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Dredged Material Management in Hamburg

Abstract

The history of the port of Hamburg goes back more than 800 years. The port has been dredged for hundreds of years so as to maintain water depths for the passage of ships. Traditionally, the dredged material has been brought on land where it was put to use for land reclamation or in agriculture.
The port of Hamburg is situated at the upper end of the estuary of the River Elbe. The contamination of the sediments from the Elbe was only noted around 25 years ago. The causes of this contamination lie predominantly in the former East Block nations. As a result, until the turn of political events in 1989, it was virtually impossible for Hamburg to bring about an end to the discharges that were causing contamination.
It was against this background that a highly technical dredged material management concept was developed and realised. The central elements of the land-based treatment of the Hamburg dredged material management concept are the treatment and dewatering of the dredged material in dewatering fields and in the METHA treatment plant (**ME**chanical **T**reatment and Dewatering of **HA**rbour-sediments). The resulting sand, as well as suitable fine grain silt, can be put to beneficial use, while the contaminated silt is being safely deposited in special disposal mounds. Since the political transformation, there has been a very noticeable reduction of the contamination of the Elbe. Today the major portion of the dredged material generated by maintenance works is relocated into the Elbe.

Twenty-five years ago public discussion contributed to initiatives for the development of the dredged material management concept. Today, the legal requirements of the European Community often constitute a tight framework. The Water Framework Directive can provide guidelines for solving the remaining problems of contamination. In the future, however, the proper handling of dredged material will require efforts on the part of those who are responsible for ports and waterways.

Introduction

The port of Hamburg is the largest port in Germany and one of the ten largest in the world. The port is situated

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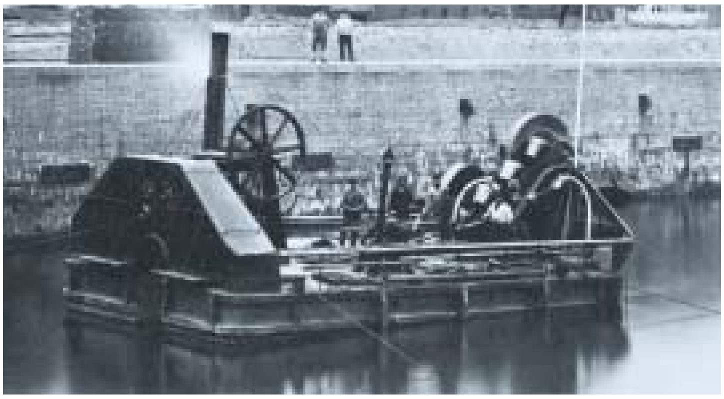


Figure 1. Steam dredger, 1877.

inland on the River Elbe some 100 km from the North Sea. The tidal current has a strong influence on this region. Continual intervention in the river has been necessary to make ship traffic possible and to maintain an adequate fairway depth. A known ordinance dating back to about 1530 prohibited the digging of sand at certain locations and the depositing of debris and other materials. There was also a control commission for the purpose of monitoring it. In 1834 Hamburg purchased the first bucket ladder dredger from England (Figure 1). The fairway depth in 1860 was approximately 4.50 m; today it is roughly 14.50 m.

The need for dredging measures has been a consequence of the natural sedimentation and the increasingly shallower depths it produced. Nowadays, roughly 3 to 4 million m^3 of Elbe sediments are dredged year in and year out. To deal with it over the course of time an equipment and operating system specially matched to the port of Hamburg was developed and constantly adapted to the port's technical, economic and ecological requirements.

Until the 1950s and 1960s, the port's development was extensively influenced by technology. About 25 years ago however new demands came to the fore. As a result of various investigations, the considerable burden imposed on the Elbe and its sediments by contaminants became known in the 1970s. The first extensive investigation in the port with respect to contaminants in the sediments took place in 1978-1979.

The greater part of the river basin of the Elbe lies in the Czech Republic or in the former German Democratic Republic. Ore mining went on in this region for hundreds of years. Important industrial centres of these former East Block nations are situated in the river basin. There was little or no industrial and municipal waste-water purification and refuse was partially "disposed of" directly into the water bodies. The "Iron Curtain", however, prevented any direct observation of this situation. Only the immense contaminant loads on the German-German border could be measured, and taking real action towards remediation was simply prohibited.

The development of the Hamburg dredged material management concept must be seen in light of this background. In 1981, the federal state government of Hamburg passed a dredged material investigation programme for the purpose of ascertaining feasible solutions for the utilisation and disposal of dredged material and the causes of the sedimentation and of the contamination, and finally to seek new disposal sites.

