THE EFFECT OF OIL SANDS PROCESS WATER INORGANIC MATRIX ON THE PHOTODEGRADATION OF ORGANIC CONTAMINANTS

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BACKGROUND

- Oil sands process water (OSPW) contains complex inorganic and organic constituents of environmental concern.
- Research has been done to study the photodegradation of OSPW organic contaminants. The OSPW inorganic matrix (IM) comprises a variety of metal cations and anions, which may affect the photodegradation of organic contaminants.
- The effect of OSPW inorganic matrix on the photodegradation of its organic contaminants has not been reported.

AIMS AND OBJECTIVES

- Explore methods to separate OSPW inorganic and organic fractions.
- Investigate the effect of OSPW inorganic matrix on the photodegradation of model naphthenic acids (NAas): Cyclohexanecarboxylic acid (CHA), 1-Adamantanecarboxylic acid (ACA) and real OSPW organic fractions.

RESULTS

OSPW inorganic solution characteristics

After activated carbon (AC) adsorption, the total organic carbon (TOC) of OSPW was removed by 96.9%, while the change of other parameters such us pH, alkalinity and ions concentrations was insignificant. Hence, the solution obtained by AC adsorption was qualified as the OSPW inorganic fraction.

Effect of OSPW inorganic matrix on NA photodegradation

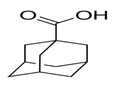
Table 1 lists the structure of the two model compounds.

Figure 1 shows the photodegradation of CHA and ACA in buffer and OSPW inorganic solutions. In buffer solution, neither CHA nor ACA was degraded after UV exposure, while with the presence of OSPW IM, both CHA and ACA degradations were accelerated.

The high degradation of model NAs with the presence of OSPW IM presumably attributes to two factors:

- Higher UV radiation absorbance of OSPW IM contributed to the production of reactive radical intermediates and advanced oxidation process (Figure 2 shows higher UV radiation absorbance of OSPW IM).
- The formation of photoactive metals-NAs complex with the presence of OSPW IM.

Table 1. Structure of model compounds.

Naphthenic acids	Molecular formula	Structure formula	Molecular weight
Cyclohexanecarboxylic acid	$C_7H_{12}O_2$		128.17
1-Adamantanecarboxylic acid	$C_{11}H_{16}O_2$		180.24

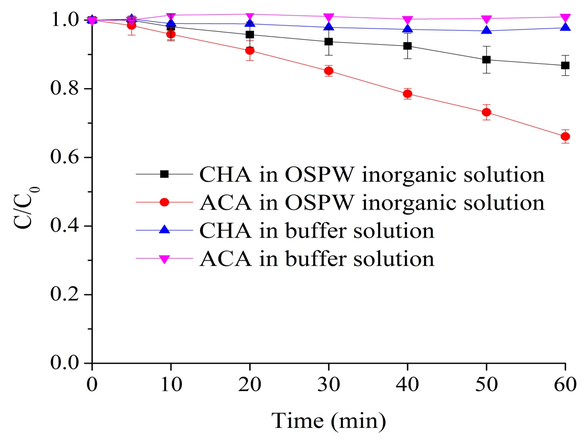


Figure 1. CHA and ACA degradation in buffer and OSPW inorganic solution.

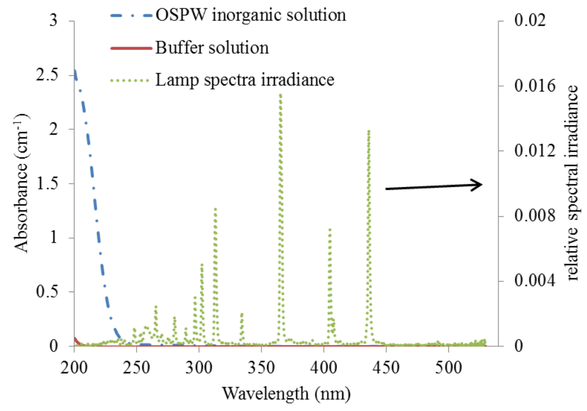


Figure 2. Absorbance of buffer and OSPW inorganic solution and relative spectral irradiance of the UV lamp.

FUTURE DIRECTIONS

- Identify which ions play the main effect on promoting the photodegradation of model NAs and the mechanisms.
- Investigate the effect of OSPW IM on the photodegradation of real OSPW organic fractions.
- Study the application of economical *in-situ* solar driven OSPW treatment process.

PARTNERS

FES PROJECT OVERVIEW

Resilient Reclaimed Land and Water Systems: Environmental issues associated with energy development, management and supply must be addressed for all energy systems. Regardless of the type, source or transport mode of energy, land and water will be affected. Hence, land and water will be integral components of all future, current and legacy energy systems, addressing land and water use, management, conservation and reclamation. After disturbance from energy focused activities, land and water require reclamation to resilient systems that support desired end land uses. Reclamation success can be achieved if metrics to determine trajectories and final outcomes are robust and science based, with good communication among stakeholders and practitioners. Our theme projects address a systemic approach to energy production and delivery and cross theme benefits.

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