Guidelines for Marine, Nearshore and Inland Confined Disposal Facilities

Case Study

Slufter CDF

Owner + Operator

The Ministry of Transport and Public Works and Water Management, Regional Directorate South Holland in co-operation with the Rotterdam Municipal Port Management.

Location

Maasvlakte (Port of Rotterdam), South Holland, The Netherlands

Type of CDF

Nearshore CDF

The Problem

Description of the problem

Regular dredging in the Port of Rotterdam is necessary for nautical reasons. A large amount of the sediment in the port of Rotterdam is contaminated. For environmental reasons the contaminated dredged material has to be disposed in a CDF.

Characterisation of the material

The material dredged in the port of Rotterdam is predominantly clay and silt. In some deeper parts of the harbour more sandy material is present. The port is contaminated with a cocktail of contaminants. In some cases the level of contamination in the sediment makes remedial dredging necessary. In the Netherlands there are 4 categories/classes of contaminated dredged material, class 4 material being the most heavily contaminated.

At the moment the Slufter mainly contains class 2/3 material, with relatively small amounts of class 4 material. Heavy metals and PAHs are the main contaminants.

Description of the solution

Environmental Impact Assessment (EIA) studies carried out in the 1980s indicated that the best option for the disposal of the dredged material from the Port of Rotterdam would be to build two disposal facilities. One facility to be used for the disposal of contaminated sediments of categories 1, 2 and 3 (the Slufter) and a temporary facility for the disposal of the highly contaminated dredged material for category 4 (→ *Parrot's Beak* case study).

The Slufter facility was built on the nearshore area west of the existing industrial Maasvlakte (see Figure 1) area and has a storage capacity of 150 * 10^6 m^3. Its layout was designed to minimise the negative impact on the environmentally valuable area on the island of Voorne and to minimise building costs. Initially it was estimated that it would take 15 years to fill the Slufter, i.e. 10 * 10^6 m^3/yr. The facility came into operation in 1987.

Because of the Dutch Water Contamination Act (WvO), which stimulated the taking of source-based prevention measurements and due to intense communication with upstream polluters abroad, which led them to take preventive action also, the quality of the sediment deposits is improving more rapidly than expected. The result of this is that a smaller quantity of material has to be placed in the Slufter. Moreover it is expected that the amount of heavily contaminated dredged material will decrease even further in the future.

In January 2001 the available storage capacity was about 60 * 10^6 m^3.

Regulations and permitting

Several permits were issued for the Slufter disposal facility, with regulations based on the predictions made in the initial IEA. The most important are:

- Environmental Protection Law: this gives guidelines for the installation of a monitoring system for the subsoil groundwater and regulations for a Hydraulic Prevention System, which must be executed based on the results of the monitoring data
- Water Contamination Act: this gives rules regarding disposal in the pit and quality of the effluent water
- Concession based upon the Land Reclamation Act: this commits the operator to report on morphological end biotic changes

Site characterisation

The site is a nearshore bunded pit disposal facility, more or less shaped like a hand. It covers a total area of approximately 260 hectares, with the pit itself covering 200 hectares.

Characteristics of the CDF

Capacity and Design of the Facility

The design capacity of the Slufter is 150 million m^3. The facility consists of a pit with a bottom level of - 28 m NAP and with surrounding dykes to a height of + 24 m NAP.

The dykes were constructed by dredging material from inside the pit. Initially the fine sands from a level extending down to 22 m below NAP (sea level) were used to build the dykes up to a level of 3 m above NAP. The outer sides and upper parts of the dykes were built by using the material dredged from 35 m below NAP, which consisted of coarse Pleistocene sands. This was still well above the impermeable Kedichem layer at 40 m below NAP, which prevents the emission of contaminants into the deeper layers.

Upon completion of the dikes special grass was planted to prevent erosion. On the seaside of the facility a recreational area was created, compensating the loss of existing recreational facilities. On top of the dykes an inspection road was built with public viewing points into the pit area. South of the Slufter a nature reserve was created, which gradually became vegetated and attracted various species of birds.

Operation & Management

Method of filling, operation

The Slufter is mainly filled hydraulically. Dredged material is either discharged by trailer suction hopper dredgers pumping ashore or by a barge suction dredge. Both use the same pipelines. Inside the pit is a moored disposal pontoon, which sprays the material in layers of 3 to 4 meters, this activity being monitored by a survey vessel. In order to minimise turbulence the disposal pontoon uses a diffusor positioned several metres above the deposited sediments,. The disposal pontoon can be moved to any position in the pit by using several mooring buoys.

Between 1990 and 1994 small amounts of sewage sludge (55.000 tons/yr) were placed in the Slufter. In order to prevent negative impacts on the system, this sludge was added to the dredged material at a rate of 1:20 (tds). Discharge took place via a custom-built injection plant. The sludge was brought in by ships and trucks.

In anticipation of changes in disposal rules, small amounts of class 4 material were already being discharged in the centre of the pit.

In order to reduce the quantity of material to be stored still further, settlement basins through which the more sandy deposits are led have been constructed. In this way sand can be won, which is either being used in the construction of bunds or sold locally.

Between 1996 and 1999 a large scale demonstration project on treatment of contaminated sandy sediments with mechanical sieving of sediments from the settlement basins was carried out. With a total input of 218.000 tds 65 % has been reused as building material.

Clay is also being produced by creating clay ripening fields; into these a layer of relatively uniformly grained class 2 contaminated material is being discharged and allowed to settle during a period of one year. After one year the material can be used to cover dikes etc.