As in other ports and countries, they found themselves on new ground. It was quickly recognised that the solution lay in a safe disposal of the contaminated silt. As, apart from the sand and water, these represented only a part of the dredged material, prior separation and dewatering would be required. Available flushing fields were converted to accomplish this over the short term. Moreover, at the beginning of the 1990s a technical treatment system was developed, which was realised as the industrial METHA plant facility. The contaminated silt has been disposed of in two silt mounds built especially for this. Parallel to this action was the constant search for feasible means of putting the silt to beneficial use.

The political changes in Eastern Europe that came with the opening of the internal German border in 1989 were completely unexpected but had significant impacts on the Elbe. Because of measures undertaken following the political transformation, as well as the disappearance of entire sectors of industry, midway through the 1990s the condition of the Elbe was already clearly improved. The result was decreasing contamination of the dredged material in the port of Hamburg. Since 1994, large-scale tests on the relocation of dredged material in the Elbe below the port of Hamburg have been conducted, accompanied by comprehensive investigations.

Today the Hamburg dredged material management concept stands on several pillars. The open water disposal in the Elbe has developed as the most important. Contaminated dredged material is, as previously, treated on land in the METHA plant and the dewatering fields. Contaminated silt is deposited in the two Hamburg silt mounds. Part of the silt is utilised as sealing material. No feasible, large-scale, external beneficial use has as of yet been found. Potential applications for the utilisation of small amounts are however also under study and, when practicable, are also being put into operation.

Dredging and Surveying

The basic prerequisite for dredgers to work on the securing of fairway depths is the regular hydrographic measurement (echo-sounding) of the riverbed. The Department of Port and River Engineering of Hamburg employs four echo-sounding ships with

Figure 2. Hopper dredger in front of the port of Hamburg (source: Nordsee Nassbagger- und Tiefbau GmbH).

ultra-modern equipment throughout the year to constantly monitor the water depth. The *Deepenschriewer IV* is used only in shallow waters, small canals and harbour basins. The *Deepenschriewer I* takes soundings in the medium sized harbour areas with a fan echo-sounding system. The other echo-sounding ships likewise have an on-board sounding system for planar detection. All the vessels are capable producing an initial result on-board immediately following the echo-sounding and delivering it to the user.

A sounding programme establishes how often what port and river areas are to be sounded. A water surface area in excess of 110 square kilometres is surveyed annually by means of programmed echo-soundings. For comparison: The entire water surface of the Hamburg port area encompasses about 30 square kilometres.

The most modern measurement electronics and computer technology are employed on board the four sounding ships. The position measurement is done either from land or via satellite with an RTK-DGPS positioning system. The respective current water level is measured by means of a radio water depth probe. Timely sounding data within an adequate scope are indispensable for the safety and competitiveness of the port of Hamburg. The voluminous measurement data of the sounding ship are transmitted to the complex HydroCAD (Hydro = Water, CAD = computer aided design) evaluation system. There the data are prepared, examined, processed and evaluated, before being sent on to the various users.

Nowadays, hopper dredgers of private companies do the majority of the dredging works in the port of Hamburg. For several years now hopper dredgers specially equipped for the dredging of silt sediment have been used wherever adequate manoeuvring space is available. These trailing suction hopper dredgers have capacities from around 2,000 to 3,000 cubic metres. They transport their cargo to their respective destinations (Figure 2).

In the case of open water disposal, the hopper capacity can again be discharged into the river. If the dredged material is treated on land, the hopper dredger is coupled to a pipeline and the material is pumped by dedicated on-board pumps directly into the dewatering fields or buffer storage. Thus hardly any water needs to be added.

A part of the dredging works in the harbour is executed with the port's own equipment. A grab dredger is used for small-scale dredging, in tight harbour sections or in the vicinity of quay walls. In addition, two bucket-ladder dredgers are operational. Barges transport the dredged material into the Finkenwerder Vorhafen where it is unloaded with dredging pumps. The annual dredging capacity of the dedicated dredger fleet is roughly 1.0 to 1.2 million m^3.

Since 1987, dredged material has been relocated using water injection dredging devices of contracted private companies. With injection dredging, a pipe is moved over the ground crosswise to the direction of travel. Large volumes of water are chased into the sedimentations on the riverbed by nozzles lined up closely to one another. A sediment-water mixture results, that is heavier and thicker than the water of the Elbe and therefore flows into the deeper parts of the water. Today injection dredging is predominantly used for the levelling of riverbeds following the use of hopper dredgers and for the local flattening-out of shoals.

