RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Wastewater Pretreatment for Potable Reuse

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Challenge

A typical advanced treatment process, following municipal wastewater treatment, includes ultrafiltration (UF) or microfiltration (MF) followed by reverse osmosis (RO), and finally ultraviolet (UV) light irradiation with or without oxidants. Our goals are to develop a universal pretreatment protocol for wastewater that reduces the cost and complexity of RO system operations. We propose that the cost of water can be significantly reduced, and the effectiveness of wastewater pretreatment improved, with the opportunity to use strong oxidants throughout the pretreatment and RO processes. This can only be accomplished by using chemically resistant RO membranes that withstand exposure to strong oxidants without degradation. The project will culminate in testing real-world wastewater supplied by Orange County Water District, CA (OCWD), and with a techno-economic analysis by Trussell Technologies to evaluate the cost impact of the proposed new technology.

Research Approach

The goal of this project is to understand how the use of a strong, more effective oxidant through the entire advanced wastewater treatment train could decrease biological and organic fouling to reduce cost and simplify the whole process. The new, patented RO membranes under continuous development are highly ionic, and as such, are expected to reject different types of contaminants. The project will include testing real-world wastewater supplied by OCWD, and with a techno-economic analysis by Trussell Technologies to predict the cost impact of the proposed new technology.

RESEARCH PARTNERS

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Impact

Application of strong oxidants to degrade organic foulants and remove their residuals in rapid cleaning operations, and to prevent biofouling in wastewater pretreatment have not been investigated because the current polyamide thin-film composites are not durable against strong oxidants. The project will culminate with a techno-economic analysis of wastewater treatment trains using stronger oxidants enabled by more chemically durable RO membranes, and controlled pH and ionic strength to leverage Donnan exclusion enabled by ionic membranes. This may lead to less system maintenance with higher production methods to improve decentralized treatment cost metrics. Lower energy results in lower carbon emissions. System reliability, availability, and adaptability will be more resilient to changing inputs, diverse organic contaminants, and temperature.

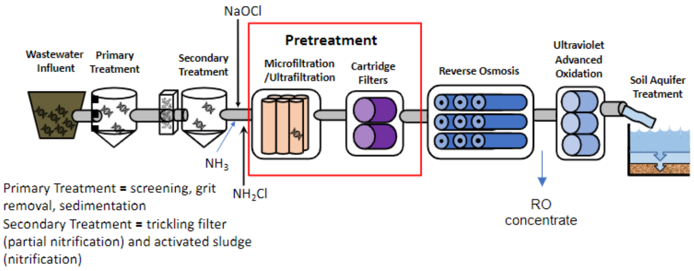

Figure 1. Example of an advanced wastewater treatment train. Wastewater influent is biologically degraded and treated to remove large particles; Hypochlorite is added to convert any remaining ammonia to weak oxidative chloramines (ammonia is added, if needed); what is termed PRETREATMENT appears in the red box but we are considering the advanced oxidation and removal of contaminants as a whole; reverse osmosis to remove salt ions and other small molecules; then ultraviolet radiation in the presence of an oxidant is used to remove residual organic contaminants, as well as providing another barrier against bacteria and viruses for added safety. The figure depicts indirect potable reuse where the treated wastewater effluent is returned to a primary water source for augmenting the supply.

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