The interaction between microplastics and suspended particulate matter

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Introduction: There is a large amount of plastics with particle sizes smaller than 1 mm (microplastics (MP's)) present in rivers flowing into the sea. In ports suspended particulate matter (SPM) carried by the river tends to settle, including the finer (<64 µm) fraction. The focus of this study was to study if the presence of MP's impacts the settling properties of SPM.

Methods: To study the impact of MP's on the SPM flocculation and settling, column tests were carried out for 48 hours on sediment from the port of Rotterdam. One of the more inland docking ports, the Maashaven (river sediments) was chosen. The Maashaven has a relative high (>70%) fraction with a grain size <64 µm. Two types of MP's were added (with a size of 10-20 µm and with a size of 63-75 µm). Since we could not exclude the presence of MP's in relative recent (last 5-10 years) sediment, older (estimated sedimentation age 10-20 years) sediment was also collected. All tests were done on both the recent and old sediment.

Results: Adding MP's to the sediment impacts the settling rate. Figure 1 gives an impression by looking at the amount of MP's that floated at the top of the settling column after 48 hours. The impact of MP's on settling was most pronounces in the old sediment.

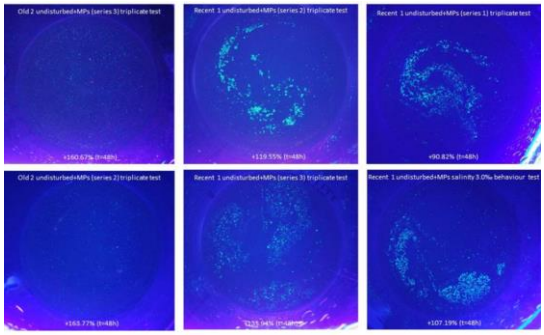

Figure 1 An overview of the floating MPs after the settling tests (48 hours), old versus recent sediments

The addition of MP's had a minimal influenced on the particle size distribution of the old sediment. For recent sediments there was an increase around ~100 µm at the expense of the fraction smaller than 10 µm (Figure 2).

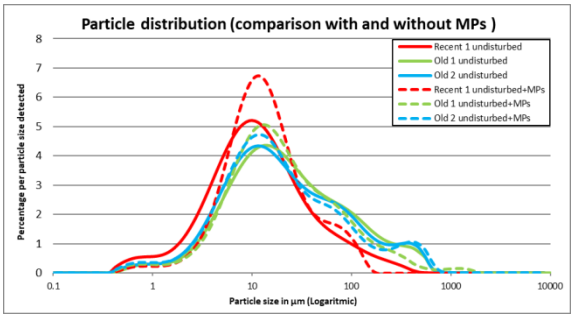

Figure 2 Impact of MP's on the particle size distribution of the settled sediment

Discussion: MP's seem to enhance the settling rate of SPM, causing an increase in the sediment volumes to be dredged for harbors. Using the enhanced settling rate for SPM in a numerical model shows an increase in the settling volume in the main navigation channel, and a minimal impact on the sediment volume in the docking ports (Figure 3). Based on the observed trend in the dredged volumes in the port over the past years it can be concluded that this model result is incorrect. Most likely there is a balance between the MP concentration, the SPM load, the flow velocity and the bottom shear stress. This balance needs to be researched in more detail.

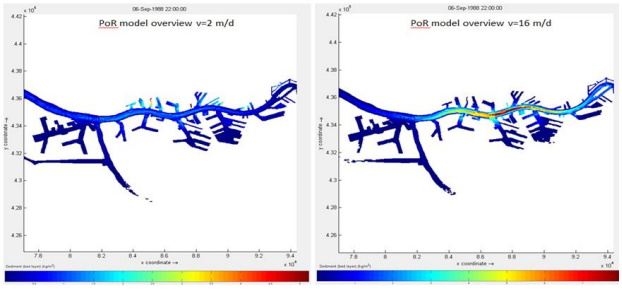

Figure 3 Translation of the impact of MP's on SMP settling in Port of Rotterdam, left without and right with MP's

References: Michiel J.W. Blok (2018), The interaction between microplastics and suspended particulate matter, Method development and analysis to quatify the effects of microplastics on the sedimentation process in the Port of Rotterdam, Hogeschool Rotterdam.