For controlling the operations and quality of the hopper dredging work in Hamburg. a special remote monitoring system has been developed by the staff of the

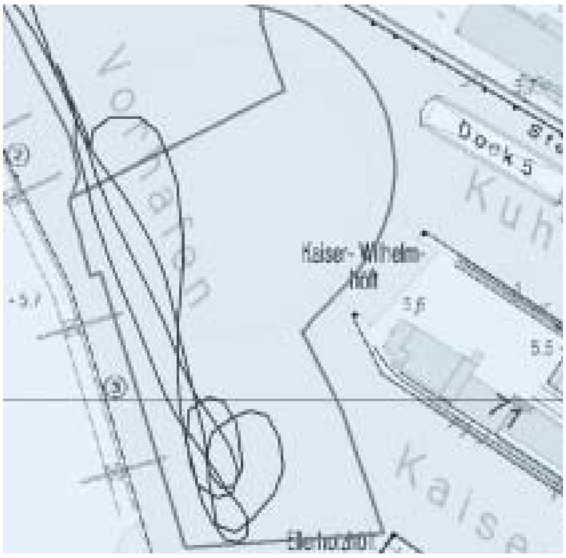


Figure 3. On-line documentation of the hopper course: The red line delimits the dredging field.

Figure 4. On-board computer for remote monitoring of the hopper dredger.

department itself. All necessary information is recorded and evaluated electronically. The data pool of the hopper dredger like "dredging" or "unloading", "actual dredging depths", "position", "load condition", "tide gauge level" and so forth is passed by mobile radio to the desk of the customer. In combination with the general aspects of the contract like "dredging area", "intended depths of dredging", it is possible to calculate on-line if everything is running well. Manpower-intensive and cost-intensive on-board monitoring is thus avoided (Figures 3 and 4).

Open Water Disposal

Consideration of open water disposal was abandoned in the 1980s, because at the time the contamination of the Elbe sediments was high. Since the Elbe has become cleaner, open water disposal of sediments, which is the most common process worldwide, is now utilised in Hamburg as well. This process is more economical than disposal on land and is ecologically sound, as the extensive natural sedimentary equilibrium is disturbed as little as possible. The fine material that is also important for the formation of tidal flats remains in the river.

The port of Hamburg is situated at the upper end of the estuary of the Elbe. At the lower end of the harbour there is a turbidity zone in the Elbe with a very high content of suspended matter. The open disposal site for the dredged material is the Elbe north of Neßsand Island. In this spot, great water depths, a high velocity flow, and a strong turbidity owing to the natural turbulence of the suspended matter influence the river. The riverbed exhibits a ripple formation that is constantly altered by the tidal effect (Figure 5).

In the mid-1990s, open water disposal in the river was evaluated in large-scale tests over several years; these were followed up by extensive investigations.
The dredged material was first removed with bucket-ladder dredgers and subsequently transported in split-hull barges. These days, for the most part hopper dredgers are being used owing to their suitability and economy.

In this region of the Elbe low oxygen concentration occurs in the river in the warm season and fish breeding grounds are located in the vicinity. Thus, measurements of the expansion of the disposed

Figure 5. Natural clouds of suspended matter the Lower Elbe.

