Deltares

Enabling Delta Life

Strengthened sediment

An innovative building material particularly in view of climate change

Social context

Global climate change

Climate is changing: sea levels are rising, rainfall is increasing, whilst long periods of drought will also occur. Moreover, the ground level is sinking in delta areas with a soft subsurface. Large-scale construction is taking place in areas that are vulnerable to flooding. The importance of flood protection will therefore increase. The costs of measures to protect against flooding will continue to rise.

Flood protection in and outside The Netherlands

There have been numerous examples of flooding incidents in recent decades ranging from serious to catastrophic (as well as drought problems), with the result that flood protection has become an issue. In The Netherlands, these incidents include the devastating flood of 1953, high-water problems along the Rhine and Maas rivers in 1993 and 1995, and various dike breaches as a result of drought in 2003. This has led to the (ongoing) investment of billions of euros in projects aimed at strengthening water-retaining structures.

The euro 2.1-billion-project “Space for the River” (“Ruimte voor de Rivier”) has been started. The measures call for the excavation and transport of large quantities of primary building materials (clay, sand, gravel, rubble, etc.) and also lead to the release of millions of m^3 metres of (partly contaminated) sediment and soil. Flood disasters in countries such as Hungary, Czech Republic, Germany, Poland, England, Romania, Thailand, Bangladesh and Indonesia are still part of recent memories, where billions of euros of damage was caused and major social upheaval ensued. All these disasters together have cost the lives of thousands of people.

The dredging issue

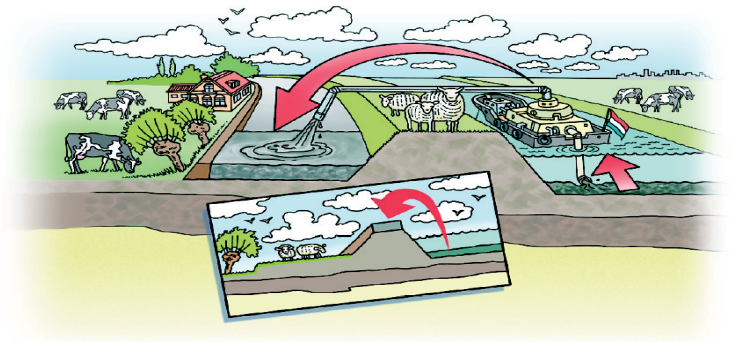
The dredging issue is a different problem that also involves a great deal of money, substantial economic interests, and safety aspects. Regular dredging is vital to guarantee the supply and drainage of water, the navigability and/or nature function of the waterways, and to protect the population against contamination (public health) or against flooding (quality of life, safety). In the latter case, dredging also indirectly ensures flood protection.

Sediment or sludge is generally seen as waste, a negative product. In The Netherlands, a situation exists where structural dredging maintenance has fallen behind. The various public authorities are making hundreds of millions of euros available for a one-off attempt to catch up. In addition, the annual dredging budgets have been increased by tens of millions of euros. Approximately 20 million m^3 of (partly contaminated) sediment is released each year in The Netherlands, which can potentially be made suitable for use as a building material. Other countries are experiencing similar problems.

Strengthened sediment as a logical link between dredging issues and flood protection

What is strengthened sediment?

Deltares carried out various studies into the innovation of using strengthened sediment in a useful, safe, and sustainable way as a building material in the strengthening of water-retaining structures and roads. The innovation is essentially an inexpensive, simple, and quick-to-use technique where dredged sediment can be strengthened using secondary building materials (as fly-ash or cement and sodium silicate) in order to, for example, strengthen nearby water-retaining structures (see illustration). What is unique is that this process can take place 'directly' (no unnecessary transportation and storage): the dredged sediment is converted into a building material on-site and can be used straightaway. The strengthened sediment is already hardened a few hours after processing. It is clear that the combination of greater security against flooding with the dredging issue provides a three-fold benefit: a contribution to flood protection, cost advantages, and environmental benefits.



Applications

As example the following (dry and wet) applications are possible (construction of):

- primary and secondary dikes/embankments, levees
- groynes/abutments, breakwaters, riverbank and -bottom protections
- coverage of (contaminated) landfills and underwater depots
- roads, noise-protection dams
- cemeteries, golf courses and other soil structures
- islands in lakes within the framework of nature development.

As far as underwater uses are concerned, a laboratory test was performed where strengthened sediment was successfully placed underwater. The aim was to test whether riverregulating measures could also be carried out using the product.

When considered further, it can be seen that both a process innovation (combining supply and demand between parties) as well as a technical innovation is involved. By combining dredging and river-training works (e.g. groynes/abutments), in other words creating work with work, cost- and environmental benefits result.

To implement this innovative idea, test projects need to be initiated with various stakeholders/contractors so that experience can be gained of different implementation aspects, environmental situations, and contamination situations. The development of knowledge and the distribution of know-how between involved parties are essential in this.

Added social value

Once test projects have been successfully carried out, contractors can market strengthened sediment as a useful, safe and sustainable building material in the (inter)national market. The added value is enormous. Dredging leads to cleaner water and increases the navigable depth. Sediment can be used in a positive way (e.g. for flood protection or otherwise in the building industry). Both now and in the future, hundreds of kilometres of water-retaining structures must be tackled in and outside Europe - in addition to river-widening measures - to provide an answer to the effects of climate change. The use of strengthened sediment - also under water - results in a beneficial use of secondary building materials, and thus reduces the use of primary building materials as well as the costly storage of contaminated sediment in depots. In this way, a contribution is also made to reducing CO_2-emissions. The environmental benefits are clear. By linking dredging maintenance to dike-strengthening programmes, the long-term cost savings are structural in character and amount to hundreds of million euros. Creating work with work pays!

Cooperation and information

Deltares is searching for forms of collaboration with parties and governments in order to carry out test projects. If you are interested, please contact Deltares.

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