Sustainable Nanotechnology Conference 2015

Fate of Fullerenes (C_{60}) during Peracetic Acid (PAA) Post Disinfection of Treated Alum Enhanced Combined Sewer Overflow (CSO) Primary Treatment

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UNIVERSITY OF ALBERTA

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Outline

1. Introduction
2. Project Objectives
3. Selection of Unit Processes
4. Results and Discussion
5. Work Currently in Progress

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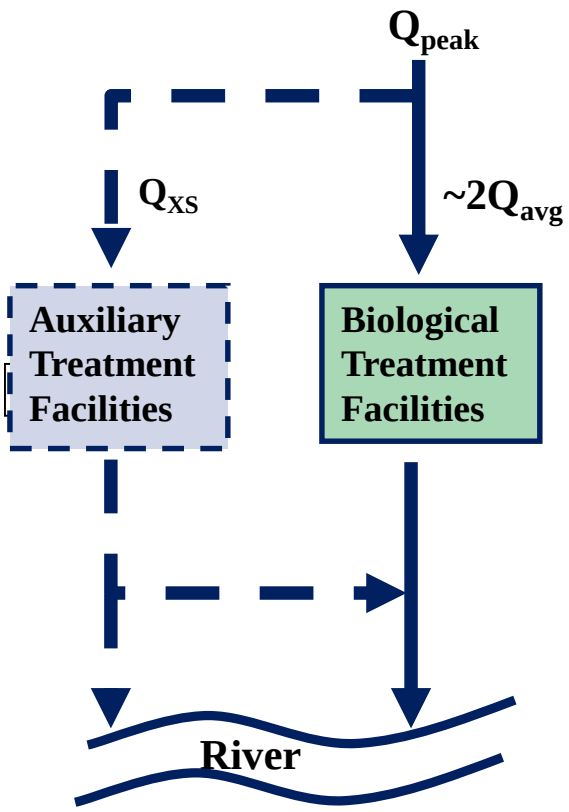
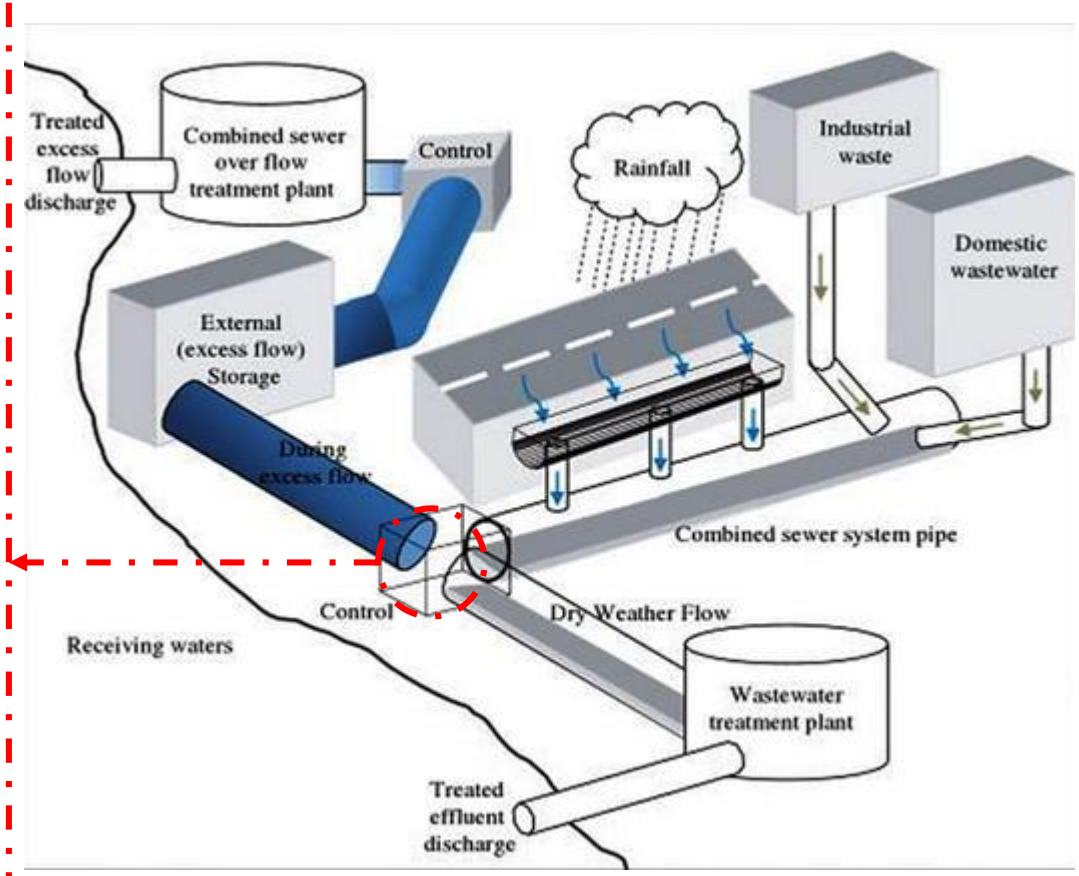
Combined Sewer Overflow System

