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Geotextile containers in hydraulic applications

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Abstract. This paper will give an introduction in geotextile containers, covering typical sizes and the materials used. A case study of a typical application highlights the advantages of geotextile tubes, which are a subcategory of geotextile containers, and explains their installation in challenging conditions.

1 General introduction in geotextile containers

Geotextile containers consist of a geotextile shell that is filled with granular fill and then closed. As fill material sand is preferred. Depending on the size and type of the container system, filling is done mechanically using an excavator and funnel or hydraulically by dredging a sand water mixture. The container sizes vary from small size bags with a content of approx. 25 kg, to sandbags with a capacity of a couple of m^3, to geosynthetic tubes with a capacity of several hundred cubic metres. Bezuijen (2013) and Pianc (2011) give a precise definition of the different element boundaries. These can vary depending on the literature source and author.

A wide variety of geosynthetics can be used depending on the size and intended use. Usually, small-format sandbags are made from nonwovens and larger-format tubes from wovens or geocomposites. In comparison to conventional construction methods, the use of geosynthetic container solutions offers elementary advantages. On the one hand, the filter-stable encasement of the fill material (usually sand) prevents its erosion. On the other hand, the use of locally available filling material minimises transport effort, reduces the costs and the carbon footprint. As engineered and well-designed geotextiles are used, the materials are durable and not prone to degradation. Above it, the integration into the environment is usually much more aesthetical. Studies on the ecological potential of geotextiles have found a high acceptance of marine flora and fauna, both in the North Sea (BfG, 2009) and in the Mediterranean Sea (Mori, 2009). The geotextile surface is colonised quickly and sustainably, so that the geotextile structure beneath the "ecological" protective layer is no longer recognisable or distinguishable from a natural one.
Thanks to their flexibility, the scour protection of geotextile container structures can be built out the elements themselves. Geotextile bags and tubes allow not only the construction of a revetment but also the construction as well as the restoration of an entire revetment. Application examples can be found in (Wilke and Flügge 2017).

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2 Case Study: Coastal protection jetty in Tocopilla, Chile

To improve the quality of life for the population of the city Tocopilla in Chile, an artificial beach by installation of approximately 28.400 m³ of white sand has been created. The beach is protected by a jetty with a total length of 550 m. This jetty has been constructed by the use of geotextile tubes filled with local sand functioning as the core of the jetties. The tubes have been arranged in up to three level, installed in depths of up to 10 m.
The design did not only reduce the amount of rock required, which is hardly available in that region, but also the encapsulation of a large part of sand contaminated with coal and heavy metals (9.110 m³). The sand got polluted due to inadequate disposal at a nearby power station.

Figure 1 shows the general design for the jetties. The tubes are stacked up to three layers. Above the tubes, an intermediate stone layer has been arranged. Erosion resistant amour rock was used as final revetment.

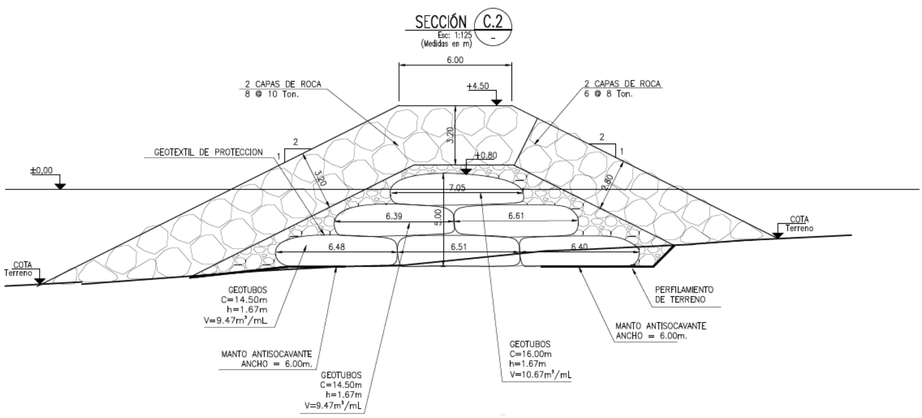

Figure 1: Cross section of the jetty

Due to the challenging conditions at the open Pacific Ocean, the tubes needed to be ballasted with a metal frame during initial filling. After removing the frame, the filling continues by the support of divers. During entire filling, a temporary cofferdam dissipated the wave load. All elements are shown in Figure 2.

Figure 2: left: Initial filling of a tube; right: tube filling with diver support

To fill the tubes, an excavator mounted slurry pump has been used. The final structure is shown in figure 3. Further details of that project can be taken from Müller et al. (2018).

Figure 3: Final structure (Müller et al., 2018)

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