RYERSON UNIVERSITY

Experimental Study of Polyvinyl Alcohol Degradation in Aqueous Solution by UV/ H_2O_2 Process

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Outline

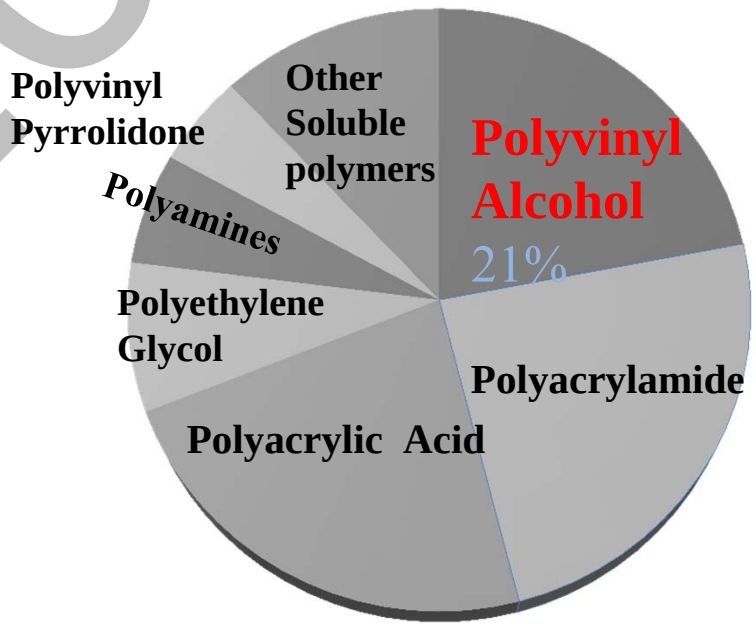
- Introduction
- Objectives
- Experimental Setup
- Results and Discussion
- Concluding Remarks

Introduction

Water Soluble Polymers: PVA, PAA, PEG, PAM,….

Synthetic polymers that can dissolve, disperse or swell in water.

- Large scale production
- Wide spectrum of applications
- Considerable amounts of PVA-containing wastewater: production, use, and disposal
- Released into the aqueous environment



World Consumption of Water-Soluble Polymers

Advanced Oxidation Process (AOPs)

Powerful technologies to transform organic contaminants into water and carbon dioxide

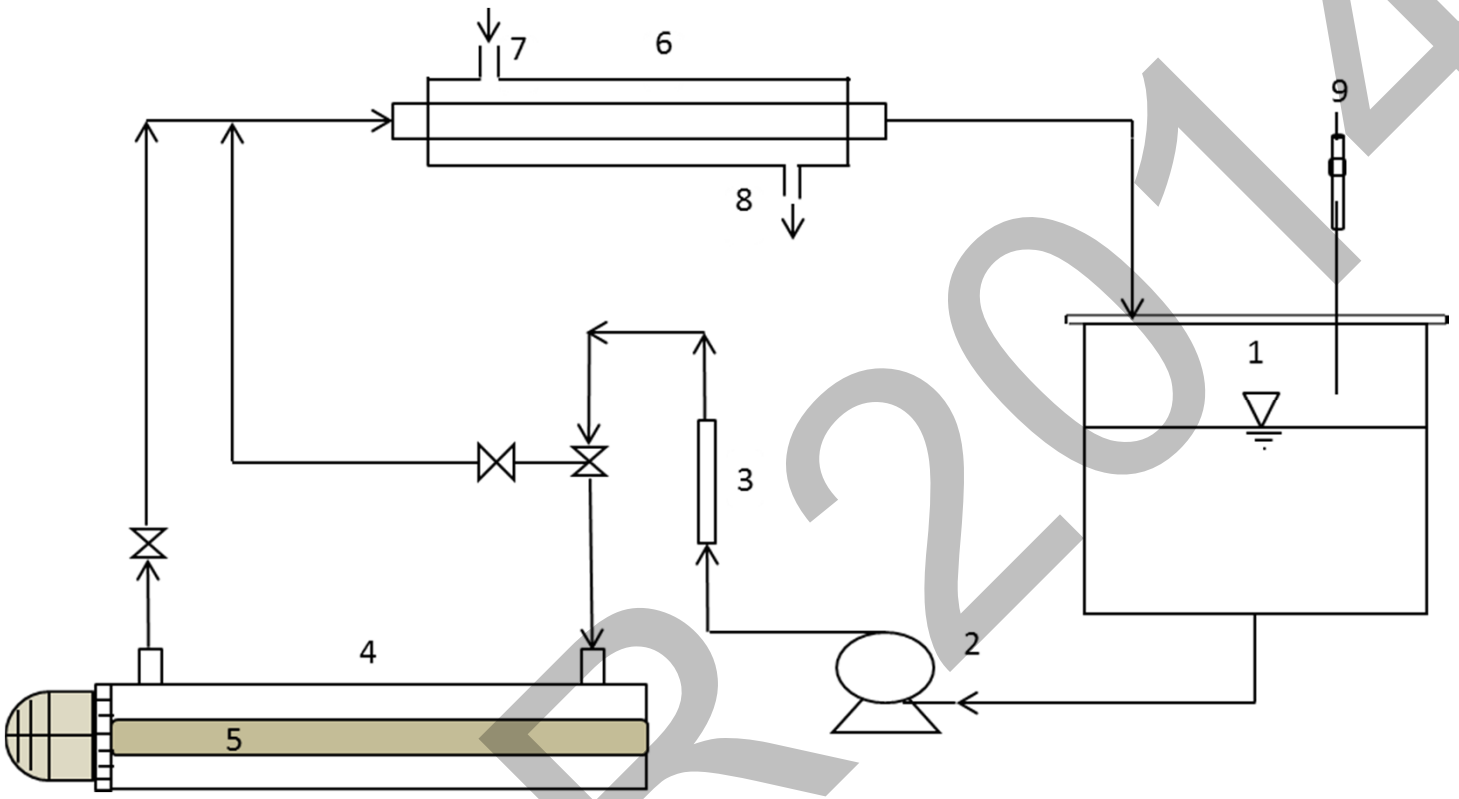
- Formation of hydroxyl radicals (strong oxidants)
- Reaction of these radicals with polymers soluble in water