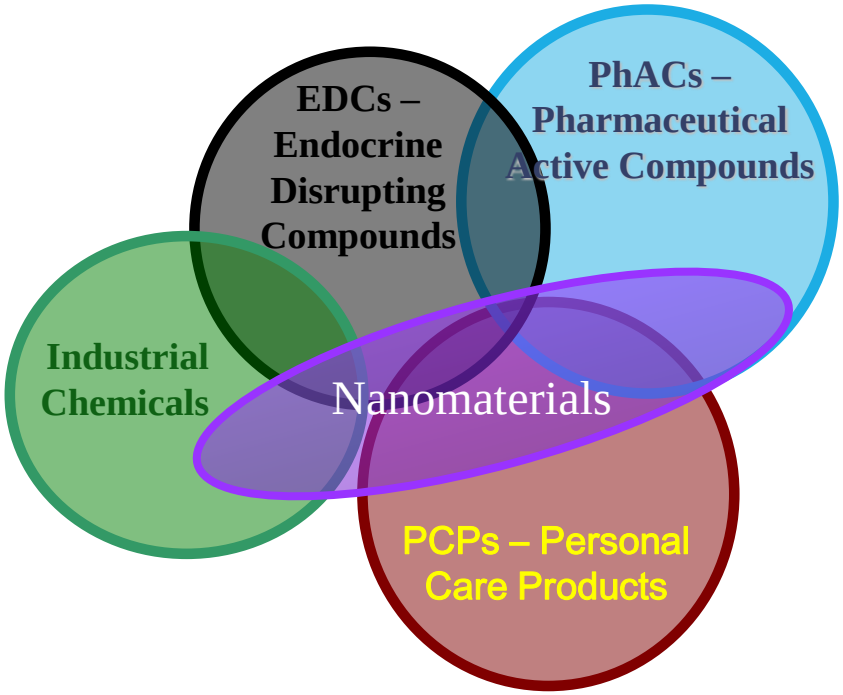




Hung, Y.-T.; Abdul Aziz, H.; Ramli, M. H. (2012)

Emerging Contaminants "small IS DIFFERENT"

"existing regulatory approaches and risk management strategies are appropriate for the challenges presented by nanomaterials," however, it recommended that more investment be made in strategic risk assessment research.



Council of Canadian Academies
Conseil des académies canadiennes

Council of Canadian Academics, 2008, "Small is Different: A Science Perspective on the Regulatory Challenges of the Nanoscale"

Toxicity of Fullerenes C_{60}

- **Solvation Method**

(Solvent Exchange, Ultra-Sonication, Long Stirring)

- **Surface Modification**

(Adsorption of other Materials)

- **Functionalization or Derivatization**

(Fullerol, Oxo-deravatives)

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Selection of Unit Processes

Enhanced Primary Treatment (Settling + Disinfection)

- **Coagulation/Flocculation/Sedimentation:**

Destabilization of colloidal impurities- Transferring small particles in to large aggregates – Adsorption of dissolved organic materials into the aggregates- Removal of aggregates by sedimentation

