The Blani, optimalization of a dredging processe in Blankenberge and Nieuwpoort

Introduction

In 2002 a new federal decree for the protection of the marine environment in Belgium made an end to the way maintenance dredging was carried out in the small ports of Blankenberge and Nieuwpoort on the North Sea coast. Until 2002, maintenance dredging in these ports was carried out in a rather straightforward manner: a small cutter suction dredger was used that discharged the dredged material through a pipeline, partially floating and partially on land, directly into the sea. But according to the regulations of the new decree such a discharge falls under the category of industrial discharges no longer allowed in the marine environment, even though the dredged material is not contaminated.
With the new decree coming in force, disposal of dredged material in the marine environment from then on was only allowed in regulated disposal sites like the ones used by the trailing suction hopper dredgers that carry out maintenance dredging in the larger North Sea ports of Zeebrugge and Ostende.

Finding a solution

The department 'Maritime Access' of the Flemish Community, responsible for the maintenance dredging of the ports, thus faced the problem to find a new dredging method comprising the disposal of the dredged material into these disposal sites that are located several miles off the coast. Deployment of tshd's in both ports is out the question. The port of Blankenberge is nothing more than a marina where the access is restricted to small yachts and sailing vessels and offers no room at all for a tshd to manoeuvre and carry out dredging operations. The port of Nieuwpoort is slightly bigger and knows some modest economical use in the form of sand and gravel transhipment but for the greater part the port is also used as a marina and has comparable circumstances as Blankenberge.
For the same reason of restricted accessibility, the use of a mechanical dredger in combination with sea-going hopper barges is not possible either, the hopper barges could simply not moor alongside the dredger in most of the cases.

Experiments have been carried out using a mechanical dredger in combination with a 'Putzmeister' pump to pump the dredged material to the hopper barges waiting at the entrance of the port.
This however proved not to be an optimal solution, the dredged material was far too cohesive and too viscous to be pumped efficiently to the hopper barges and production rates dropped significantly. As far as the dredging process itself and the subsequent pumping process, the use of a cutter suction dredger still remained to most optimal solution. In that case however the loading process of the hopper barges had to be strongly improved in efficiency.

In the situation before 2002, the material was pumped with an average density of 1,08 tons / m3, a very low density that gives no problems when pumping directly into the sea but in case of loading barges is of such a low degree that an excessive amount of barges would be needed. Barges that would subsequently have to spent their time sailing to the disposal site carrying mostly water. The solution had therefore to be found in a structural increase of the density of the dredged material, a goal that can of course only be achieved by optimising the complete dredging process.

The cutter suction dredger 'DC 203'

Starting point of the study to optimise the dredging process was the same dredger that until 2002 had always carried out the maintenance dredging, the DEME owned csd 'DC 203'. With an unique configuration of its cutter ladder, this dredger has over the years proven to be the ideal piece of equipment to dredge in the small marinas with all its floating jetties and small corners. In fact the 'DC 203' does not have a rigid cutter ladder that goes in a straight line from the floating pontoon to the cutter like most csd's do.

The cutter ladder of the 'DC 203' consists of two articulating parts, during dredging operations the first part runs from the floating pontoon down to the bottom where it is connected to the second part by a articulating joint that rests on the bottom with a special support.
The second part runs horizontally from this supported joint to the cutter. During dredging the sweeping movement is generated by hydraulics located on the support and it is only the second part of the cutter ladder that moves instead of the entire dredger as is the case with most csd's. This configuration allowed the 'DC 203' to dredge under the floating jetties without the need to remove them and also reach every small corner of the ports.

Optimising; the 'DC 203' becomes the 'Blani'
The study to optimise the 'DC 203' lead to a total of six measures to be taken. Four of these measures relate directly to the cutter suction dredger itself:

- the productivity during the movements of the dredger: sweeping and forward stepping
- automation of the pump speed and dredge movements
- the position of the underwater dredge pump
- adjustable covers at the cutter

When making a step forward during the dredging process, the 'DC 203' had to lift the support of the cutter ladder from the bottom and for stability reasons this could only be done with the ladder positioned in the centre line of the dredger's pontoon. When raising the cutter ladder and the support in one of the corners the dredger would, due to the weight, show a severe tendency to capsize. This fact resulted in a rather low productive sweeping movement, which can be seen in the following scheme:

- sweeping from the centre line to starboard while dredging, approx. 2 minutes productive
- sweeping back to the centre line not dredging, approx. 2 minutes non-productive
- sweeping to portside while dredging, approx. 2 minutes productive
- sweeping back to the centre line not dredging, approx. 2 minutes non-productive
- stepping forward to start the next sweep, approx. 1 minute non-productive

As can be seen, of the nine minutes to perform one complete sweep, only four are productive, which is less than 50 % !

