Franziska Lorz (Technische Universität Dresden)

Settling or Spreading? How Industrial Contaminants Affect Settling Dynamics

Large-scale infrastructure projects, such as tunnel construction in Norway, generate vast quantities of fine-grained rock material. Due to local constraints, the produced sediments sometimes require marine disposal. When discharged into sensitive marine environments like fjords, this cohesive sediment (≤ 63 µm) exhibits complex flocculation and settling dynamics.

Despite extensive research on clay suspensions, little is known about the flocculation and settling behaviour of blasted rock fines from tunnel excavation, particularly in the presence of construction-related contaminants. To address this, this study experimentally investigates how natural factors and industrial contaminants, specifically cement, influence these processes and the resulting settling rates.

Two experimental approaches were employed: (1) empirical settling tests using transmitted light intensity through small flasks to quantify how fast the sediment settles under various conditions, and (2) controlled shear experiments, where suspensions were exposed to turbulent conditions, combined with high-resolution imaging to analyse the shape and size of individual flocs.

The results demonstrate that increasing salinity significantly accelerates sedimentation - an effect further enhanced by the addition of cement. Floc characterisation revealed that in fresh water, flocs remain small, compact, and rounded. In contrast, saltwater conditions promote the formation of larger, irregular flocs.

Overall, the findings align with electrochemical theories of particle interaction, complemented by chemical processes such as cement hydration. The rapid deposition observed suggests that large sediment volumes entering fjord systems could quickly accumulate on the seabed, potentially impacting local ecological conditions. While the laboratory experiments reveal clear trends, further studies are required to assess their transferability to different geological settings and additional contaminants such as hydraulic oil. Therefore, an automated image analysis needs to be employed to investigate the process more efficiently.