compressive strength 31 MPa, bending strength 6.5 MPa, specific density: 2200 kg/m<sup>3</sup>. At the same time, life cycle analysis (LCA) gives an improvement of at least 20% compared to concrete.<sup>2</sup> These results are very promising considering this to be the first pilot with dike revetments from dredged material as local waste stream. Application of GEOWALL® dike revetment elements was done by a pilot section in the Dutch Western Scheldt.



By locally using dredged sediment as waste product environment impacts are kept to a minimum. Low emission rates (compared to concrete elements) decrease the LCC (Life Cycle Costs) and Eco Costs significantly, depending on the sediment composition and recipe. In addition created elements are 100% circular as these can be completely crushed into the original sediment to be reused again for any other or same GEOWALL® elements.

The material is suitable for application in dike reinforcement projects, since conceptually it complies with technical standards described in the Dutch NEN norms for dike revetments (NEN 7024-1+C1(n)). Next step is to optimize the mixing ratio and production for this material to reach an even lower environmental impact and reduce the production costs. Also, the shape and size of the material will be optimized to boost hydrological performance and ecological benefits.

In the near future for sustainable projects this material offers enormous benefits in terms of sustainability, circularity and ecology. The latter will be studied from ecologists from NETICS, Deltares, and NIOZ. The ongoing pilot section will give insight in the potential for this material and the development challenges. Currently NETICS and Deltares are writing a specific guideline for GEOWALL® dike revetment elements.

## References:

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