



Energy efficient treatment schemes for water reuse -Drinking water augmentation-



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Background / Motivation

Population growth, demographic changes (urbanization), climate change, lack of conventional freshwater supplies, and more frequent and severe drought conditions are stressing the availability of conventional freshwater resources. Water reuse is one option to close local water cycles and relieve the local water resources. In semi-arid and arid regions, including European regions with water scarcity the utilization of municipality wastewater for water reuse purposes is well established. A significant disadvantage of the used treatment schemes currently in water reuse is the high energy demand ($\sim 1.2 \text{ kWh/m}^3$) and generating objectionable waste streams. Given that the theoretical energy content of municipal wastewater is approximately 2.5 kWh/m^3 , opportunities exist to integrate energy recovery strategies in alternative treatment trains (Horstmeyer et al. 2017).

Objective / Methods

The aim of this research is to develop potable water reuse schemes that are energy-neutral while offering opportunities to recover both carbon and nutrient. Alternative treatment scenarios are developed and analyzed in laboratory- and pilot scale (Figure 1).



Fig. 1: Ultrafiltration test-skid for municipal wastewater treatment.

Results

Due to an integrated energy recovery by improved pretreatment and physical separation of organic matter (results in higher biogas yield) the overall energy footprint is decreased. Additionally, an integrated energy recovery is realized by the intended production of nitrous oxide from concentrated nitrogen process water streams. The nitrogen removal from the wastewater is coupled via the aerobic-anoxic nitrous decomposition operation (CANDO) with the production of nitrous oxide as an additional energy source. Critical treatment steps of the overall alternative treatment train (Figure 2) regarding potential operational issues are identified.

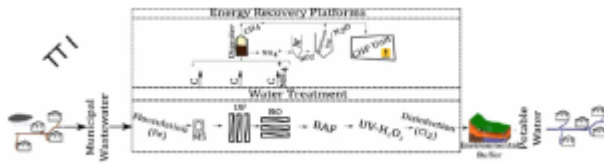


Fig. 2: Conceptual scheme of an alternative potable water reuse treatment train (adapted from Horstmeyer et al. 2017).

Membrane processes play a major role within the alternative treatment scenarios. In particular fouling and scaling effects are analyzed and fouling mitigation strategies were developed and analyzed. By usage of modeling software we analyzed the hydrodynamic and solute transport effects within the membrane cell-holders/modules (Figure 3).

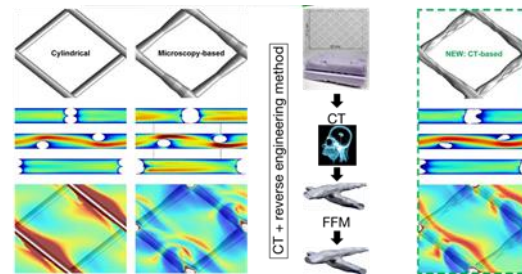


Fig. 3: Evolution of feed spacer geometry.

Outlook

Additional research will focus on granular activated carbon, hydrodynamic improvements of the membrane modules by usage of new developed feed spacers and cleaning effects by vibration of the membranes are considered.

References

Horstmeyer, N., Weissbach, M., Koch, K., Drewes, J.E. (2017), A novel concept to integrate energy recovery into potable water reuse treatment schemes. *Journal of Water Reuse and Desalination*, in press. DOI: 10.2166/wrd.2017.051.