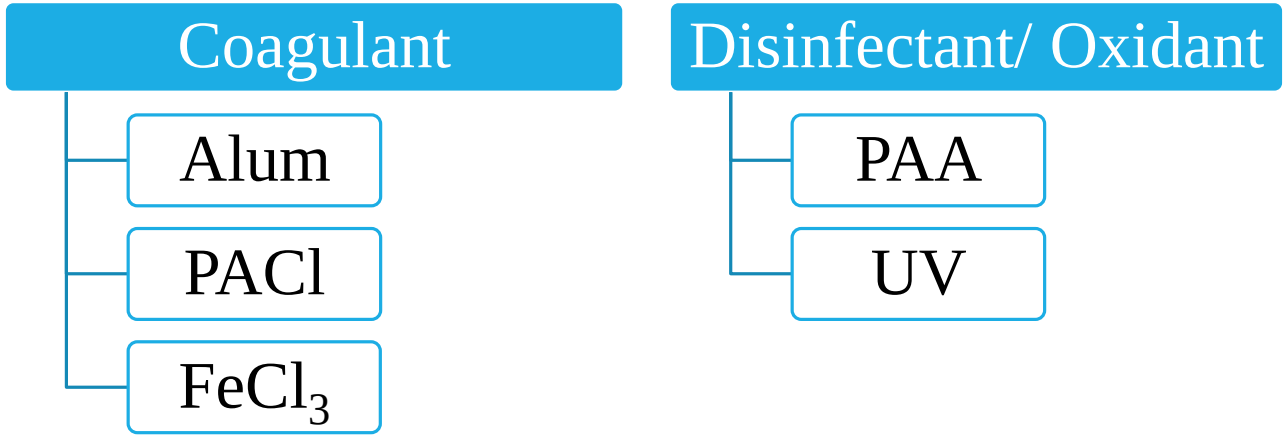
- **Disinfection:**

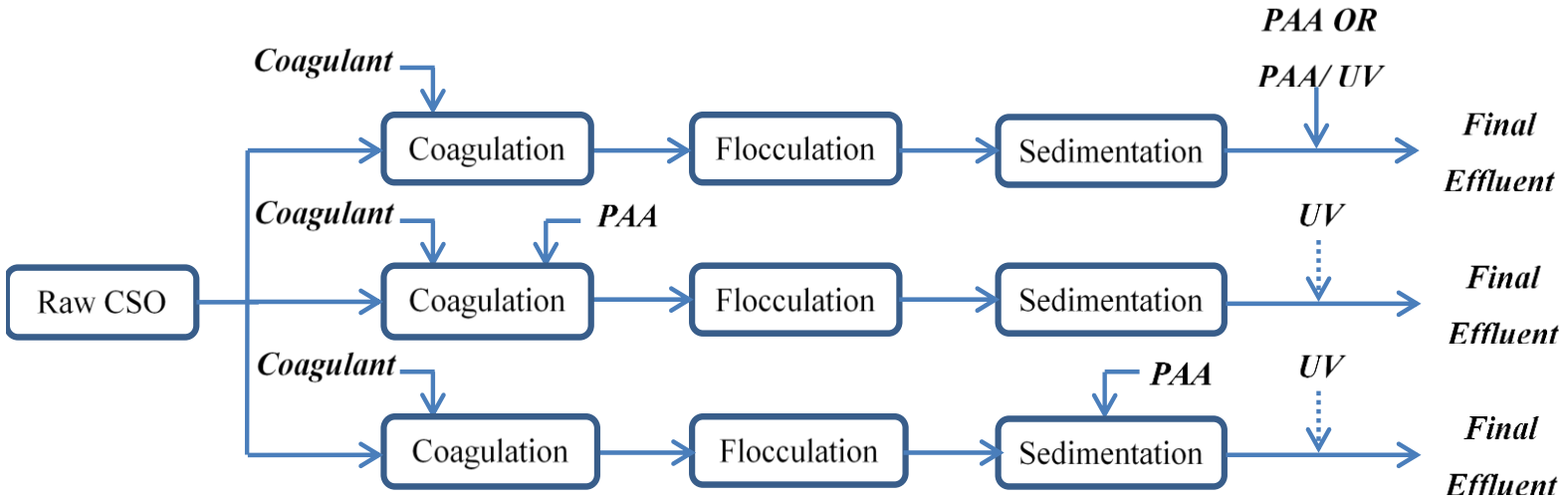
Kill/ Inactivate harmful organisms (bacteria and viruses) and control/ remove the odour precursors

Hypothesis

Combinations of oxidants and coagulants will transform and mineralize the target pollutants and result in the reduction or elimination of their toxicity.

PAA Study


Coagulant
Alum
PACl
$FeCl_3$
Disinfectant/ Oxidant
PAA
UV


PAA OR
PAA/ UV
Coagulant
Coagulation
Flocculation
Sedimentation
Final
Effluent
Coagulant
PAA
UV
Raw CSO
Coagulation
Flocculation
Sedimentation
Final
Effluent
Coagulant
PAA
UV
Coagulation
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Sedimentation
Final
Effluent

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Overall Objectives

- Enhancement of primary sedimentation process for the treatment of CSOs
- Assessment of the environmental impacts and mitigation measures of some NMs of emerging concern

Short-Term Objectives

- Selection of the optimum operating conditions of the most effective chemicals and processes for CSO treatment
- Investigation of the role of using dual disinfection system
- Understanding the fundamentals of the selected processes in handling NPs
- Assessment of the effects selected coagulants and oxidants on the transformation of selected NPs.
- Investigation of the removal efficiency of the regulated parameters such as chemical oxygen demand (COD), nitrogen, phosphorus, *E. coli*, etc. with the increase of NMs.
- Toxicity reduction

Long-Term Objectives

- Scientific foundation for the sustainable and integrated management of CSO
- Assisting decision-makers to adopt sustainable development strategies based on the simulation of actual conditions and the predictions of the impact of NPs on the environment
- Protection of environment and human health

