



UNDERSTANDING SILTATION PROCESSES. CASE OF THE BELGIAN COASTAL MARINAS.

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To understand the transport processes of sediment particles in the coastal zone one has to study both the availability of sediments and the water movements which are the drivers of the sediment transport.

It is common to distinguish between sand particles ($D_{50} > 63$ micron) and mud particles ($D_{50} < 63$ micron). In the Belgian coastal zone the sediments are a mixture of sand and mud particles. Siltation in coastal marinas is predominantly caused by the settling of mud particles. Sand particles are available at the coast but they generally settle much faster compared to mud particles, resulting in sand sedimentation in access channels and harbour entrances before they can reach the marina sensu strictu (where the yachts are moored).

Both currents and waves are important drivers of sediment transport in the coastal zone. At the Belgian coast residual tides and prevailing winds result in a net water transport alongside the coastline (from SW to NE). From many years of research in the Belgian coastal zone, especially by the Management Unit of the North Sea Mathematical Models (MUMM), this net water movement is quantified rather accurately; a water particle takes on average about 4 weeks to cross the Belgian coastal waters (65 km in length, from SW to NE). Waves and (spring tide) currents mobilise the mud particles in the water column. From remote sensing observations (satellite, airborne) as well as in situ profile measurements the concentration of mud in suspension is measured to be on average about 50 mg/l for the Belgian coastal waters. Multiplying the average mud concentration with the net water transport one can estimate the natural transport of mud advected with the water flow to be about 15 M TDS (Million Ton Dry Solids) per year along the coastline of Belgium (in a broad zone from the coastline to 25 km out of the coastline, from SW to NE). It can be concluded that natural conditions cause plenty of mud to be continuously available at the entrance of the Belgian coastal harbours.

Inside harbours and marinas waves and currents are very small compared to the conditions at the open coast. This causes mud in the inflowing water to settle once it has entered the sheltered area. The mud concentration of the outflowing water is less than that of the inflowing water because part of the settling mud has reached the bottom and is attached to the already existing muddy layer on the bottom. The amount of siltation in a marina can be understood as the volume of water exchanged through the entrance (mainly determined by the tidal prism) multiplied with the mud concentration difference between inflowing and outflowing water.

Numerical tools (software packages) are available to model the processes of currents, waves and mud transport and siltation for a given marina or harbour. However, for several processes more research is needed and ongoing, e.g. regarding mud floc dynamics (mud particles bonding or breaking in the water column which has important consequences for its settling velocity). Because of these limitations of numerical modelling to date it is to be advised to complement any siltation study with in situ measurements, especially the monitoring of sediment concentrations and settling velocities in the water column at various locations and depths.