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CASE STUDY

E-Clay Stabilisation

Stabilisation of Dredged Harbour Sediments Reuse as Restoration Material

Client

Department of Agriculture, Food and the Marine
An Roinn Talmhaíochta, Bia agus Mara

Consulting Engineers

Doran CONSULTING
DELIVERING ENGINEERING EXCELLENCE

Site Background & History

Killybegs is located in County Donegal and is the second largest fishing harbour in Ireland. There is a natural deepwater harbour at Killybegs. The harbour is utilised by pelagic trawlers, a whitefish fleet and many other types of shipping including passenger cruise liners and mixed specialist cargoes. Killybegs has also recently become the favoured port for the importation of wind turbines and is also a service port for offshore gas/oil drilling rigs.

Due to an increase in marine traffic in Killybegs Harbour, there was an increased demand for quayside berthing to facilitate the entrance of large ships to the harbour. To facilitate this the Department of Agriculture Food and the Marine [DAFM] proposed an extension of the north quay and the construction of four breasting dolphins.

A quantity of material found at a sediment bank known as Smooth Point was required to be removed by dredging works – this material consisted of gravels and silts. Approximately 25,000m³ of this material was considered unsuitable for disposal at sea (due to the presence of identified contaminants within the sediments at unacceptable levels).

The site is shown in Figure 1 below.

Figure 1 – Aerial View of the Site

Identified Contamination

RSK undertook a waste classification assessment on behalf of Doran Consulting (the consulting engineers for the project). The assessment was carried out on seventy-four samples collected from the harbour. RSK concluded that all seventy-four samples should be classified as non-hazardous from an offsite disposal perspective.

An additional investigation was carried on seventy-one samples collected from the area to be dredged at Smooth Point utilising the HazWasteOnline Assessment Tool recognised by the EPA. The assessment concluded that all seventy-one samples should be classified as non-hazardous under European Waste Code 17.05.06 - (dredging spoil other than those mentioned in 17.05.05).

The prime contaminants of concern preventing disposal at sea were tributyltin [TBT] and dibutyltin [DBT] – hydrocarbon pollutants were also present in some of the samples tested at low levels. The identified TBT and DBT concentration levels ranged from 0.003mg/kg - 54.3mg/kg (3ug/kg – 54,300ug/kg) and 0.004mg/kg – 1.43mg/kg (4ug/kg – 1430ug/kg) respectively.

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It was decided that the contaminated dredged materials would require treatment to make them suitable for transport and acceptance at the designated repository [quarry] in County Donegal – the treated material was considered to be suitable for restoration purposes at the repository.

A number of treatment options were considered for the material as summarised below:

Treatment Options Appraisal

The following treatment options were considered to address the identified requirements for onshore disposal:

Physical Stabilisation:

This option involved the addition of stabilisation agents to enable transport of the dredged material to a suitably licensed non-hazardous waste facility. Due to the low volume of available landfill space in Ireland, the physically stabilised material would have required transportation by lorry to Dublin (and potentially transportation to mainland Europe for treatment).

Chemical Oxidation and Bioremediation:

This option involved the addition of chemical or biological treatment solutions to reduce concentrations of targeted contaminants. These are very effective treatment technologies for certain pollutants however chemical oxidation has not been widely used on TBT/DBT and bioremediation requires longer treatment times than other technologies. The treated material would still require physical stabilisation to facilitate transport.

Chemical Stabilisation Utilising E-Clay Technology:

This option involved the addition of a purpose designed E-Clay formulation to chemically immobilise the identified contaminants of concern (i.e. TBT / DBT and hydrocarbon pollutants).

The E-Clay is applied in slurry form to minimise emissions and to ensure effective dispersion within the material undergoing treatment. It has been widely used for chemically and physically stabilising contaminated materials (including TBT / DBT contaminated dredge material).

It was decided to utilise E-Clay technology for the treatment of the identified contaminants of concern.

There was also a requirement to carry out physical stabilisation in conjunction with the E-Clay Stabilisation Process – this was necessary for transportation and acceptance purposes.

Dredging Works

The capital dredging works were undertaken under the auspices of DAFM at Smooth Point – the dredging was undertaken to facilitate harbour quay improvements. The location of the dredging works is shown in Figure 2 below.

The contaminated dredged material was transferred into barges for transporting to the quayside.

The material was then offloaded from the barges using a sealed environmental bucket as shown in Figure 3 below,

Figure 2 – Location of Dredging Works

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Figure 3 – Offloading of Dredged Sediment

Dredged material was then placed in 25 tonne dump trucks at the quay side – see Figure 4 below. The material was then transported from the quay in the dumper trucks to the dredge storage area within the treatment site. A road sweeper was utilised to clean the surfaces between the quay and the treatment site.

