ECODRAGA: A Dredger ship that overcomes the environmental impact of the dredging activities

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Abstract *- Currently, dredging processes are a necessity for a proper marine and river resources exploitation: construction and maintenance of port infrastructure, improving navigability... However, current dredging techniques can cause serious problems to the environment. ECODRAGA brings a solution to make compatible the need of dredging processes with the need of the natural environment protection.*

Keywords *- Dredge, environmental protection, contamination.*

I. INTRODUCTION

Dredging needs and environmental effects

Ports and navigation channels are keys for the economy of large regions, covering a variety of activities: maritime traffic and supply industries, fisheries and food distribution, sports, tourism and all sort of related services. These are vivid economic areas whose progress and strength are tightly connected to the richness of the coastal belt.

Dredging is a critical maintenance activity of navigation channels and specifically of ports located at the bottom of an estuary, to preserve their activities: the bay of San Francisco (USA) would be closed to traffic within one year otherwise. Without an efficient dredging, the continuous changes would affect and reduce ship traffic to avoid danger situations in the local navigation (the larger naval, commercial, industrial and recreational ships need more than 10 meters depth waters). Keeping operative the channels is a paramount of the economic activity.

Water turbidity causes the most important environmental impact due to dredging activities. Mud is loaded with contaminant agents: mercury, cadmium, petroleum-derived PAHs, dioxins and PCBs. When dredged materials are brought to the ship or put back, the water flowing out disperses the contaminants, being introduced in the trophic chains.

The ECODRAGA ship we designed drastically reduces the dispersion of contaminants, acting directly in an effective reduction of the turbidity. The International Association of Dredging Companies asses in several hundreds of millions of cubic meters the sediments dredged all over the world annually, with a market volume of 10.738 million euros (2011). In Spain, a mean value of 9 millions cubic meters are produced annually, and 125 million cubic meters were poured back to the sea since 1975. Therefore dredging directly influences not only the economy but also the wellness of the inhabitants of large regions.

In the last years we have developed industrial level prototypes (ECODRAGA). This result position our technology as one of the most promising worldwide.

Basis of environmental effects of dredging

In the dredging operations, there are two crucial points where the contamination is enormous:

- The first one is when picking materials from the seabed to the hopper, the dirty water in the hopper overflows going again to the sea. This dirty overflowing water is carrying the most contaminants materials that where quiet in the seabed. Due to the small size of the contaminants (and typically the finest materials are also the most contaminants) they last a lot (weeks) to reach the seabed again. And all that time all the contaminants are fed again in the trophic chain
- The second one is in the discharging process. If the materials collected in the hopper are not heavily contaminated, the most used option is to put them back in the seabed in another point farther to the coast, in a point selected to be a dump (vertedero). In this point the hopper is open and the materials go down freely to the seafloor. But in this fall, the finer elements, are dispersed to a wide area and again they last weeks to reach the seafloor and enter the trophic chain.

II. ECODRAGA FUNDAMENTALS

The design basics of Ecodraga are the following:

Ecodraga collects the water overflowing from the hopper and brings it with a pipe located parallel to the suction pipe to the suction point in the seabed. This dirty water is put very near the suction point in order many of this water to be picked again to the hopper (Fig 1). What happens is that only a few part of the dirty water is spread in the seafloor and very near to it. This gets that in a few hours all the contaminants are again deposited in the seafloor reducing the environmental effect to almost zero in the point of dredging.
Additionally, in the ECODRAGA some designs are included to calm the waters in the hopper and add some (environmentally safe) anionic flocculant, with the idea of decreasing the amount of fines returning to the suction point.

Two different discharge solutions

ECODRAGA has also two different solutions to avoid the environmental contamination problem in the process of putting the materials again to the sea depending of the dredge ship.
If the dredge hopper is a full aperture opening the hopper to leave its contents directly the sea, we use a geotextile canvas sheet covering all the hopper before the dredging process.
Once at the point of discharge, when opening of the hopper, the geotextile wraps the materials carried in the hopper keeping them inside and preventing them to be spread to the sea until they reach the seafloor (Fig 2). When it arrives to the bottom the geotextile opens laying below the materials, but over the previous materials that have been deposited in the same place. Once completed the dredging process, some clean materials (sand) will be discharged in the same way. This allows geologically isolation of the contaminated materials under multiple layers of geotextile canvas. The seafloor in the dump point is finally covered with clean sand over which new marine life can grow.