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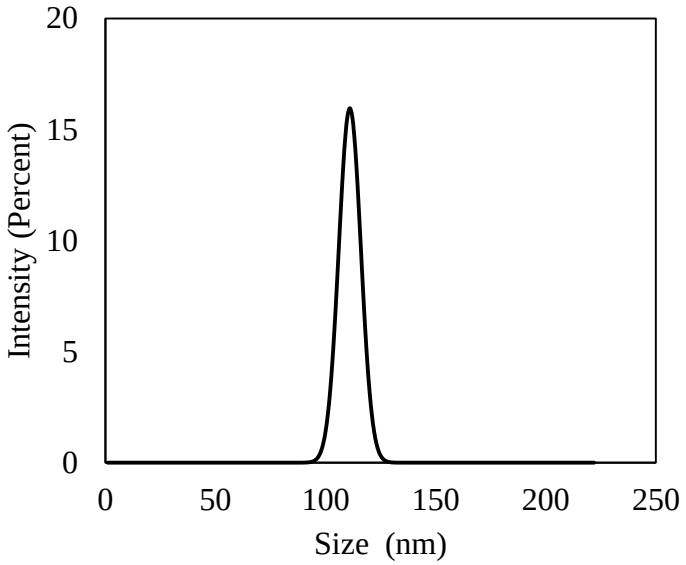
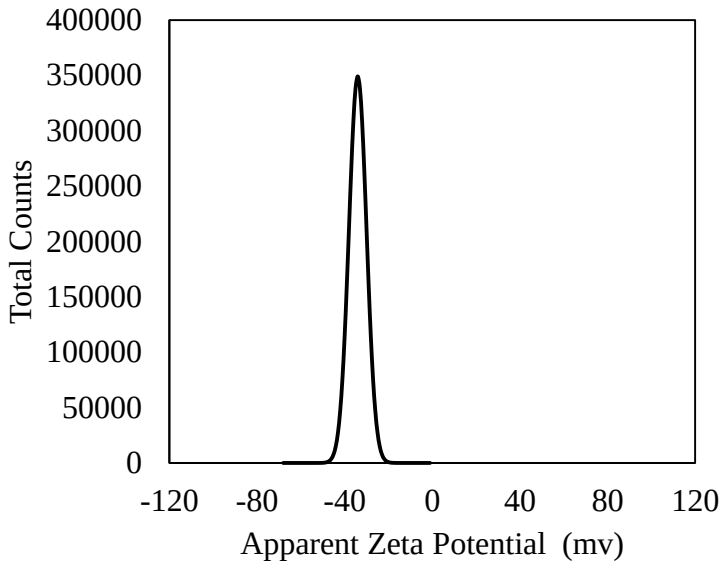
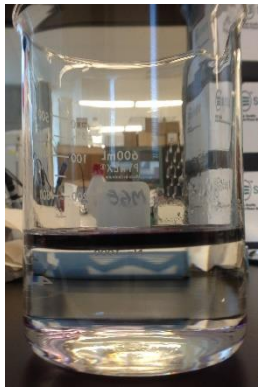
Sub Project#1: Fate of fullerenes (C_{60}) during peracetic acid (PAA) post disinfection of treated alum-enhanced combined sewer overflow (CSO) primary treatment

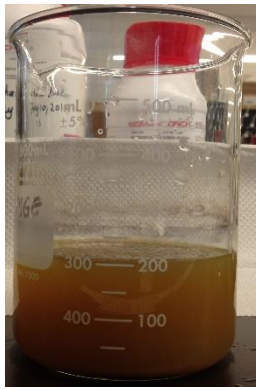
Preparation of nC60

- **Solvent Exchange (Toluene)**



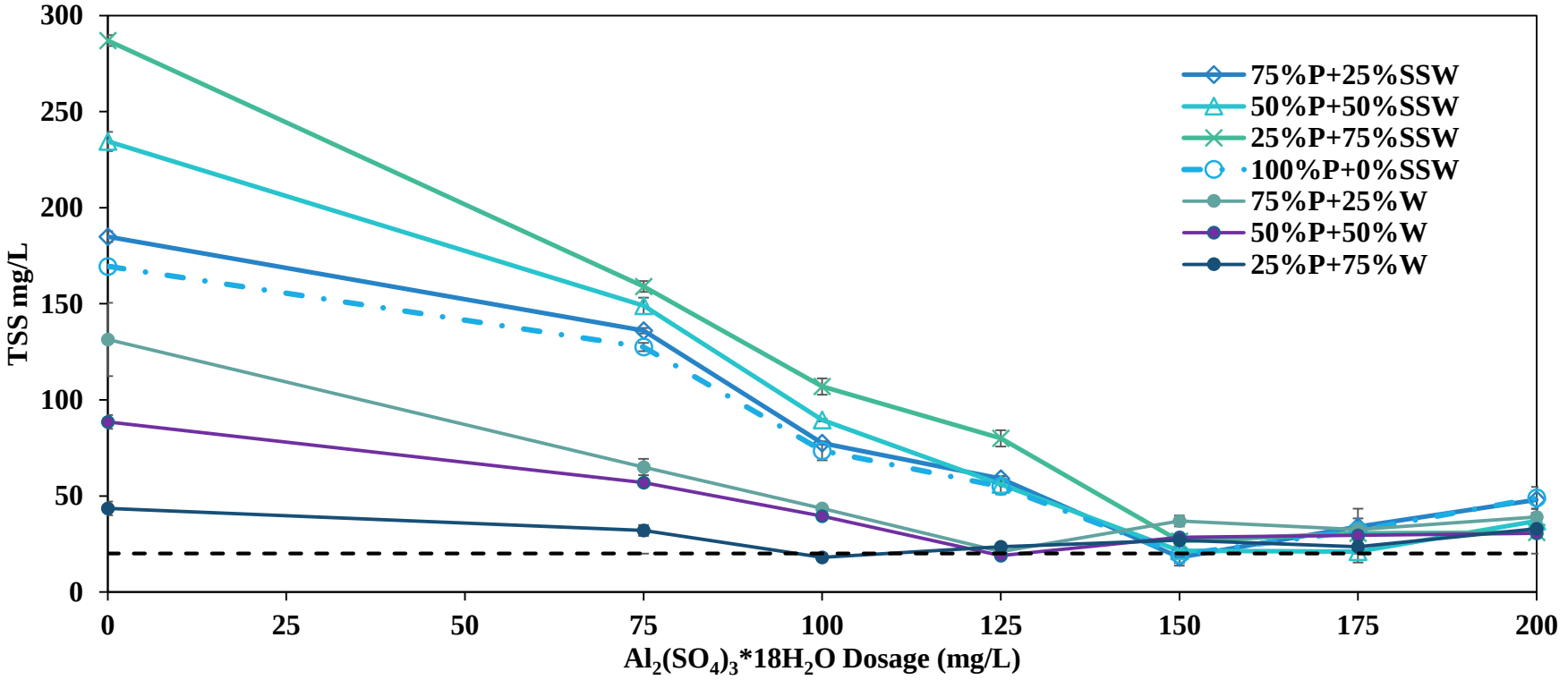






CFS- Flushes Role

Sample Type	25%P+ 75%W	50%P+ 50%W	75%P+ 25%W	100%P	75%P+ 25%SSW	50%P+ 50%SSW	25%P+ 75%SSW
Avg. TSS (mg/L)	62	127	189.5	251.5	310.5	424	534



