

Mud: Large scale sediment transport processes from a very small scale physics perspective

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Nowadays, we are observing some new trends regarding the optimization of **loose** mud (fluid mud) management:

- Evolution on time of the coastal morphology.
- Navigability through fluid mud in ports is becoming a top priority.
- Soft soil is starting to be used for land reclamation projects.
- The cost effectivity of deep sea mining is under new evaluation. The mining industry needs to manage and re-use its mining waste product, after a productive and effective dewatering of soft soil waste product.

As a consequence, a better understanding of loose mud behaviour is required. Within the consolidation context, understanding the small scale physics is one of the possible approaches to tackle this issue.

The aim of this work is to link the flocculation, settling and consolidation of cohesive sediments through the colloidal and rheological properties of clays. Flocs are formed by the aggregation of clays and polymers depending on the environmental conditions like presence of ions, contaminants, pH, etc (Manning et al. 2011, Lee et al. 2012, Mietta, 2010). Due to electrostatic interactions (Coulomb, van der Waals ...) bridging between polymer and particles occurs. The use of cationic and anionic polymers allows understanding the role of surface charge in the binding to the clay (Ibanez, 2018). The bridging of polymers to clay particles is evaluated through the study of the interfacial properties of the clay-polymer system by zeta potential measurements. The zeta potential is a good indicator for predicting the changes (particle size, density and floc strength) of clayey materials as a function of the fluid properties (salinity, pH, shear stresses...) (Chassagne et al. 2009; Hunter, 2013). These changes can in turn be related to changes in settling and consolidation behaviour.

When a cationic polymer is used a very fast settling occurs resulting on a very open structure with almost no stresses bed. In contrast, when an anionic polymer is added, a slower settling yields larger stresses in the bed and a more packed bed. The samples have the same particle size distribution and concentration but different environmental conditions (in this case polymer with different charge). Therefore, the differences in settling and consolidation phases are due to the different polymer present in the system.

References

- Chassagne et al. (2009) Electrokinetic study of kaolinite suspensions, *J. Coll. Int. Sci.* 336, 352-359
- Hunter, R. J. (2013). *Zeta potential in colloid science: principles and applications*. Academic press.
- Ibanez, M. (2018). *Flocculation and consolidation of cohesive sediments under the influence of coagulant and flocculant*. TU Delft, Delft University of Technology.
- Lee, B. J., Schlautman, M. A., Toorman, E., and Fettweis, M. (2012). Competition between kaolinite flocculation and stabilization in divalent cation solutions dosed with anionic polyacrylamides. *Water research*, 46(17):5696-5706.
- Manning, A., Spearman, J., Baugh, J., Whitehouse, R., and Soulsby, R. (2011). *Cohesive sediment flocculation and the application to settling ux modelling*. INTECH Open Access Publisher.
- Mietta, F. (2010). *Evolution of the floc size distribution of cohesive sediments*. TU Delft, Delft University of Technology.

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