

DREDGING A NEW HARBOUR SITE IN THE PORT OF ROTTERDAM

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ABSTRACT

For construction of new harbour dredging operations are needed. In a large port like Rotterdam, situated at a coastline and at the estuary of the River Rhine and Maas, large amounts of sediments and sand have to be removed to create the necessary depth. New and deep harbour basins are needed for a new generation of ships. The container business is booming, new and large container terminals sites have to be constructed in short time. Simultaneous new plans for a large extension of the harbour site are ready for construction, millions of m³ of sand are needed to construct these reclamation. Rules and new regulations prevent any start of this new project.

At the last open space in the existing harbour area a new key wall is under construction for the new generation container vessels. Before 2009 a total of 22 million m³ sand has to be dredged. Making work with work and placing the out coming sand on the place of the forthcoming harbour extension would be the easiest and cheapest way, but for now this is not yet possible. The challenge for the project “Dredging a new harbour site” is now to distribute a total amount of 22 million m³ of salt sand in 3 years. A large amount in a market which needs only 3.5 m³ sand a year.

This paper describes the struggle of dredging in a time schedule to complete the new harbour site and find a useful place for re-use of the dredged material in the direct surroundings.

Keywords: Dredging, flexibility, optimisation, economics

INTRODUCTION

The conference theme “Global Dredging, Its impact on the Economy and environment” can be translated both from the view of a contractor as from the clients view. Port authorities/ private or common related with local authorities or government is acting frequently as clients for big dredging contracts. The container business is booming and new and larger ports are needed to meet this worldwide demand for more goods. New and deep harbour basins are needed for en new generation of ships.

Global Dredging and its impact on the Economy and Environment are for a port like Rotterdam, situated at the coastline and at the estuary of the River Rhine and Maas, of great importance. In the port large quantities of sand and sludge constantly have to be removed. The contamination of the released material is important for the re-use or storage off the material. For the Port of Rotterdam sand is important. On one hand port expansion demands sand as a building material, on the other hand the port is the only place where the necessary depth is present to receive the dredging equipment capable to dredge, transport seas and to transfer this sand to inland-barges to transport this sand to the destinations in the hinterland. The Port of Rotterdam plays an important role in the dredging activities to link the import of sand with the maintenance dredging activities. A large quantity of the dredged sedimentation from river and harbours is not contaminated and can be stored at sea (ca. 2 to 4 million m³/year). By using the empty return voyage to dredge and transport seas and, an optimisation of the use of the dredging equipment takes place (combination trips) which will lower the maintenance dredging costs.

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Port expansion demands its own approach, for new harbour expansion plans often a great amount of sand are needed which has to be dredged and transported in a short time (capital dredging). Only rarely big quantities of sand come available by port expansion projects. In the past years this was out coming sand by harbour enlarging or dredging new ports and mostly these quantities of sand could be used in other optimisation plans in the same port or nearby the city. At present the Port of Rotterdam has started large expansion plans (project Yangtze harbour) releasing a total amount of 22 million m³ of sand within a total period of 3 years. This sand has to be placed in a market with a demand of only 2 to 4 million each year in relation with the ports interest in this same market for the sand incoming from sea with the maintenance dredging process.

In the same time new plans are started for a large expansion Maasvlakte 2 of the Port of Rotterdam. In total an amount of more than 300 million m³ sand is needed for the realisation of this plan. Direct use of the out coming sand in these new plans would give the best benefit for the port, however this is impossible in time due to the present time-consuming procedures.

If it is not possible for the port to find enough sources for re-use of the sand, there is only one possibility to continue the dredging activities in this project. The most expensive and less demanded way for the project is removing and storage the sand again at the North Sea.

This paper gives a closer view of the struggling of a port authority to realise dredging operations in the most economic way.

General Description

The Euromax/Yangtzehaven Project.

The container business is booming and new and deep-sea terminals are needed in time. In the port of Rotterdam the north-west corner of the Maasvlakte is the last free area to realise these new port expansion plans and new contracts have been signed to realise the new Euromax terminal. De Euromax is joint venture of ECT Participations B.V and Chinese Shipping Companies. The new terminal, based on proven technology, will be one of the most sophisticated in the world. The criteria for the design, build and operation of the terminal will be based on high performance, flexibility, safety and low cost. In total the project contains the realisation of a deep-sea key-wall with a length of 2000 meter. The key-wall can be extended in the future on the east side with 600 meter and to the west side by 1800 meter and will in future be available to receive the latest generation of container ships (12.500 TEU) with a depth of 20 meter.

Preconditions to realise this project are most drastically for the dredging activities for the sand. In this project has to been taken in account the new plans for the future expansion of the harbour, the plans for Maasvlakte 2.

The Planning for Large Port Expansion Maasvlakte 2

At the same time with the planning of the realisation of new plans for the last available space in the existing harbour area, Rotterdam did start the plans for a further large expansion of the port. Meanwhile these plans are ready for the realisation of a total new harbour and industrial area for deep-sea related companies. This port expansion, named Maasvlakte 2, will be connected with the existing harbour infra structure. This land reclamation exists of a seawall which will enclose a harbour and industrial areas. The sand needed for the reclamation will be found in the nearby North Sea.