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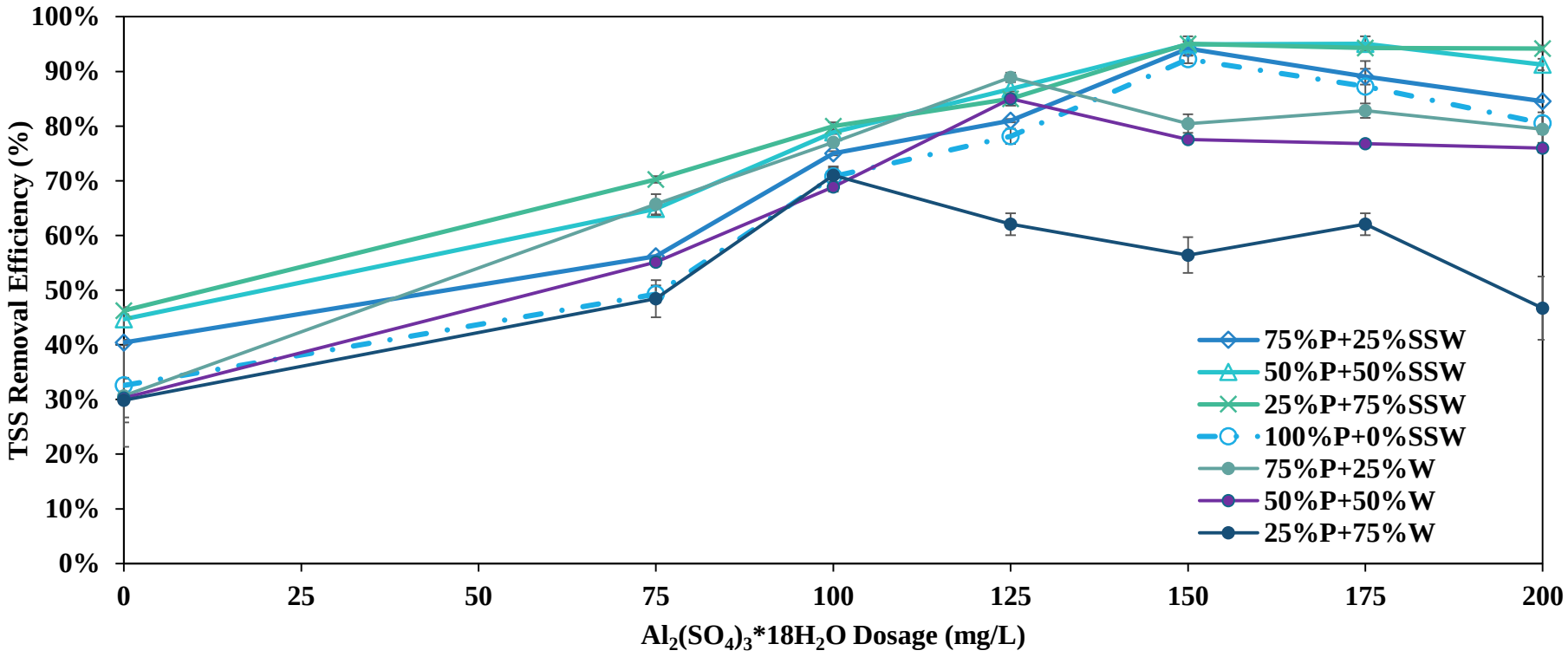