Effluent control

As the level inside the pit has to be kept stable, a large quantity of water has to be discharged into open water. This effluent water may be contaminated, mainly by the amount of suspended material in it. The most important way to reduce this discharge is to use the previously mentioned diffusor. Excess water is discharged via a pump-pit and a return pipeline. This effluent is continuously monitored. If the suspended material exceeds a maximum level, effluent is re-routed into a settlement basin with an area of several hectares and is discharged later. Owing to the special shape of this basin, a high reduction in suspended materials is achieved.

Monitoring

A monitoring system has been installed to check the mobility of the contamination. The system consists of 17 boreholes, 2 inside the pit down to 42 m below NAP and 15 in the dyke down to 23 m below NAP. Each borehole contains 3 or 4 monitoring drains at different levels. At fixed intervals, samples are taken and processed. Only after a long period will it be possible to draw conclusions on the validity of the computer simulations, which show an extremely slow spread of contamination. Besides the impermeable layer of sediments, which has been formed by depositing the dredged material inside the pit, the pit functions as a fresh water bubble, ‘floating’ on the salt groundwater, with hardly any interaction between the two systems. In the worst case, if any spread of contamination is measured outside the expected area, the hydraulic prevention system will be activated and a drainage system will be installed in the dyke area. The contaminated water will then be pumped to a treatment facility.

Long-term management

As the amount of sediments is far lower than expected, the facility can be used for much longer than was anticipated. This will depend on changes in regulations, the acceptance sediments from third parties, taxation, and other factors.

Because of the new knowledge on mobility of contaminants an EIA has again been carried out to broaden the criteria for the dredged material that can be disposed of in the Slufter. It is expected that the future permits for the Slufter disposal facility will make possible the disposal of category 4 dredged material in the Slufter.

In addition to the discussion on technical acceptation criteria, a discussion on the strategic choices which have to be made on accepting third party (i.e. from outside the Rotterdam mainport area) sediments, is in progress. Related to this is the question of allowing more private influence on the operation of the CDF.

Other

Costs

The total cost of constructing the facility was about 68 million €. Operating costs run at approx. 9 million € /yr., and are more or less independent of the quantity of material that is disposed of. The costs of the discharging barges or dredgers are not included in this figure. The costs of keeping the equipment on site up-to-date, after treatment and the execution of several tests are also omitted. All included unit costs will remain well below 4.5 €/m^3.

The average cost of treating sandy sediments by using the mechanical sieve was 11 €/tds. Use of the sedimentation basins added 2.7 €/m^3 to the total cost.

Lessons learnt

Since 1987 much new information about the effects of contaminated dredged material has become available. It has emerged that the influence of CDFs on the environment is far less than was expected and the impact depends very little on the quality of the contamination. Moreover it seems that emissions from contaminated silt are far lower than was predicted. These combined factors reduce the need for the treatment of dredged material and allow facilities to receive more heavily contaminated soils.

The political influences can have big effect on the operation of a CDF; in particular politically motivated choices for the treatment of contaminated soils may make a large impact. Predicting developments in the handling and treatment of dredged material has proved difficult.

For the time being, only sand separation by using sedimentation basins and mechanical sieving seems to be economically feasible. Relatively clean clay can be produced. However, it is hard to find a commercial destination for either of the materials thus produced, because they originate from contaminated sediments and the location distant from most construction sites.

Dry parts of the facility are frequently used as breeding grounds by birds (seagulls, ducks and other shore birds). This can sometimes impede operations on the site.

References

Herziening acceptatiecriteria en het scheiden van zand in het depot de Slufter, Milieu-effect rapport, Directoraat Generaal Rijkswaterstaat, Directie Zuid Holland, december 1998

Mechanische zandscheiding Slufter, AKWA-rapport 00.009, 22 january 2001

Leaflet “De Slufter”, not dated

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Figures

Figure 1: Situation of the Slufter CDF in the Port of Rotterdam

Figure 2: Aerial view of the Slufter CDF

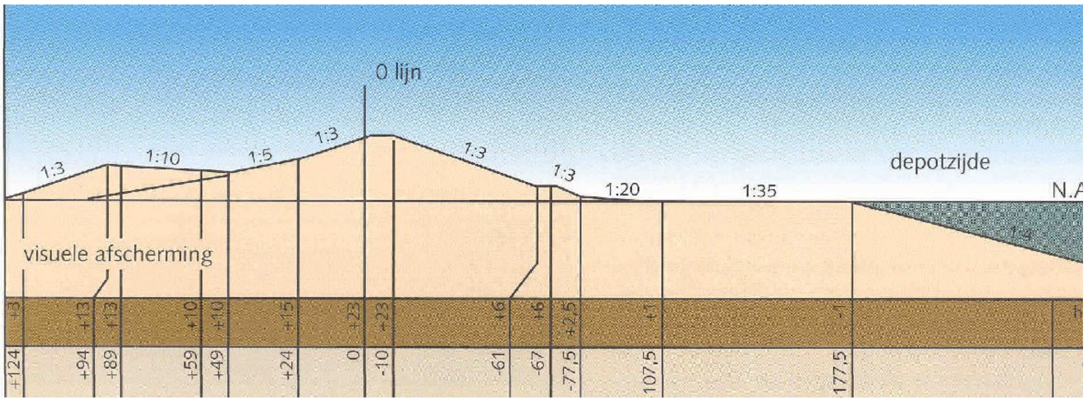

Figure 3: Typical cross-section of dyke

Figure 4: Sedimentation basin and clay production fields