Maasvlakte 2 will be constructed in phases. The planning is focused to start the construction in 2008. In the first phase, which will be finished at the very last in 2013, the seawall will be constructed and the first harbour sites will be ready for exploitation. Further construction will be started after 2013 and will depend on market developments. In the final plans in total ca.1000 hectares (net release) new harbour area will be realized. In addition, ca. 960 ha. will be used for space for the harbour basins, seawall, dry infrastructure and all other provisions. To realise the total plan an amount of some 300 million m³ sand is necessary.

Plans for this port expansion were started in 1995. Due to the size of the project a number of national decisions had to be taken by the Dutch Government. This procedure for large infrastructure plans has been laid down in the

regulations for environmental planning and is effected in four steps in which shortly mentioned as a first step a government position is made followed by approval of the national congress. Against this proposed decision a lot of objections were put forward, namely on basis of the expected effects of the reclamation on surrounding wildlife area's. These objections were grounded by the High Court and the providers could do nothing else than start a complete new recovery route. For the port authorities one thing was very obvious in this case: any form of starting the project is not possible until the final green light is given. This moment is now expected in 2008 and all activities (all necessary permits and negotiations which the candidate contractors) are tuned for that very moment.

Project Euromax/Yangtze Harbour

The final discussion not to construct a complete new harbour entrance for the Maasvlakte 2 project but to make use of the existing harbour entrance of Maasvlakte 1, the Beerkanaal was of importance for the Euromax/Yangtze project. This decision means that a 600 meter wide and 20 meter deep channel had to be constructed both to have the possibility to moor at the Euromax key-wall and to reach the future harbour expansion. This project was started on November 1st 2005. In the final lay-out a total amount of 22.000.000 m³ sand has been dredged within a period of three years.

The main goal for the project was the realisation of the new Euromax key-wall and the project can be divided in the following phases:

Phase 1: 1/1/2007	construction of 300 meter key-wall and necessary depth for the delivery of container cranes
1/12/08	600 meter key-wall operational
Phase 2: 1/6/2008	900 meter key-wall operational
Phase 3: 1/9/2008	1500 meter key-wall operational
Phase 4: 1/1/2009	2000 meter key-wall operational

Contracts

Form of Contract

The dredging project "Euromax/Yantze harbour" is (or will be) executed in under multiple contracts (or "in multiple phases").

- Contract 1, dredging in Yangtze Harbor and reclamation at the Euromax Terminal
- Contract 2, dredging in Yangtze Harbor and reclamation at the LNG Terminal
- Contract 3, dredging in Yangtze Harbor and backfill in a part of the Hartel canal

The first contract is tendered in conformity with EU requirements and consists of dredging approximately 6 million m³. The dredged material is (or will be) used to reclaim an area to expand the Euromax Terminal. This first contract includes the possibility, note not an obligation, to award the following contracts (contract 2 and 3) based on the same terms and conditions. These contracts complete the total project volume to dredge of 22 million m³.

The first contract provides a possibility for the contractor to take away a maximum of 3 million or a minimum of 1 million m³ and to offer this on the Dutch sand market. The result of the first tender procedure is an acceptable contract-price and an experienced contractor on the job with the necessary contacts.

During the first contract, further agreement on the other two contracts is achieved. It is decided to continue the project with the same contractor. These contracts covered a deal to provide the local market with salty and desalinated sand from the Yangtze harbor on an even-split (or 50-50) profit base with the contractor.

Equipment and Methodology

The first layer to a depth of approximately -10 m is dredged by a Cutter Suction Dredger (CSD), the dredged material is pumped through a floating pipeline (directly connected to the CSD) to a spreader pontoon and spread in the future Euromax Terminal area. A CSD is a stationary dredger able to transport material via a floating pipeline or to pump material into barges for further transport.

After dredging the first layer, the Trailing Suction Hopper Dredgers (TSHD) commenced dredging. The dredged sand is transported to other projects nearby where sand is required. A TSHD is a sea-going self-propelled dredger able to transport material independently and discharge the material via bottom doors, via a floating pipeline or via a rainbow installation. During this stage of the project Backhoe Dredgers (BHD) and Grab Dredgers were removing revetment and loading the material (mainly rock) in barges for transport to nearby projects.

