PILOT PROJECT: "GROTE GEUL - LEFT BANK"

Silt treatment in lagooning installations

The central problem of industrially processing fine grain material derived from maintenance dredging is how to achieve rapid dewatering.
In view of the grain-size distribution of such material an entirely mechanical procedure is technically vulnerable and above all expensive. For this reason cheaper and more reliable methods have been sought.
After analyzing the various alternatives a lagooning installation was decided upon. In this kind of installation the liquid dredged silt is pumped into specially designed lagooning basins. The depth of the layer (1.5 to 2 m) is purposely restricted. The natural dewatering processes are accelerated by a variety of means so that a consistent material is obtained after a period of about 1 year. This material is then excavated and used for landscaping or for other recycling projects, leaving the lagooning installation free for the dredged material produced during the forthcoming year. In order to perfect this approach a large-scale project known as the "Grote Geul (Large Ditch) Project" was started at the initiative of the Administration of Waterways.
The main aim of this project is to determine the basic limit conditions

for the construction and operation of an efficient installation for the dewatering of silt based on the acceleration of natural processes.
The "Grote Geul" project occupies an area of roughly 25 ha including 5 separate basins. Each of the basins has been provided with a different drainage system, including one site without drainage.
Each basin was filled with dredged material (500 and 800 kg of dry matter per m. After an initial period of sedimentation, consolidation and drying of about 4 months, a number

of operational procedures aimed at accelerating the natural dewatering processes were tested:
- reduction of back pressure in the drainage system;
- provision of ditches to improve rainwater run off;

- sowing of deep rooting and fast growing vegetation;
- the erection of silt bridges.

During the course of the project the whole was precisely guided and supervised by a monitoring programme in which the progress of

the geotechnical and environmental characteristics of the silt were carefully monitored by means of:
- daily measurements of the surface level;
- regular measurements of the density of the silt;
- regular measurements of the shear strength of the silt;
- sampling and chemical analysis

of the silt, the evacuated water and the surrounding soil and groundwater.
- a meteorological station;
- a series of standpipes for monitoring the groundwater.

The entire pilot project, including the monitoring programme, was coordinated by a steering group, made up of representatives of the Waterways Authority and from the companies and design offices carrying out the work.

Principal:

Ministerie van de Vlaamse Gemeenschap
Departement Leefmilieu en Infrastruktuur
Administratie van de Waterwegen en van het Zeewezen

Antwerpse Zeediensten Dienst Ontwikkeling Linker Schelde Oever

Scientific supervision:

Waterbouwkundig Laboratorium Borgerhout

in co-operation with:

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Instituut voor Hygiëne en Epidemiologie
Rijksuniversiteit te Gent
Katholieke Universiteit te Leuven
Vrije Universiteit te Brussel

Contractors:

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DREDGING WORKS IN THE MARITIME SCHELDT AND IN THE ANTWERP REGION FOR NAVIGATION AND THE ENVIRONMENT

PROCESSING OF DREDGED SPOIL INTO USEFUL MATERIALS

SILT DISPOSAL IN UNDERWATER CELLS

The use of underwater cells offers an environmentally safe way of disposing of dredged material.
This solution consists of creating deep pits or excavating cells in the bottom of docks in which the silt can be directly disposed. The cells are dredged by deep-acting cutter suction dredgers. The reclaimed sand is used for the preparation of industrial sites within the port area, for which there is a considerable demand as a result of the powerful economic growth of recent years. The dredged material is deposited with the aid of an underwater diffusor, which prevents the silt coming into contact with the water above, and allows the cells to be filled virtually entirely free of turbulence.

The principle of spoil disposal in deep cells is in itself nothing new. The systematization of such a disposal system and effective monitoring of its continuous impact is, however, an innovation. For this reason a large-scale programme of trials was implemented during 1988-1990 in order to gain experience with the special equipment and the techniques which are used for this purpose.

The programme was combined with an environmental impact study. This study, which was carried out in association with the IMDC consultancy (Tractebel) examined the immediate impact on the environment as well as the long-term effects on the water in the docks and the groundwater both during and after disposal. The study included:
- in-situ measurements;
- stability studies;
- consolidation tests;
- physico-chemical tests;
- studies of groundwater flows and dispersion model in order to determine long-term effects (10,000 years).

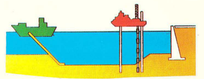
The pilot project has shown that the disposal of dredged material underwater in the Waasland complex of the Port of Antwerp would have no influence on the surrounding environment. Apart from the underlying stratum of "Boom" clay, the groundwater conditions are also extremely favourable.
The results are in fact so positive that the detailed development of plans for the large-scale use of underwater disposal sites for dredged material can go ahead.

Once a cell has been filled it can be sealed by a capping system, thus isolating the silt entirely from the surroundings.

This method of underwater disposal has already been shown to be the most environmentally satisfactory disposal method in other countries (the Netherlands - USA), simply because the material is placed in a reducing environment for an indefinite period of time, thus greatly limiting the potential risks of leaching and the biological availability of any pollutants which may be present in the material.

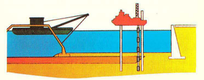
Original situation

Dredging of overdepth

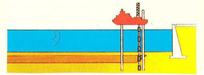


Filling with silt

Sand capping



Monitoring before, during and after execution



INITIATIVES FOR A RENEWED PROJECT SPECIFIC APPROACH

– EXTRACTION OF CONTAMINANTS

In view of the fact that a residual proportion of dredged material may be polluted, work is being carried out on the development of decontamination techniques. During the dredging operation silt is mixed with specific products so that heavy metals adsorbed onto the silt particles are brought into solution. After separation the watery phase is subsequently treated by anaerobic methods.
After the preparatory theoretical analyses and laboratory scale trials a pilot project was tried on a semi-industrial scale.