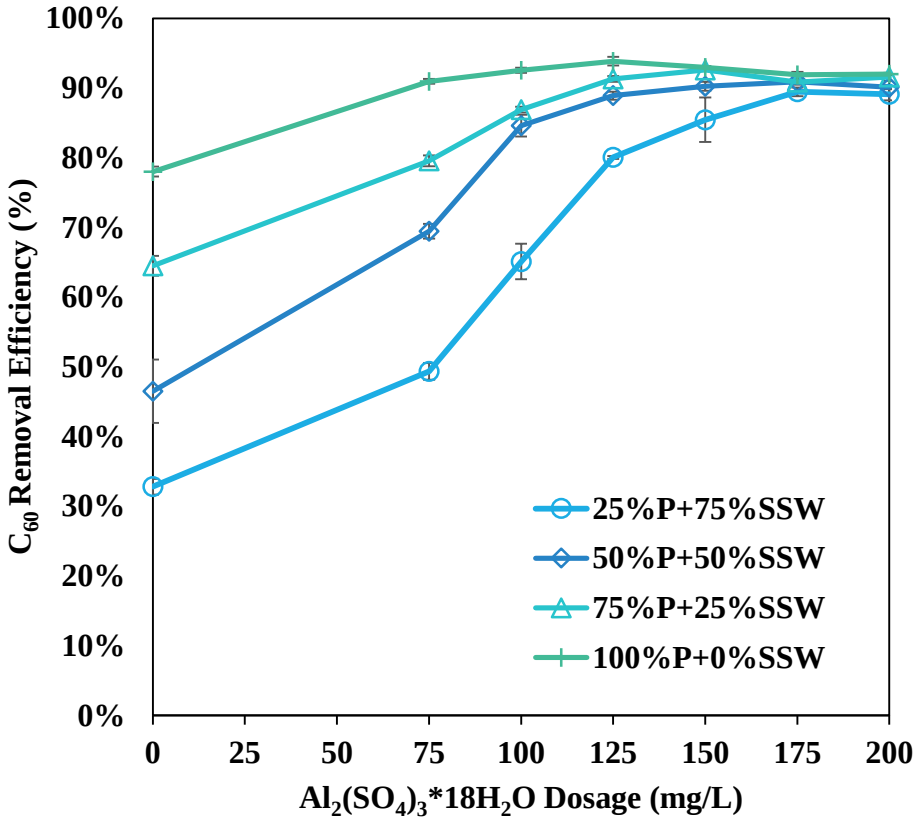
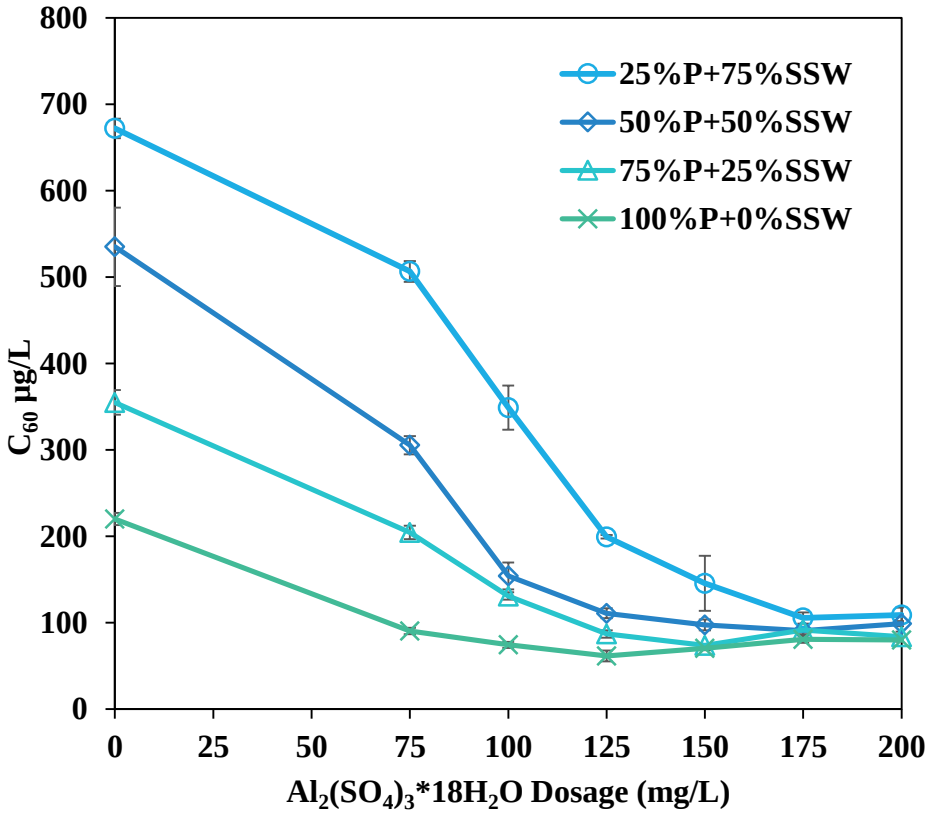