Working out the solution for the available sand

With the first start of the project we had three possible directions for the available sand:

- a) distribution to projects in the harbour area;
- b) making use of the contractors network to put as much sand as possible on the market;
- c) Optimize the removal of sand in view with at the continuation of both the Euromax/Yangtze harbour and the start of Maasvlakte 2.

ad a) distribution to projects in the harbour area

For a large port like Rotterdam it is necessary constantly to optimize the harbour areas, especially when there is a great demand for new areas and only a few areas are available. Making work with work the available sand from the Euromax project could be used to realise a number of projects:

- 1) Euromax extension
Direct extension of a new container terminal in the project area. Required amount of sand 4.000.000 m³, construction period 2006/2007. Dredging material: CSD and pipelines to pump the sand direct in the building site.
- 2) LNG-terminal
Construction of a new LNG terminal. Required 4.000.000 m³ sand. Construction period 2006/2007. Dredging work was carried out by CSD and dredged material was pumped direct into the site.
- 3) Filling up Hartelkanaal
The availability of sand and the direct necessity for removal of sand from the Euromax project makes it possible to start up projects. A former part of an inland channel was filled with sand to create a new industrial site. Required amount of sand 2.500.000 m³, construction will start in 2007 using TSHD.
- 4) Delta Barge Feeder terminal
An extension of the nearby ECT container terminal realising a new key wall for barges and feeders. A total of 1.000.000 m³ was required and dredged and transported by TSHD and raised (rain bowing) after the new constructed key-wall. The client has to take care of the time-aspects in the cooperation of the two contractors (building site of key-wall and de the delivery of the sand).
- 5) Waalhaven
Waalhaven Port City. The Waalhaven, constructed in the 1920's, is one of the large older harbour basins situated not far from the city centre. The new change for this older harbour sites is the transformation to harbour related business sites. A first step will be made in 2007 to start Waalhaven Port City creating 4 hectares of industrial site using 250.000 m³ of sand.
- 6) Strengthen coastal site Maasvlakte
The current coastline is constructed partly from stone and for a part of sand (beaches). These beaches need everlasting maintenance. Sand from the Euromax project will be used for coastal protection in 2007. A total amount of 1.000.000 m³ will be pumped by CSD through a 5 km pipeline system to the beach.



Figure 1. Project overview.

ad b) Re-use of sand in the market

In contrast to the use of sand within projects in the harbour area, where the port (as an owner of the soil) for each location can consider the quality of the sand, for delivery of sand outside the port area national standards for building materials are required. Sand on the market can only be re-used when it meets the conditions of the right granule and chemical composition.

The part of the Maasvlakte where the construction takes place has been build in the late sixties of the past century using sand from the nearby North Sea. Regular in these days the coarsest material was used for the construction of the seawall, using the other material for filling up the area. Dredging equipment used in that time were TSHD removing the sand from the upper layers of the bottom of the sea. The general grain diameter for the sand in the project area is 150 μm .

Due to the construction of the harbour area partly in sea, salt sea sand can be used for construction. For inland construction only sand can be used with a salinity degree $< 30 \text{ mg Cl / l}$. To bring the sand from the project on the market the salt the salinity degree of the salt sand has to be turned under the desired limit.

De-saltation of sand with a grain diameter of 150 μm is not easy and takes time, the only way to improve the product was to enlarge the common grain diameter of the sand. This was achieved by bringing rough sea sand (350 μm) by TSHD from sea which was spread in a layer over the bottom of the harbour. By using the CSD as dredging material the coarse sea sand was mixed with the other dredged material which gives a proper product to sell with a grain diameter 220/230 μm . This sand was pumped in the barges and during the sail to the destination in the hinterland the

sea sand was brought back to the required salinity degree $< 30 \text{ mg Cl /l}$. In this way the sand was usable for all purposes.

The coarse sand is also used to build underwater bunds to construct a slope of 1:4 at the surroundings of the reclamation areas. The under water bunds are build by discharging the sand via the suction pipe of the TSHD.

Current situation

At this moment a total of $1.000.000 \text{ m}^3$ sand has been put on the market and the sale of another $2.000.000 \text{ m}^3$ is expected in 2008. All large city project demands sand and the port is in consult with project developers for the sale of more large quantities of desalinated sand.

Ad c) Optimize the dredging process

It is clear that the port has not yet been able to find a solution for all sand that will be available from the market. Most profit for the harbour authorities can be reached when sand can be pumped directly from the project to the nearby port expansion Maasvlakte 2. In this way in 2006 is started to minimize the dredging activities: Minimize in this project means:

- a constant tuning of the sand balance for both projects;
- a regular consultation with the nautical division of the port about the minimum required depth of the new dredged harbour in close relation to the size of the incoming ships.

The port tries to prevent to start the most expensive and re-use unfriendly implementation. Namely to remove and dispose the sand from the project to deeper parts in the North Sea and to dredge this same material again a few years later for the new expansion harbour plans.

In this paper the Port of Rotterdam has described its impact of global dredging op de Economy and environment. Without the availability of the right dredging equipment and the professional skills of the dredging companies all described activities would not haven been possible.

CONCLUSIONS

- Knowledge of the dredging equipment, applicability and availability of the dredging equipment on the market is essential for a client to carry out large-scale project.
- flexibility of the contract form and preparedness of contractor for construction the plans (open relation)
- The time necessary to start large-scale project is underestimated.
- Durable use with “simple” sand can gain advantages.

REFERENCES

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