Figure 4 – Loading of Dredged Sediments

On-Shore Works

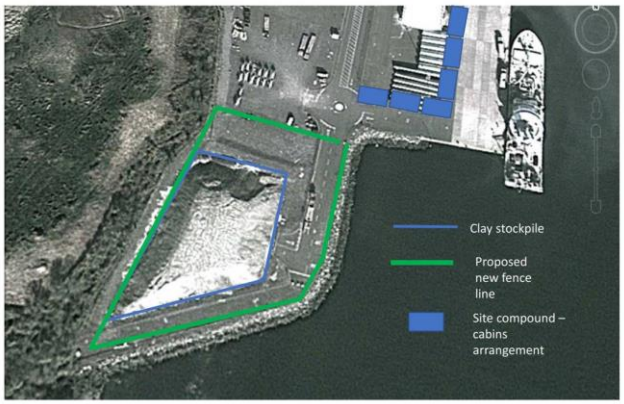
The on-shore treatment and transportation / deposition works were undertaken by the main contractor

Envirotreat Technologies Limited provided the company's proprietary E-Clay Stabilisation Technology, designed to chemically immobilise the identified contaminants of concern.

Preparatory Works

A treatment site was identified at Smooth Point as shown in Figure 5 below. The necessary regulatory approvals were obtained including the requisite permit for the treatment works.

Figure 5 – On-Shore Treatment Site



The proposed treatment site comprised of made ground, stone, clay and hardcore. A 13,000m³ stockpile was located on the site – this comprised of previous dredged materials (clay and stones) – the stockpile was removed to facilitate construction of the treatment site.

The formation of the treatment area is shown in Figure 6 below. The necessary protection to the environment was provided by the installation of polythene lining on the base of the area and on the perimeter bund as shown in Figure 7 below. The completed treatment area is shown in Figure 8 below.

Figure 6 – Formation of Treatment Area

Figure 7 – Installation of Polyethene Lining

Figure 8 – Completed Treatment Area

Two treatment platforms were constructed in the centre of the site. Mixing units were installed to mix the purpose designed E-clay formulation in slurry form with the dredged material and to physically stabilise the treated dredge material with cementitious materials as shown in Figure 9 below. A curing area was prepared (incorporating a truck loading area) - the curing area was designed to hold the treated dredge material whilst awaiting laboratory analysis confirming the success of the treatment process / compliance with target requirements. A loading area was constructed to load chemically and physically stabilised dredge material into trucks for transport to the designated repository site (for reuse as restoration material). A water collection sump was installed to collect run-off – this was removed from site as required.

Figure 9 – Construction of Mixing Units

On-Shore Treatment Works

The onshore treatment works involved chemical and physical stabilisation of the dredged sediments.

The prime purpose of the chemical stabilisation process was to reduce the leachability of tributyltin [TBT] and dibutyltin [DBT] to acceptable levels to enable disposal. The chemical stabilisation involved the use of a project specific, bespoke formulation of E-Clay® technology.

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The E-Clay technology was utilised in combination with a cementitious binder to provide the physical stabilisation element. The treatment of the contaminated sediments was undertaken in the mixing units utilising a predetermined volume and concentration of treatment slurry (comprising of the designated E-Clay formulation produced on-site in the grout mixer) – the treatment slurry was pumped to the mixing units as required. The treatment process involved mixing the sediments with the slurry and cementitious materials (added in dry form) to produce a homogenous treated mass using an excavator bucket as shown in Figures 10 and 11 below.

Figure 10 – Mixing [Treatment] Process

Figure 11 – Treated Sediments

The treated dredged material was removed from the mixing units and stored in the curing area awaiting off-site disposal as shown in Figure 12 below. A sample of the treated material was retrieved each day and sent for laboratory analysis at a UKAS accredited laboratory for TBT/DBT leachate analysis. As there is no actual regulatory leachate value for TBT/DBT, AAA implemented a highly conservative remedial target threshold of 200ng/l (0.2 ug/l) based on previous project requirements – this target requirement was agreed with Donegal County Council. Samples were also obtained for WAC analysis to ensure compliance with the acceptance requirements of the repository.

Figure 12 – Treated / Cured Sediments

On completion of the curing and validation process the treated material was loaded onto lorries and transported to a local licensed disposal site for infilling / restoration purposes. All lorries were wheel washed prior to leaving the treatment site and the road was regularly washed to ensure that muds and sediments did not pollute the surrounding environment.

The use of the treated material for restoration purposes is shown in Figure 13 below.

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Figure 13 – Reuse of Treated Material for Restoration Purposes (Licensed Quarry Site)

Environmental Monitoring

A comprehensive environmental monitoring programme was implemented throughout the duration of the works. Dust, odours, noise and VOCs were monitored in and around the site during the remediation works (for the required protection of site personnel and environmental receptors). All environmental monitoring data was below the agreed trigger levels.

Validation

The validation requirements were primarily focused on compliance with agreed leachate target values for TBT / DBT.

The agreed leachability target value for TBT / DBT was 200ng/l (0.2ug/l).

Supplementary Waste Acceptance Criteria [WAC] testing was carried out on the treated materials to confirm suitability for use at the disposal site for restoration purposes. These tests were carried out to confirm that the materials were compliant with inert WAC criteria. The analysis confirmed full compliance with the agreed leachability targets for TBT / DBT and with the inert WAC requirement.

Conclusions

Envirotreat demonstrated that the remediation objectives for the site had been achieved and the treated sediments were suitable for off-site disposal / restoration at the designated site through a comprehensive validation and verification report.