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METHODOLOGY FOR THE CONTROL OF BEACH NOURISHMENT WORKS IN THE GULF OF CADIZ (SW SPAIN)

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1. Introduction

Field data and aerial photographs over the last half-century were analysed and a recession rate of approximately 1m/year was found in some points of the SW Spanish coast. Because of the erosion, the Spanish Coastal Authority decided to begin an important coastal protection program (Muñoz-Perez *et al.*, 2001). Leaving apart phenomena like subsidence, sea level rise, man-made barriers, dams or building constructions on the beach, erosion is caused by a negative sediment budget. Consequently, periodic sand nourishments appear as the most natural way to solve the problem.

Geophysical campaigns were performed in 1990 in order to identify submerged borrow sand areas from where extract the sand by using trailing suction hopper dredgers. Payment is made on the hopper measurements taken before the sediment is pumped onto the beach, and granulometric essays must be done on board, before the pumping, in order to study the aptness of the sand. Furthermore, the Administration has to take care of the possible archaeological remains. Moreover, according to the Spanish Environmental Act, the nourishment project must be reviewed by the Environmental Authority which demands precautionary measures to prevent possible impacts. Item, profiles should be taken before and after the work is completed not just at the beach but at the borrow site as well. Finally, some special security measures at the beach have to be adopted.

The aim of this paper is to show the general methodology to consider all the former aspects when performing beach nourishment in Spain.

2. Study area of a practical case

Victoria is a 3 km long beach located in the Gulf of Cadiz, facing the Atlantic Ocean, on the SW coast of Spain, near the Strait of Gibraltar. A renourishment project of 2.106 m3 took place in spring 1991. A monitoring based on topo-bathymetric levellings was performed till nowadays. An average erosion rate of about 70.000 m3 per year was found and new 280.000 m3 nourishment was poured on summer 2004.

Placer de Meca, an underwater sand deposit in the surroundings of the Cape of Trafalgar and at a distance of 25 nautical miles, was chosen as the borrow site. The trailing suction dredger, the Iria Flavia, has a hopper capacity of 1,597 m3. The dredged sediments, mostly of silicyclastic origin) consisted primarily of fine sands (D50=0.34 mm).

3. Control methodology

Although a portable meter system for dry weight control in dredging hoppers was already developed (Muñoz-Perez *et al.*, 2003), up to the present, human supervision is still required until some type of protection measures can be put into effect for the maintenance of the device against involuntary manoeuvres cause by unauthorised personnel. So, distance between deck and sand surface are measured at the end of each loading phase by two technicians, representatives of the contractor and the government respectively. Once this information was applied to the vessel ullage chart, the precise load sediment volume was calculated and a certificate was signed by both technicians. Granulometries were performed to guarantee a minimum D50 and be able to apply the graphs of James (Shore Protection Manual, 1984).

As the controlling technician was a sea science bachelor, he/she was charged as well with the environmental vigilance tasks, e.g. to identify, weigh and number the fishes trapped into the hopper.

It is not just a lot of many different culture wrecks laying along all the Spanish coast, the Placer de Meca is very close to the site where the famous naval battle of Trafalgar took place. That is the reason why an archaeologist was on board too and another at the beach.

The position the ship was determined by DGPS and recorded to be sure that the limits of the extraction zone were never crossed while dredging.

Safety measures at the beach (in order to avoid the curious people come into the working site with the consequent dangers related to heavy machines, quick sands, etc.) consisted mainly on fences, informative signboards and private guards.

Details about all the former measures, including examples of forms to be filled in, comparison of sands, equipment and methodology for the bathymetric works, usual problems and their solutions, useful pictures and sketches, complementary references, etc., will be included at the final paper.

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