Some dredge chips can't open its hopper and they empty the hopper through a pipe. For this type os dredgers the solution consists of a monobuoy located in the dump point and having a pipe from the monobuoy to the seafloor. The discharge process is accomplished connecting the pipe from the dredge to the pipe in the monobuoy. This makes that all the materials in the hopper go directly to the seafloor wher they con only have a little dispersion.

Dredge efficience increasing

Current dredges are ships that have all the dredging equipment and hopper in the same body. After filling the hopper, the dredge must stop dredging to ship to the dump point (typically several miles from the coast). This makes the dredger spends the most of the time going and returning from the dump point and only a small part really dredging. To increase the efficiency of dredging, Ecodraga incorporates the possibility of separating the dredger ship to its hopper. The idea is to have several hoppers and, once filled, they are carried by a tug to the dump point. Meanwhile the dredge remains dredging and filling other hoppers, making much more efficient the dredging process.

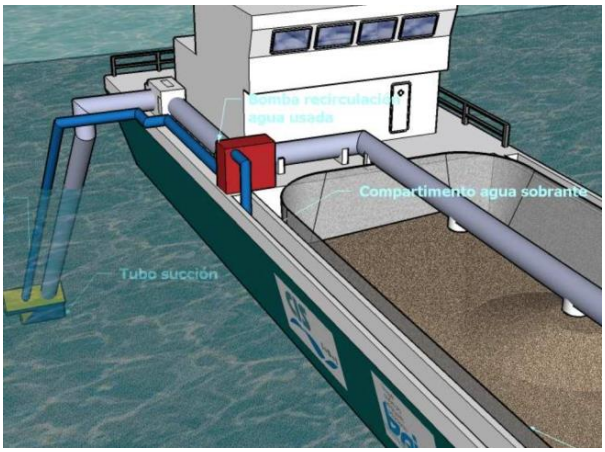

Fig. 1: Recirculating the water overflow of the hopper. All the dirty water is left in the suction point in the seafloor thus avoiding turbidity.

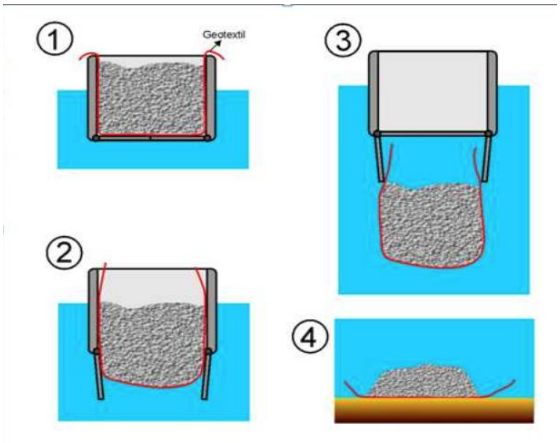

Fig. 2: Geotextile covering the hopper and how it wraps the materials when dropping them in the dump point.

III. RESULTS

In years 2012 to 2014 three Galician firms and four research groups have developed the Ecodraga in its aspects of the recirculating the overflow water from the hopper and the geotextile wrapping of the hopper in an INNTERCONECTA Project (ITC-20113086) “Diseño y desarrollo, estructural y de sistemas, mediante el uso de herramientas CAD, FEA y CFD, de un prototipo de draga ecológica para la limpieza por succión de fondos marinos”.

Results have been completely successful in the overflow recirculating part and quite good in the geotextile part.

Furthermore to the mechanical aspects, a Supervising Dredge Equipment has been completely developed allowing the real time control of the dredge processes and its environmental effects.

IV. ACKNOWLEDGEMENTS

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