Making it possible to step forward with the cutter ladder positioned in the starboard and portside corner would mean an important increase of the production rate as the following scheme shows:

- sweeping from portside to starboard while dredging, approx. 4 minutes productive
- stepping forward to start the next sweep, approx. 1 minute non-productive
- sweeping from starboard to portside while dredging, approx. 4 minutes productive
- stepping forward to start the next sweep, approx. 1 minute non-productive

Now two complete sweeps take a total time of 10 minutes of which 8 are productive, so by changing the sweeping and stepping process the productivity rate would increase from under 50 to 80 %. To make this change possible floats were installed on the cutter ladder to make it completely buoyant under water.

Built in 1985 by the French company Hydroland, the 'DC 203' had always been operated manually. The change of the sweeping and stepping process however lead to a situation in which so much actions had to be taken in a very short period that this could not be done efficiently anymore by hand. The change called for a radical automation of the process to avoid the gain of productivity being reduced to naught.

But the automation went further and covered the complete dredging process: the speed of the pump has been automated in function of the sweeping speed and also the vertical position of the cutter is automated to obtain an optimal cutting depth in every situation. The automation of the dredger has been carried out by IHC Systems in very close cooperation with the engineers of DEME.
This operation include amongst others:

- the replacement of the old dredging desk by a new one
- the installation of an 'Integrated Monitoring & Control System' (IMCS)
- a complete renewal of the hydraulics, all manually operated valves were replaced by electrical ones
- the installation of a new positioning system: 'Kart DGPS'

The third measure that was taken to optimise the dredging process was to replace the underwater dredge pump by a high-efficiency one and move it closer to the cutter head. Originally the underwater pump was located on the upper part of the cutter ladder resulting in a suction length of 25 meter, in this situation trying to dredge with higher density would immediately lead to cavitation problems in the pump. By moving the pump to the lower part of the cutter ladder the suction distance has been reduced to 5 meter. This position however demanded for an inventive design to integrate to pump in such a way into the cutter ladder that it would still be able to dredge under the floating jetties in the ports. The last measure to be taken on the 'DC 203' was the installation of adjustable covers round the cutter to prevent an excessive flow of water from the non-dredging side of the cutter while sweeping.

After all these measures have been taken, it was as if a new dredger was born and DEME judged the dredger was ready for a new name and so the 'DC 203' became the 'Blani', after the two ports it is destined to serve: BLAnkenberge and NIeuwpoort.

Other measures
Besides the measures on the cutter suction dredger itself, two more measures have been taken to optimise the density of the total dredging process:

- an extra floating booster pump was added that can be installed on any spot of the pipeline between the dredger and the hopper barges. This booster pump is a electrically driven and works with a variable frequency that is controlled by telemetry from the 'Blani'.
- on the two 1,000 m3 hopper barges, the 'Vlaanderen 7' and the 'Vlaanderen 8' a so-called 'AMOB' system is installed, which stands for 'Arm Mengsel Overboord', in English 'Poor Mixture Overboard'. This system automatically directs the mixture from the dredging process directly overboard instead of into the hopper whenever it is below a pre-defined density.

Finally
With all these measures taken the maintenance dredging process in both ports is now been carried out with an average density of 1,2 tons/m3, an impressive performance achieved by the engineers of both DEME and IHC Systems. In this configuration the 'Blani' and its auxiliary equipment is still capable of dredging the approx. 500.000 m3 on an annual basis despite the new environmental regulations.

An amount that can by the way only been dredged during the off-season winter period. No dredging activities are allowed in both ports during the high-season when thousands of tourists make use of these attractive ports on the Belgian North Sea coast.

(Source: Dredging and Port Construction September 2004)