CFS- Flushes Role

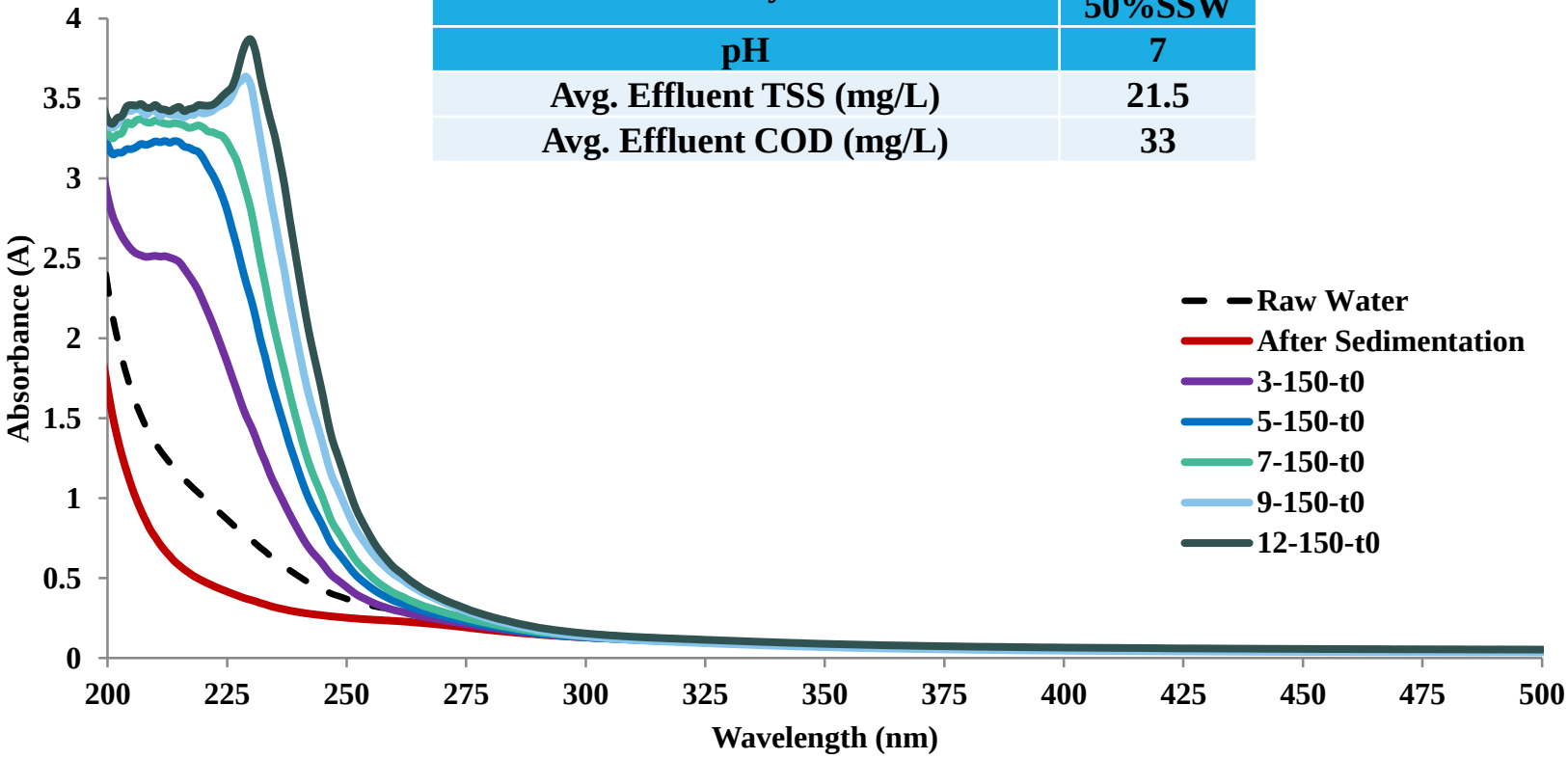
Spiked C_{60} in the Influent	1 mg/L





PAA Post Disinfection

% of Primary Influent	50%P+ 50%SSW
pH	7
Avg. Effluent TSS (mg/L)	21.5
Avg. Effluent COD (mg/L)	33



