PACl Coagulation-Ceramic Filtration as an Advanced Water Treatment Process for Virus Removal

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INTRODUCTION

Direct Potable Reuse (DPR) - a Growing Reality for Arid Lands
- Tucson, Arizona: historically a groundwater-reliant city (population ~955k and growing)
- Sonoran Desert climate
- Increased demands on limited water supplies available

Study Site: Water & Energy Sustainable Technology (WEST) Center
- Located in Tucson, AZ USA
- Partnership between Pima County, The University of Arizona, and Industry Members
- Aims: promote development/demonstration of new technologies, provide local to global outreach and educational/research opportunities in water & energy sustainability

Study Purpose
- Determine the efficacy of PACl coagulation-ceramic microfiltration as an advanced treatment process for virus removal via collaborative research
- Assess log10 reduction data for process credits → potential DPR application and implementation in Arizona

METHODS

Figure 1. Diagram of research collaborators also in attendance at IWA 2018.

Continuous Flow Experiments: Pepper Mild Mottle Virus (PMMoV)
- Purpose: determine log10 removal values of PMMoV (infectious & non-viable) from 3° Effluent Feed
- Test Organism
- PMMoV: a potential indicator for non-enveloped, human enteric viruses
- Isolated from wastewater-associated matrices1,2
- Isoelectric point (pI) = 3.7 - 3.8

Figure 2. Experimental Set-Up at the WEST Center

Table 1. Removal of PMMoV from 3° Effluent using high-basicty PACI (PAX-1L19) at 50 mg/L

<table>
<thead>
<tr>
<th>Equivalent Volume Assayed per 2L Feed Sample (L)</th>
<th>PMMoV Detected in 3° Feed (gc/L)</th>
<th>PMMoV Detected in Tertiary Effluent</th>
<th>Log10 Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>~10 mL</td>
<td>&lt;3.83E+00 to &lt;3.83E+00</td>
<td>~1.05E+00 to ~1.05E+00</td>
<td>3.83E+00 to 3.83E+00</td>
</tr>
<tr>
<td>~100 mL</td>
<td>&lt;3.83E+00 to &lt;3.83E+00</td>
<td>~1.05E+00 to ~1.05E+00</td>
<td>3.83E+00 to 3.83E+00</td>
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</tr>
</tbody>
</table>

CONCLUSIONS

- Coagulation-microfiltration is a promising advanced water treatment technology for consistent virus removal from 3° Effluent wastewater that may be employed for DPR purposes in the near future.
- High-basicty PACI (PAX-1L19) is more expensive than other AdvTech, but higher capital costs impacts greater removal efficacy as demonstrated by log10 reduction data.
- More research is needed to determine sources of variability for PMMoV in 3° Effluent, including inherent seasonality effects and sample processing/concentration methods to enhance equivalent volumes.

References:

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