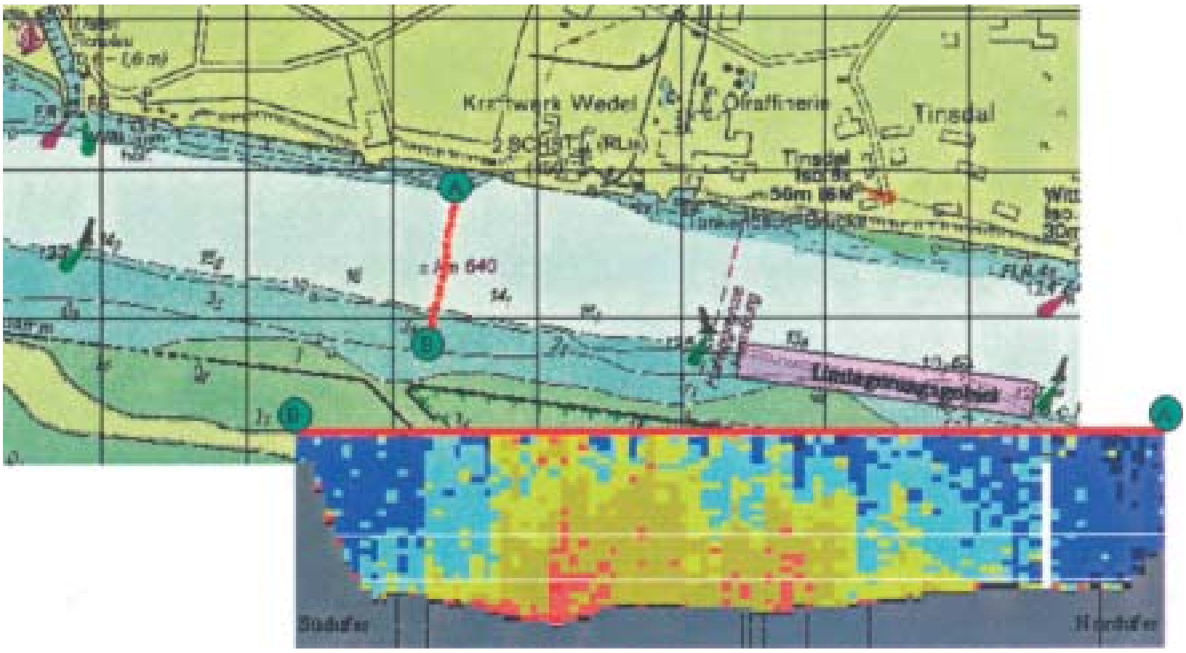


Figure 6. ADCP-Plot of open water disposal process.

materials in the water head and the drifting caused by the current (tidal effect), as well as the oxygen consumption and the effects on the local biology receive particular emphasis. Accordingly, various disposal techniques and sites, referenced on the cross-section of the river, have also been investigated.

These investigations showed that relocated solid matter was very quickly reincorporated into the stream of solid matter of the Lower Elbe and within a short time could no longer be distinguished from the other suspended matter or sediments. The fine-grained dredged material was barely deposited at the disposal site, but rather quickly became mixed with the naturally available suspended matter, becoming increasingly widely dispersed as a function of the tide (Figure 6).

Small amounts of dredged material are again transported upstream by the high tide. The renewed depositing of suspended matter in nearby harbour basins can be reduced through suitable disposal strategies. In so doing, the tidal phase, the amount and density of the dredged material, and the location of the open disposal site are to be taken into account. This also makes it possible to prevent the influx of the dredged material into the adjacent shallow water of the Mühlenberger Loch.

As a result of the investigations, a handling concept was agreed upon between the port and environmental administrations. Under this agreement the framework conditions for the open water disposal of dredged material from the port of Hamburg was established. The basis for the evaluation, as to whether the contaminant content in the dredged material permits an open water disposal, are the dredged material recommendations of the German states bordering the Elbe River. Up to now the actual biological and hydrological conditions in summer in parts of the Lower Elbe has led to low oxygen concentrations in the water from time to time. At the same time the greatest appearance of young fish occurs from June to August. For these reasons there is basically no open water disposal in the period from April to August.

Through the process that has been adapted and the selection of a suitable open disposal site, the effects on the water quality, the benthos (that is the clinging and moving organisms living at the bottom of the river) and the fish have been minimised or averted.

Dredged Material Treatment

METHA technology

One of the most important conclusions to come out of the dredged material investigation programme of the early 1980s was that heavy metal and organic contaminant content in the dredged material essentially depend on the grain size distribution. The higher the organic constituent in the sediment and the smaller the particle is, the higher the contamination. Considering the actual grain size distribution and the contamination of the Elbe sediments, separation into various fractions is a sensible approach for the continued handling of dredged material. Following the first positive laboratory and technical scale experiments, an initial pilot project was commenced in 1984, with the objective of demonstrating the applicability of the preceding experiments on the technical scale. It was followed in 1987 by the

Figure 7. METHA plant – Mechanical treatment and dewatering of harbour sediments.

METHA II pilot plant. This enabled optimisation of the process, the development of measurement, control and regulation equipment and the conducting of operating tests (Figure 7).

METHA has been in industrial operation since March 1993. It has an annual throughput of approximately 550,000 tons of dry substance corresponding to a profile volume of 1,000,000 m^3 for a silt/sand ratio of 50/50 %. The overall investment including the technical equipment of the required above and underground construction came to roughly € 70 million. The operation of the METHA plant requires 96 employees. The operating costs have been approximately € 17 million per year, including personnel costs, depreciation and interest charges.

Figure 8. Hydrocyclone unit.

For a reliable handling, the METHA treatment technique is based on a two-step separation at 63 µm and 20 µm using hydrocyclones, upstream current classifiers and spirals. The products of separation sand, fine sand and silt are dewatered by an aligned technology for each type of the products.

From the hopper dredgers or barges the water/ dredged material mixture is pumped into a 300,000 m^3 storage basin. In the beginning of the METHA process a drum sieve separates out all particles that are larger than a centimetre, such as stones and debris. In hydrocyclones the fine-grained silt (< 63 µm) moves upwards under centrifugal forces, and the coarser-grained sand downwards. The sand, with a residual silt fraction, now passes to the upcurrent sorter, the following separation unit. As silt is lighter than sand it distributes itself in the upcurrent water that flows upwards. Together with the silt from the hydrocyclones it then passes on to the thickening step. The sand from the upcurrent sorter is dewatered by means of a dewatering sieve.

