

## Master's Thesis 2023:

### *Possible Topics in Urban Water Management*

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## **Alginate-Like Exopolymers (ALE) recovery from aerobic granular sludge and its application to phosphorus removal**

### **Background**

The wastewater treatment plant of the future will represent a net source of energy and valuable products, e.g., high-value polymers. Aerobic Granular Sludge (AGS) technology represents on the other hand a major advancement over conventional activated sludge systems, as AGS systems can be operated at very high biomass concentrations while associated with excellent settling properties and effluent quality. AGS also contains a wide range of exopolymers, such as Alginate-Like Exopolymers, associated with various relevant properties for industrial applications (coagulation, production of concrete, paper coating, etc.). **In the future, we expect that a relevant route of valorisation of the excess sludge from AGS systems will consist in recovering Alginate-Like Exopolymers (ALE) for their utilisation in industry.**

ALE are composed of various biopolymers (e.g., polysaccharides, proteins, humic substances) associated with gelling properties (Schambeck et al., 2020). Recent insights also indicate that ALE hydrogels can serve as adsorbent for phosphorus and potassium from wastewater, thus representing a relevant opportunity for application in agriculture (Schambeck et al., 2021). However, understanding the mechanisms and adsorption capacities of ALE-hydrogels isolated from AGS requires more detailed investigations. The overall objective of the proposed master thesis is therefore **to develop further our fundamental understanding of the mechanisms of phosphate/potassium recovery from municipal wastewater by ALE hydrogels.**

### **Objectives**

- To develop a methodology to produce ALE-hydrogels with a large surface/volume ration in order to increase adsorption rate.
- To quantify the maximum adsorption capacities over different adsorption tests.
- To test the adsorption of phosphate and potassium using ALE-hydrogels from real AGS and using supernatant from anaerobic digesters.
- To identify to what extent heavy metals also accumulate in ALE-hydrogels (during ALE extraction or during adsorption tests).

ALE will be isolated from AGS from both laboratory- and full-scale plants and compared to commercial alginate. Adsorption tests will be performed under different conditions using synthetic WW or real digester supernatant.

**Requirements**

Interests in advanced technologies for biological wastewater treatment  
Interests in microbial processes applied to wastewater treatment

**Advisors**

*Main supervisor:* Hab. Dr. Nicolas Derlon (Eawag)

*Co-supervisor:* Dr. Cassio Moraes Schambeck (Eawag)

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**References**

Schambeck, C. M., R. H. R. da Costa and N. Derlon (2021). Phosphate removal from municipal wastewater by alginate-like exopolymers hydrogels recovered from aerobic granular sludge. *Bioresource Technology*. 333(

Schambeck, C. M., E. Girbal-Neuhauser, L. Böni, P. Fischer, Y. Bessière, E. Paul, R. H. R. da Costa and N. Derlon (2020). Chemical and physical properties of alginate-like exopolymers of aerobic granules and flocs produced from different wastewaters. *Bioresource Technology*. 312(123632).