– RECYCLING OF DEWATERED SILT

Bearing in mind the overall policy options of the Flemish Region, a large part of the research effort has been devoted to developing the possibilities of recycling.

* The most promising possibility is the use of dewatered silt as a raw material for the production of construction materials (including gravel).

Because of the presence of pollutants in the silt, an alternative firing process using higher temperatures was chosen. In this process the basic material is incinevated to form a structure in which any residual polluting elements are bound in inert form.
At present tests are being carried out on a laboratory scale, and the preliminary designs and basic plans of a semi-industrial pilot plant are being worked out. This work is being carried out in association with Germany's Lurgi corporation.

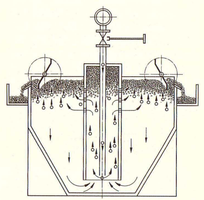
* A second possibility is to combine uncontaminated silt with liquid manure to create a new fertilizer which can be used as a soil improver for sandy soils. The liquid manure provides a broad range of nutrients. This project is now in the laboratory phase, with the first test fields due to be laid out. This work is being done in association with the Belgian Farmers' Union ("Boerenbond" - AVEVE).

– SILT SEPARATION AND DEWATERING

The fact that the pollution characteristics of dredged material are related to the grain size of the basic material, means that separation into a number of different fractions is a realistic way of considerably reducing the volume of problem material:

* One such method is the ELUTRIATOR, which is being tested on an industrial scale. It is a conventional counterflow sorting installation which separates the silt into three separate fractions with differing grain sizes and pollution characteristics.
* The pilot installation can process roughly 300 m of silt per hour.
* Another solution is provided by the HYDROSILT installation. This uses hydrocyclones to separate the silt into three fractions. The fine grain fractions are then mechanically dewatered using filter belt presses.

After preparatory laboratory tests and trials with a semi-industrial pilot installation (25 m/h), an industrial installation (1000 m/h) is now in the design stage.



Mechanical test processes for the cleaning and consolidation of dredged silt

Landscape design using concentrated silt

Natural processes for the fast dewatering of dredged silt

The diffusor for the environmentally friendly disposal, of dredged silt in underwater cells

A LONG-TERM VISION FOR DREDGING WORKS IN THE LOWER MARITIME SCHELDT A STRATEGY FOR TOMORROW

In recent years various phenomena have spurred the rethinking of policy on dredging works in the Maritime Scheldt.

These have included:
- an increasing tendency towards silting in some areas of the Scheldt;
- increasingly constrained physical planning options, which has meant that only a few sites are now available for raising with dredged material;
- growing awarenes of the fact that it is primarily the fine-grain sediments in the Maritime Scheldt which tend to accumulate the pollutants discharged in the river.

The new approach is based on the following objectives:
- attainment of the desired depths in navigation channels;
- ensuring the good environmental quality of sediments in the Western Scheldt, i.e. no transport of silt over the border;
- reversal of the trend towards silting in the Maritime Scheldt;
- environmentally safe treatment techniques for dredged material;
- to start reclaiming dredged materials for use (recycling);
- to find an economically sound solution.

In order to meet these objectives a major change in policy direction was decided upon. In contrast to past practice material with a high silt content will be extracted from the Maritime Scheldt.

This new approach will help to improve the quality of the sediments in the Scheldt and to clean up the river. This, however, is also a source of new problems, namely the disposal and useful recycling of dredged material with a higher content of polluting elements.

A phased approach has been adopted in order to deal with these:

** short term* (0 - 5 years)
A number of cells have been dredged in the docks. The sand from these has been used for laying out new industrial sites, for which there is an acute demand at the present time. These cells are to be filled with dredged material, which will consequently be stored in virtually natural conditions so that leaching will be prevented of any pollutants which may be present.

** medium term* (5 - 15 years)
The dredged material will be transferred from the Scheldt to an industrial silt treatment plant, where the dredged material will be dewatered to yield a clay product which can be handled by mechanical means. One use for this material will be the construction of a suitable buffer region between the docklands and the surrounding agricultural land.

The silt treatment plant can (perhaps at a later stage) also be used for silt arriving from other sites (Antwerp's right-bank port complex for example).

** long term* (10-30 years)
Ways of recycling the dredged material will be sought, for example as a clay substitute, which would make it possible to reduce the exploitation of natural clay resources in Belgium.
The first phase will be aimed at producing granulate materials. This would make it possible partially to replace the extraction of natural gravels (e.g. gravel pits the Maas (Meuse) region.

Another application under examination is aimed at the farming industry. Here silt and manure will be mixed together to create a soil improver. There is considerable interest in such a product in foreign countries (including Tunisia and Morocco).
The aforementioned policy options will require major technological and financial efforts by our society, but on the other hand they constitute the only way of ensuring the maritime accessibility of the Port of Antwerp, which is a sine qua non for the enduring industrial and cultural growth of Flanders in general and the Antwerp region in particular.
A further advantage will be the establishment of an entirely new industrial activity in the Antwerp region: the industrial treatment and recycling of dredged material.

Sand from maintenance dredging works for dike reinforcements, sandsupplies and beach nourishment