The silt fraction of the first separation unit is passed to smaller hydrocyclones where the silt and fine sand (particle size > 20 µm) are separated from each other by centrifugal force. The residual organic components such as coal particles and plant residues are separated in a spiral separator and passed on to the thickening step. The cleaned fine sand is dewatered using a vacuum belt and reused (Figure 8).

For effective separation, the process engineering requires a great deal of water to be added to the dredged material, which, following the separation of the individual fractions, is again separated with the addition of flocculants from the silt suspension.

The dewatering of the flocculated silt suspension is carried out in two stages with the application of a filter belt press and a high pressure press (Figure 9). Six dewatering lines each with a respective throughput of 9 –10 tons/hr operate in parallel. In addition, two industrial membrane chamber-filter presses with a respective throughput of 10–12 tons/hr of dry substance have been used since 2002. The dewatering achieves a shear strength that assures adequate stability for the silt product as a building material (Figure 10).

Dewatering fields

Aside from the dewatering in the METHA, dewatering of the silty dredged material is also done in the so-called dewatering fields. These fields exhibit sizes ranging from 2 to 4 ha and encompass a total area of about 100 ha. They were built on old flushing fields, after which they were sealed by means of a silt sealing and an additional drainage layer to protect the groundwater.

The annual treatment capacity is up to a 200,000 m^3 profile volume. The dredged material is flushed into the dewatering fields up to a height of 1.3 m. After a few weeks the silt has settled to the extent that the supernatant wash water can be drained off and the actual drying process begins.

Once the first drying cracks appear, the piling up into stacks for acceleration of the subsequent dewatering begins. This process is repeated, until the application requirements, as earthwork material for example, are met. The total dewatering of the silt takes from 9 to 12 months depending on the weather conditions.

Wastewater treatment

As a result of contact with dredged material, the excess water from the treatment and dewatering process contains the finest silt particles. Heavy metals and other contaminants adhere to this suspended matter. Another problem is the high concentration with ammonium from households, industry and agriculture. In rivers bacteria naturally convert this into nitrate. For each milligram of ammonium this process removes five times that amount of oxygen from the water. In the River Elbe downstream of Hamburg nitrification can contribute to low oxygen concentrations in the water at warmer times of the year.

In a specially constructed effluent treatment installation the suspended matter content of the wastewater is reduced to values below 25 milligrams per litre. The concentration of the heavy metals is reduced by 60 to 90%. Ammonium is converted in the two-stage nitrification installation. The necessary bacteria colonise on thin plastic material with an overall space of 700,000 m^2. The ammonium concentration is reduced from up to 80 to less than 2 mg NH4-N/l.

Figure 9. METHA plant: Filter belt presses.

Figure 10. Silt product stock for beneficial use and/or disposal.

Silt Mound Disposal Sites

Two special sites are available for environmentally safe disposal that meets all technical and legal requirements. The Francop disposal site is located in the west of the harbour directly next to the METHA plant and the Feldhofe disposal site in east Hamburg. Silt that has been dewatered in the treatment installation METHA and in the dewatering fields in Moorburg is deposited here (Figure 11).

The disposal sites were established at locations that had formerly been used as flushing fields. As these fields were established about 30 years ago, the dredged material was deposited directly on the ground without any sealing layer. Rainwater could therefore transport dissolved contaminants into the groundwater. After examination of alternative sites a decision was made to use these sites for disposal. The construction of a disposal site above the old flushing fields meant that at the same time seepage from the old site was minimised and the use of new land for disposal was avoided.

Figure 11. Francop disposal site.

Silt has good sealing properties similar to clay from marshes which indeed also consists of river sediments. As a result of the high portion of fine soil particles, dewatered, compressed silt is virtually impermeable to water (kf ≤ 1 * 10-9 m/s). The base seal of the disposal site is designed as a double seal. It consists of a 2.5 mm thick, watertight and extremely resistant plastic liner made of HDPE (high density polyethylene) and a 1.5 m thick silt layer. Between the plastic liner seal and the mineral seal below it there is a 30 cm thick drainage layer of sand via which the water forced upwards out of the mineral seal is transported away. On the top of the base seal disposal of dewatered silt is done in the same layered way: a 1.5 m thick silt layer is followed by 30 cm thick drainage layer of sand (Figure 12).

Drainage layers of sand are built in between the sealing layers and the deposited silt for dewatering. This is necessary, because water is pressed out from the silt under the weight of the materials lying on top of it. This water, as well as the seepage water, which is intensively in contact with silt, is contaminated by the material contained in the silt and must be treated.

