'AMORAS' – Antwerp Mechanical Dewatering, Recycling and Application of Silt – operational since October 2011

With the AMORAS project, there is a permanent and sustainable solution for the treatment and storage of maintenance dredging material in the Port of Antwerp. This occurs by means of a unique silt treatment system. It consists of a treatment installation for dewatering dredged spoil and purifying process water. The filter cakes left behind, which are at least 60% dry, are stored or reused as environmentally friendly material. The dewatering installation can process approximately 500,000 tonnes of dry material (after dewatering). The construction of the dewatering installation was completed at the end of September 2011. The complete system has been operational since October 1st 2011.

Sufficient draught for shipping traffic is essential in order to safeguard the future of the Port of Antwerp. To guarantee this draught, a large volume of maintenance dredging material must be dredged annually. As of now, however, a spatial saturation point has been reached for applying former storage techniques, such as dumping in quays on land and in overdepths (underwater cells) in a dry dock complex. Furthermore, these techniques have become unacceptable from a social and environmental engineering standpoint. Therefore, the Government of Flanders decided 5 years ago to address the treatment and storage of dredged spoil in a new and sustainable manner with the construction of a mechanical silt dewatering installation in the Antwerp port area. The project received the name AMORAS which is an acronym for Antwerpse Mechanische Ontwatering, Recyclage en Applicatie van Slib (Antwerp Mechanical Dewatering, Recycling and Application of Silt). The project ensures in a sustainable fashion the annual treatment and storage of approximately 500,000 tonnes of dry material, namely dredged spoil dewatered by a minimum of 60%, in the Port of Antwerp.

The project consists of two phases. The first phase, completed at the end of September, entails detail engineering and the construction of the dewatering installation. The second phase, which started on 1 October, concerns the operation of the installation over a period of 15 years.

The silt treatment system contains five important zones which can be found on the location map in annex.

1. <u>Underwater cell zone</u>: Maintenance dredging material from the port docks is stored temporarily by the Antwerp Port dredging company in a newly built local underwater cell in Canal Dock B1. It has a capacity of 300,000 m3. An electronically driven dredging unit pumps the spoil from the underwater cell to the shore where the treatment process commences. More heavily contaminated spoil is not stored temporarily but is directly suctioned from the ladderwell containers and deposited ashore.

2. <u>Sand separation zone</u>: The material pumped ashore has all course elements removed by means of a sieve. Depending on the environmental quality of the dredging spoil and/or the sand content, the spoil is desanded in a sand separation installation on the quay near the underwater cell. Hydroclones handle the sand separation and are adjusted to a separation point of 63 microns, the granulometric limit between sludge and sand fraction. Separation occurs based on the difference in density of the two fractions. The separated course elements and sand are then transported outside the sand separation plant via separate conveyor belts.

3. <u>Discharge pipeline zone</u>: Then the spoil, either desanded or not, is pumped over a distance of 4 km through a discharge pipeline (2 pipes) with a maximum throughput of 1,500 m³ per hour to the treatment site at the 'Bietenveld'. This is done using low power in order to minimise energy consumption.

4. <u>Dewatering installation zone</u>: At the approximately 15 ha 'Bietenveld' site, the spoil is buffered into four thickening basins, each with a capacity of 120,000 m³. Together they form a circular basin with a diameter of 350 m. The thickening basins ensure that the dilution water (transport water) required for sieving, desanding and pumping the dredging spoil is separated again after a week of sedimentation. Three thickening basins receive the less contaminated spoil. More contaminated spoil is deposited in a fourth basin.
An innovative dredging system with a rotating gantry spanning the circular consolidation ponds allows fully automated steering of the process. The dredging gantry, measuring 175 m, is equipped with two

mobile dredge pumps that can move along the entire span and can operate independently of one another, which is conducive to precision work. This makes it possible to feed the filter press with a nearly homogeneous mixture.
In the **dewatering hall** the consolidated dredged spoil is conditioned in a centrally located buffer to which all the presses are connected. Twelve membrane chamber filter presses dewater the spoil over five successive working days of 24 hours (3 shifts per day) by pressing the water through a filter cloth (in 2 phases). Cakes with a dry material content of at least 60% are left behind in the 'chambers'. These drop onto a conveyor belt below and are transported in this way to the storage site. Each press (approximately 25m long, 5m wide and 5m high), with 193 vertical chambers, can produce approximately 30 tonnes of cakes per cycle of approximately 1.5 hours.
The filtering water from the presses is collected together with other waste water streams in the buffer basin for waste water. From there it is pumped to the biological water purification installation with a capacity of 250 m³ per hour. The first phase in the purification process consists of physico-chemical pre-purification to remove fine suspended particles. In the second phase, organic materials and nitrogen are removed by means of biological purification. After purification, the filtered water together with the transport water is discharged back into Canal Dock B1 through a third pipeline.

5. Storage site zone: The filter cakes produced are stored under controlled conditions at the approximately 30 ha 'Zandwinningsput' (sand extraction pit) site located next to the 'Bietenveld' site and between Hooge Maey, Indaver and the A12 motorway. The filter cakes can be stacked to a height of 50m above an already existing layer of moderately consolidate silt already stored earlier in this sand extraction pit. Using phased and controlled storage, the aim is for an operation period of at least thirty years. As soon as possibilities for reuse of the filter cakes arise in future, this duration can be extended even further.

In the middle of 2008, the significant AMORAS contract was awarded to the temporary trade association SeReAnt, a combination of Flemish dredging company Jan De Nul and Dredging International (DEME), supported by their respective environmental contractors Envisan and DEC. The awarded amount of approximately EUR 480 million incl. VAT includes construction costs, operation costs and the cost of financing. Construction represents an investment of EUR 118 million. To this end, the Government of Flanders has freed up EUR 46 million in current resources in the construction period (2008-2011). The balance of EUR 72 million is financed by the contractor and will be repaid during the operation phase. Every operation year demands an investment of EUR 29 million, 22 million of which for the actual operation and 7 million for repayment of financing.

Construction was completed on 30 September 2011. This is 6 months later than originally planned due to 2 exceptionally harsh winters (3 months arrears) and necessary changes to the underwater cell and the pipeline which emerged during the course of construction. Actual operation of the treatment installation started on 1 October 2011 and concludes, after 15 years of operation, at the end of September 2026.

"*With a fine feat of environmental technology, AMORAS provides an answer to the flanking policy I envision upon achievement of important investments and works. With this initiative we have made the switch to new, future-oriented treatment techniques reliable over a longer term. AMORAS guarantees efficient use of space and a good environmental score: care was taken to ensure minimal energy consumption; the purified waste water is of a very high quality; and maximum reuse of the water has been taken into account. Together with the Antwerp Port Authority, with private companies Wienerberger, Argex and De Rycke Cement and with the research institutions Flemish Institute for Technological Research, Belgian Road Research Centre and the Belgian Building Research Institute, and in the framework of the research project VAMORAS, in the coming months the Government of Flanders will investigate the extent to which the waste material (filter cakes) can be reused. This is sustainability at its best." according to Hilde Crevits.*

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Annex: location map AMORAS project