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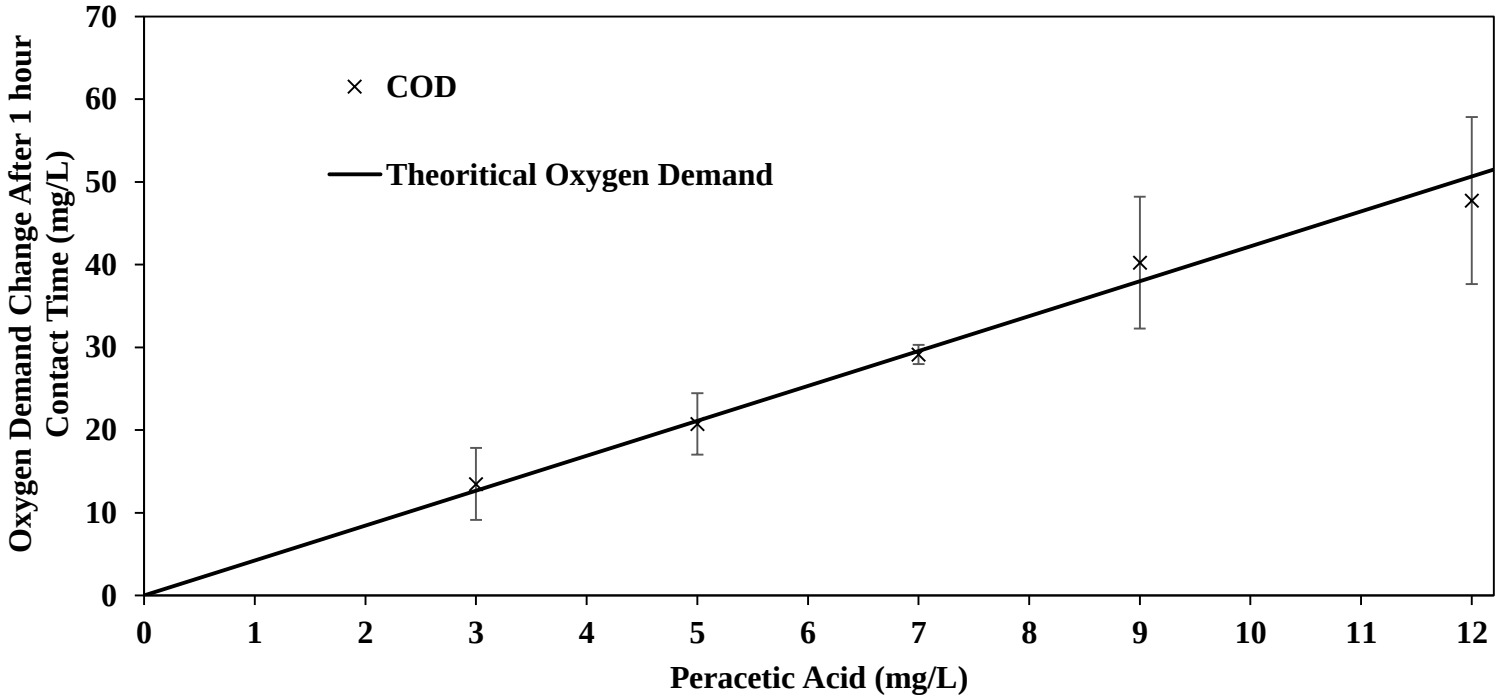
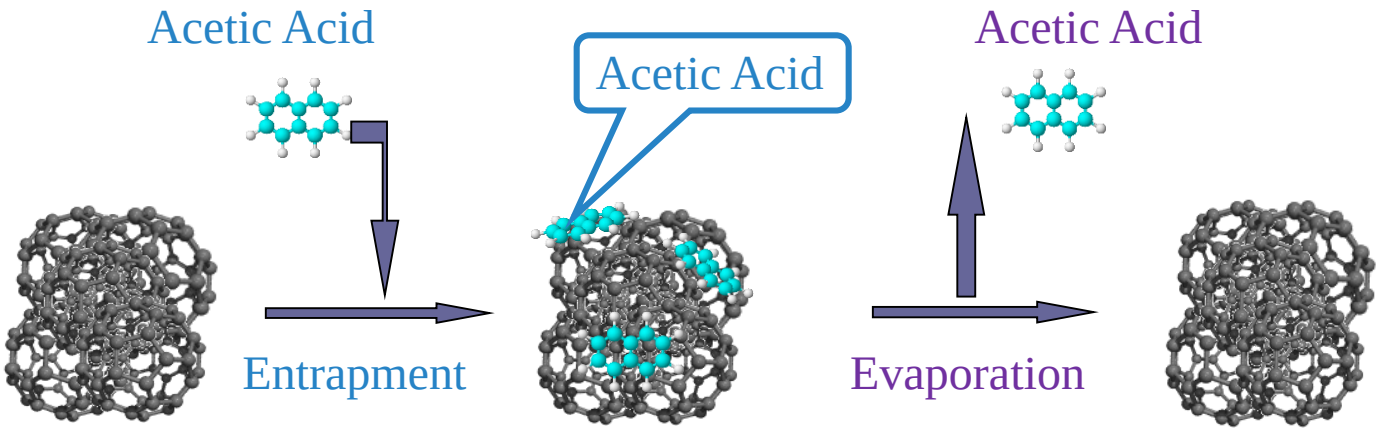
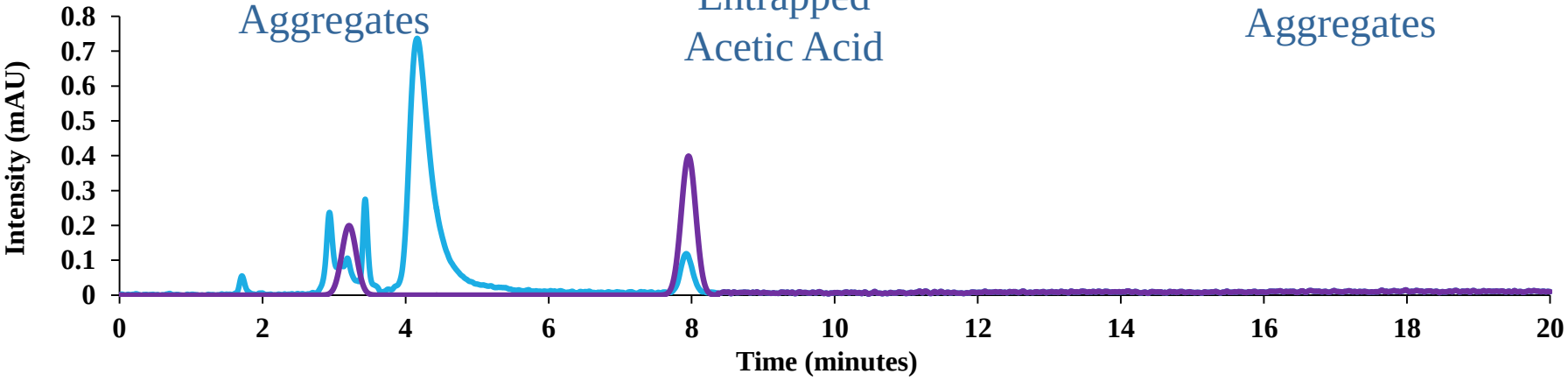


PAA Post Disinfection





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Work Currently in Progress (May 2015)

1. Simultaneous Removal of *E.coli* and C_{60}
2. Repeat Experiments at 5^{o} Celsius
3. Kinetics
4. Toxicity Studies


THANK YOU
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Q & A time
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