The upper cover of the disposal site consists of a silt seal (1.5 m), a thick drainage layer and a recultivation layer. Together this construction prevents rainwater from penetrating into the disposal site and ensures that any gas that is formed at the disposal site can only escape into the atmosphere in an unharmful form.

For the long term, the recultivation layer is the most important component in this system. It ensures that the vegetation is constantly provided with sufficient water and so consumes a large fraction of the rainwater before it reaches the upper seal as water seeping through the ground. In addition, in this way, methane is converted to less harmful carbon dioxide.

Emissions still occur even from disposal sites that meet the strict requirements of the European and German landfill regulations. It is however so slight as not to be able to cause any harm to the environment. The emissions are measured within the framework of a "monitoring" of the various points of the mound, for the purpose of monitoring efficiency of the disposal site safety system.

The Francop disposal site covers 120 hectares with a storage capacity of 8 Mio m^3 of dewatered material (corresponding to 16 Mio m^3 of sediment) and is the largest and oldest disposal site in Hamburg. The Feldhofe disposal site covers an area of ca. 80 hectares with a capacity of 9 Mio m^3.

The disposal sites higher than 30 m above sea level are shaped as naturally as possible in the otherwise flat marshes by moulding and later recultivation, and are carefully adapted to the environment.

The requirements for disposing of silt in the above-ground disposal sites are set forth in German regulations, the legal basis for which is in particular drawn from the European Landfill Directive. The objective of these regulations is the environmentally compatible disposal of wastes that can no longer be utilised or exploited, and which therefore must be safely disposed.

Filling of Harbour Basins

In the harbour basin filling process, sediments present in the river are left in situ as they are or else certain (treated) sediments are inserted. Subsequently sand is brought in up to the final site level. The danger of local crushing and displacement is counteracted by inserting into the building process the additional sand layers to be applied in the thin locations. The vertical banks to be set afterwards successfully accelerate the settlement behaviour of the floor materials.

Harbour basins were filled with dredged material for the restructuring processes implemented within the framework of the harbour expansion. Concepts were also developed that made it possible to leave the silt present in the harbour basin as it was. The settlements on the newly created harbour areas that are still allowable or maximally tolerable for later users, as well as the effects on the groundwater, were investigated through comprehensive measurement programmes.

