A check on the efficiency of an air bubble screen through the use of an artificial tracer: a test in the Port of Genoa (Italy)

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Introduction: In 2009 the Port Authority of Genoa (Italy) initiated extensive dredging work to allow the entrance in the port to the newest generation of ships. Artificial levees were constructed to contain the dredged material, creating sub-basins between two quays. To contain the sediment to be poured into a still open sub-basin without interrupting the passage of the sediment barges, the use of a bubble curtain was proposed as a barrier to the diffusion of the turbidity [1; 2]. A working group of the University of Genoa, responsible for the monitoring of the dredging, and Royal Boskalis Westminster N.V., Port dredgers, has prepared and carried out an experiment closing the land-fill area with a double air bubble screen (ABS) and verify its efficiency with an artificial tracer, Rhodamine Water Tracing (RWT).

Methods: The experiment was made in different weather condition (Southward and Northward winds) and the instrumentation used during the experiment were: a) perforated HDPE pipes were used to create the ABS, weighted with chains, and placed on the bottom by a towing; b) a CTD probe, coupled with the turbidity and RWT sensors, was used for the hydrological data collection; sensors were calibrated in laboratory and *in situ*; c) a V-ADCP with bottom-track function, using a 316L stainless-steel bracket, was used to collect current velocity, direction and backscatter data; d) RWT ($C_{29}H_{29}N_2O_5ClNa_2$) in a 5% aqueous solution was used as a tracer in different concentrations.

Results: The ADCP was useful to identify the ABS and verify its influence on the water mass circulation. In particular thanks to the vertical velocity, is possible to highlight the vertical circulation induced by the ABS (Fig. 1). The circulation pattern of the current also induces high horizontal velocities before and after the screens. The directions of the circulation current are more difficult to observe, just as the normal current pattern in the whole basin.
The CTD casts was used to follow the diffusion of tracer and to verify the efficiency of the ABSs. In clear water, the RWT sensor returns a background value which acts as a lower limit. The background value is to be determined in a clear sample of Genoa port water. In turbid water, the probe responds to the presence of suspended solids. During the ABS field measurements, probe casts have been conducted in a wide range of turbidity values, both with and without the presence of actual RWT concentrations in the water. These data offer the opportunity to establish a relation between turbidity and the probe signal.

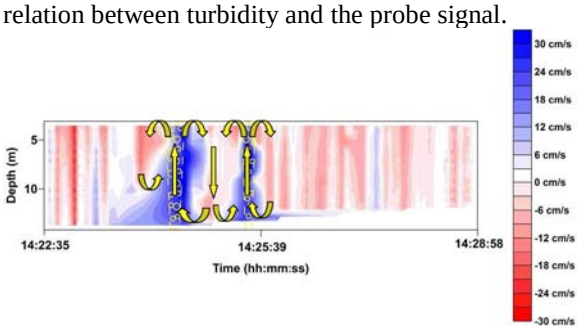

Fig. 1: Vertical velocity measured during the two air bubble screens activation.

Discussion: Despite difficulties encountered in following the tracer, the dynamics showed the functionality of the two bubble screen, especially for southern winds, maintaining the RWT confined within them. Strong winds from the north partially weakened the bubble screens (unusual situation).

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