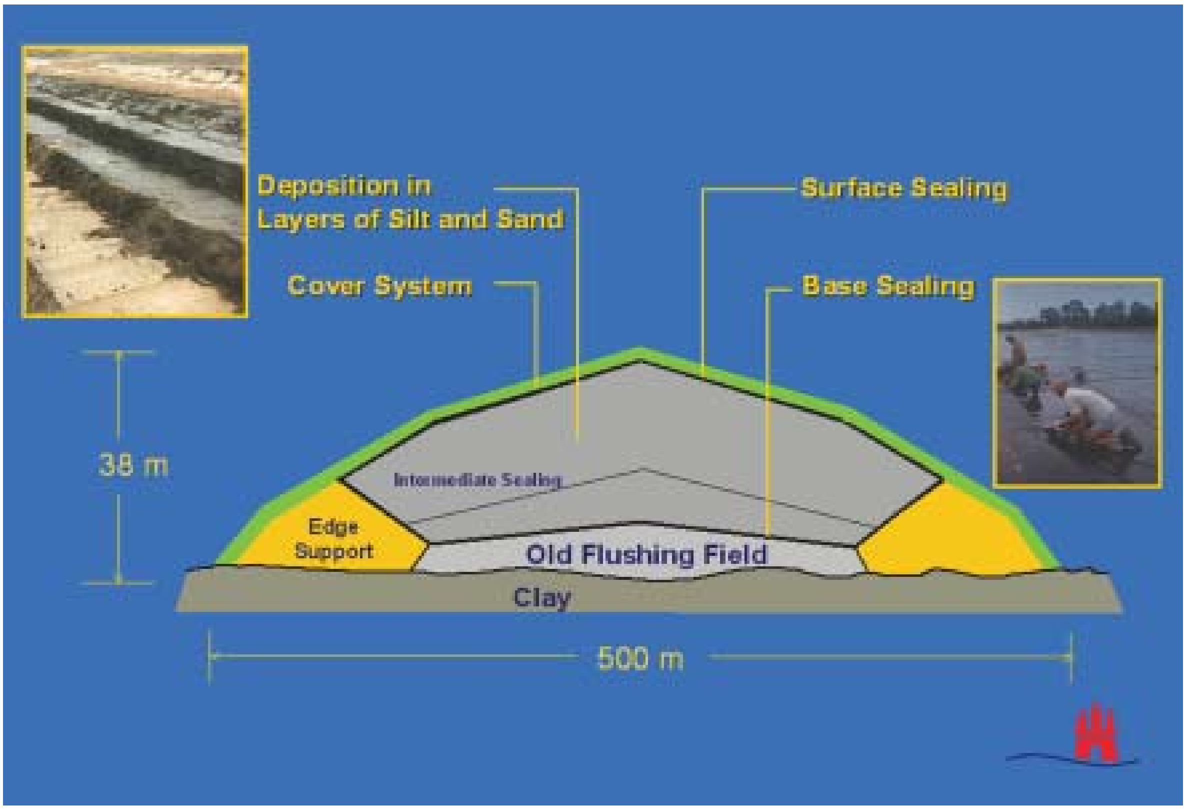


Figure 12. Sealing system principle and / or mound disposal site principle.

This arrangement was utilised for the filling and reclamation of the roughly 6 ha large harbour basin of Rodewischhafen with an approximately 6 m thick silt layer. Reclamation began with the insertion of sand into thin layers. Once a total of 3 m had been introduced in this manner, the subsequent reclamation was done using known construction techniques. Pore water escaping through the load is contained via a network of horizontal drains introduced onto the silt in the first construction phase, collected via pumping pits, and conveyed into a wastewater treatment plant. Vertical drains were put in place following the completion of the thin layers, so as to accelerate the settlement (Figure 13).

Figure 13. Filling of the harbour basin of Rodewischhafen.

Figure 14. Products made from dredged material: sand, silt building material, bricks and blown clay-pellets

"Zero emissions" at the time of the filling of the harbour basin with silt is unrealistic. Nevertheless, the specific pore water collection and the criteria that are typical for silt lead to a very low water permeability and good homogeneity with limited emissions in the water path both in terms of amount and over time. Taken as a whole, the contaminants are practically encapsulated with the silt under the filled harbour area.

The development of new silt dredging techniques without the mixing of water represents a significant step in the direction of further harbour basin filling.

Beneficial Use of Dredged Material

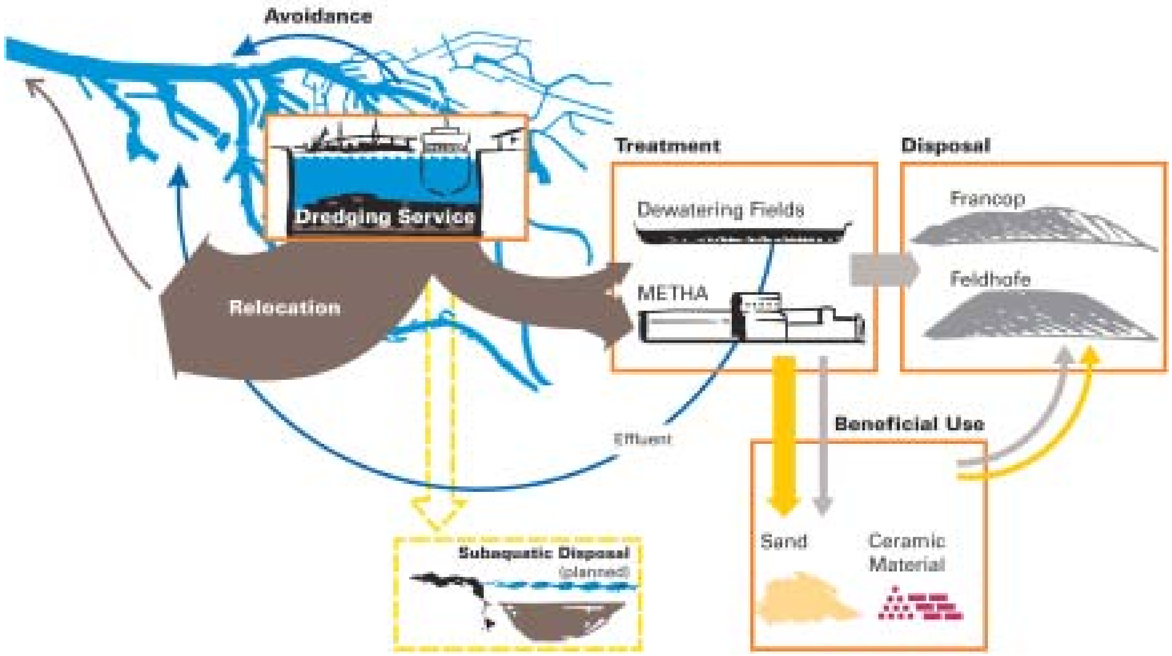
The idea of making use of dredged material or fractions of dredged material is an old one. This would allow the peculiar properties of dredged material to be used and expensive disposal site capacity to be conserved. Hamburg is particularly experienced in the beneficial use of dredged material as earthwork material in sealing construction.

The sealing property of separated, dewatered silt with a coefficient of permeability of $k_f < 1 \times 10^{-9}$ m/s was used in the construction of both of Hamburg's silt mounds. These sealing properties improve even more as the load increases. The base seal of the mound is produced from silt just as the covering mineral sealing.

The positive experiences from the beneficial use of silt as sealing material now provide the opportunity to prospect the market for additional potential usages. Examples of other potential applications are the use of treated dredged materials as earthwork material for the covering and shaping of disposal sites, the filling of pits resulting from mining activities and surface preparations as well.

Within the context of a pilot project, only positive discoveries have been obtained on the use of dewatered dredged material as substitute clay in dike works. No difference could be determined in working quality compared to clay when the materials were

Figure 15. The Hamburg dredged material management concept.



used. At present the long-term behaviour of the dredged material and the ecological effects of its use are being ascertained.

On the other hand no bid was submitted in the Europe-wide bidding procedure held in 2003 that met all the economic, legal and ecological criteria of the tender invitation.

The utilisation of dredged material in the manufacture of ceramic products is feasible. These products can be bricks on the one hand and pellets/blown clay-pellets on the other (Figure 14). Both production methods were investigated with partners in the private sector. After more than 10 years of research and development work, the middle-range company HZG Hanseaten–Stein Ziegelei GmbH developed a process for the application of silt as substitute clay in the production of bricks. It succeeded in developing a production process in which up to 70% METHA silt is used instead of natural clay for the manufacture of high-grade ceramic building materials, such as bricks or flagstone.

A pilot brickyard went into operation in 1996, which was subsequently operated for 4 years. The total annual production capacity of the plant in Hamburg-Neuenfelde was approximately 5 million bricks from the up to 30,000 tons of METHA-silt that had been delivered. The brickyard was unrivalled anywhere in the world building materials industry in terms of plant safety and filter and purification technology. The construction of the plant itself was approved under the very strict legal emission control requirements of the German Emissions Control Law. Nonetheless, the costs for acquiring METHA-dredged material in an industrial brickyard remain considerably above those of the environmentally safe disposal in the Hamburg silt mounds. As a result a large-scale project has not come into operation.

Conversely, comparatively small amounts of METHA silt are currently applied to mound costs in the production of pellets. As a result, a total of some 8,000 tons of pre-treated silty materials has replaced the natural clay in the process. It appears possible to apply 10-25% dredged material in lieu of natural clay in an existing production plant, without the need for extensive technical adaptation of the process technology.

Following the mixing of natural clay, dredged material and other additives, blown-clay pellets are produced in a rotary kiln at 1,250 ºC with a density of 0.3 to 0.6 tons/m^3. The pellets can be used as gravel substitute, geological filling material, or as a supplement for lightweight concrete. In the process, most of the organic matter is incinerated; the heavy metal and arsenic are permanently bound into a vitreous structure.

Conclusions

Today the Hamburg dredged material management concept is based on several pillars (Figure 15). Harbour maintenance yields some 3 to 4 million m^3 of dredged material per year. Easily one million m^3 are treated on land, the remaining amount being disposed of in open water. The greater part of the land amount is treated in the METHA plant, and as in the past dewatering fields are likewise in operation. The treated silt is beneficially used or disposed in the disposal mounds in Hamburg.

Since the beginning of the 1980s the federal state of Hamburg has spent more than € 500 million on the land-based treatment and disposal of contaminated dredged material. By far the largest part of contamination of Elbe sediments is traceable to sources at the upper reaches of the Elbe. Over the long term such expenditures are neither sustainable nor sensible. Therefore, over the medium term the dredged material management concept provides for the relocation of the major part of the dredged material to the waters of the Elbe. Only the contaminated dredged material that also comes from old sediment deposits is treated on land and, where possible, put to use or deposited.
The possibility of subaquatic disposal is being investigated for the long-term safeguarding of dredged material that cannot be relocated.

While in 1984 strong public protests spurred on the development of the dredged material management concept, today increasingly more legal requirements define how dredged material is to be handled, particularly when it concerns disposal on land. The bases for these regulations are often European.

Dredged material and its peculiarities have been given insufficient consideration in the regulations of the EU with the possible consequence of unreasonable requirements being imposed. The increasingly heavy regulation calls for a coordinated, active course of action by those responsible for the handling of dredged material. The EU Water Framework Directive provides management plans for entire river regions and to that extent offers a chance. Correctly understood sediment management for an entire river region should mean that water maintenance is required, that sediments should remain there as natural aquatic elements and that they require protection. Such management ought not to be a dredged material treatment operated at the end of a river at great expense, but rather the requisite measures must be established at the sources via which the contaminants reach the river.