Objectives

- *PVA degradation by batch and fed-batch advanced oxidation (UV/ H_2O_2) process*

- *Investigate the effects of H_2O_2 feeding strategy on polymer degradation rate*

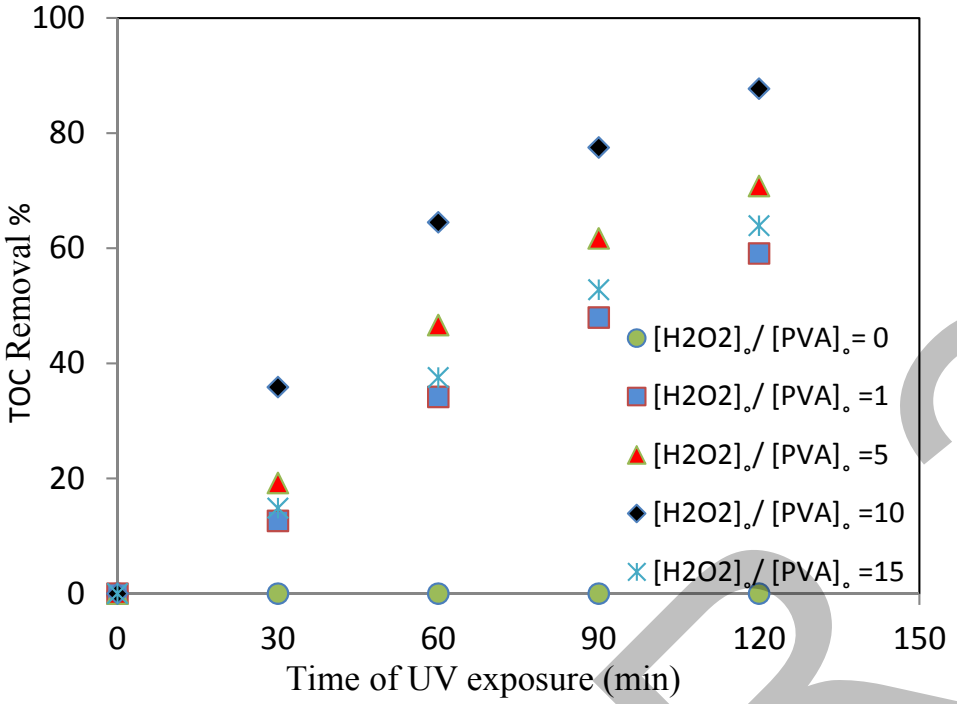
Experimental Photoreactor Setup



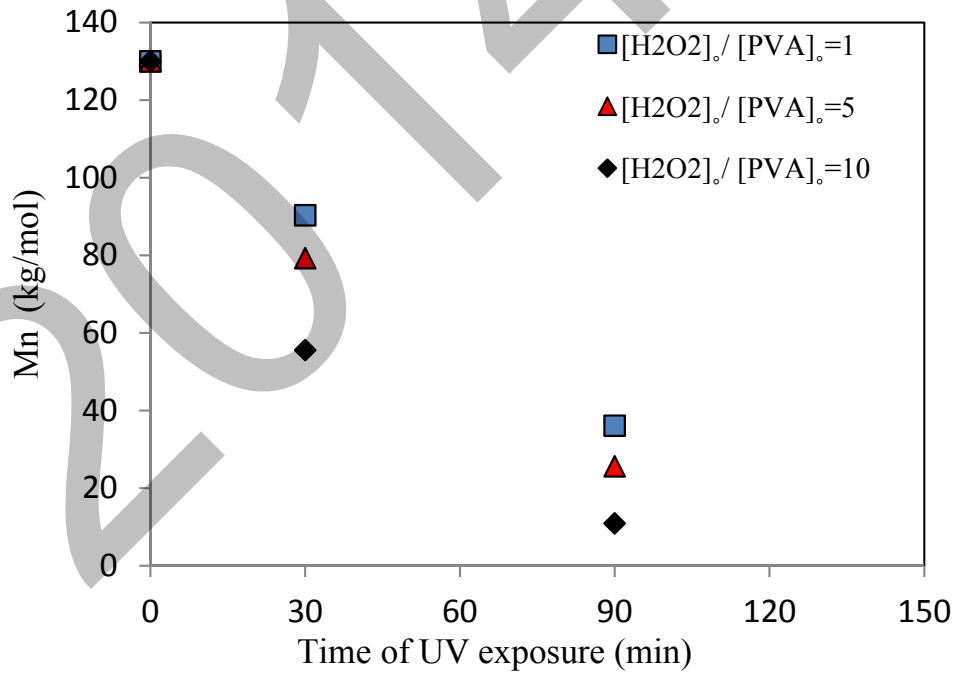
Schematic diagram of the laboratory scale batch and fed-batch system

1. Reservoir and collection tank, 2. Centrifugal pump, 3. Flow meter, 4. Annular photoreactor, 5. UV-C lamp, 6. Heat exchanger, 7.Cooling water inlet, 8. Cooling water outlet, 9. Syringe for H_2O_2 injection

Results and Discussion

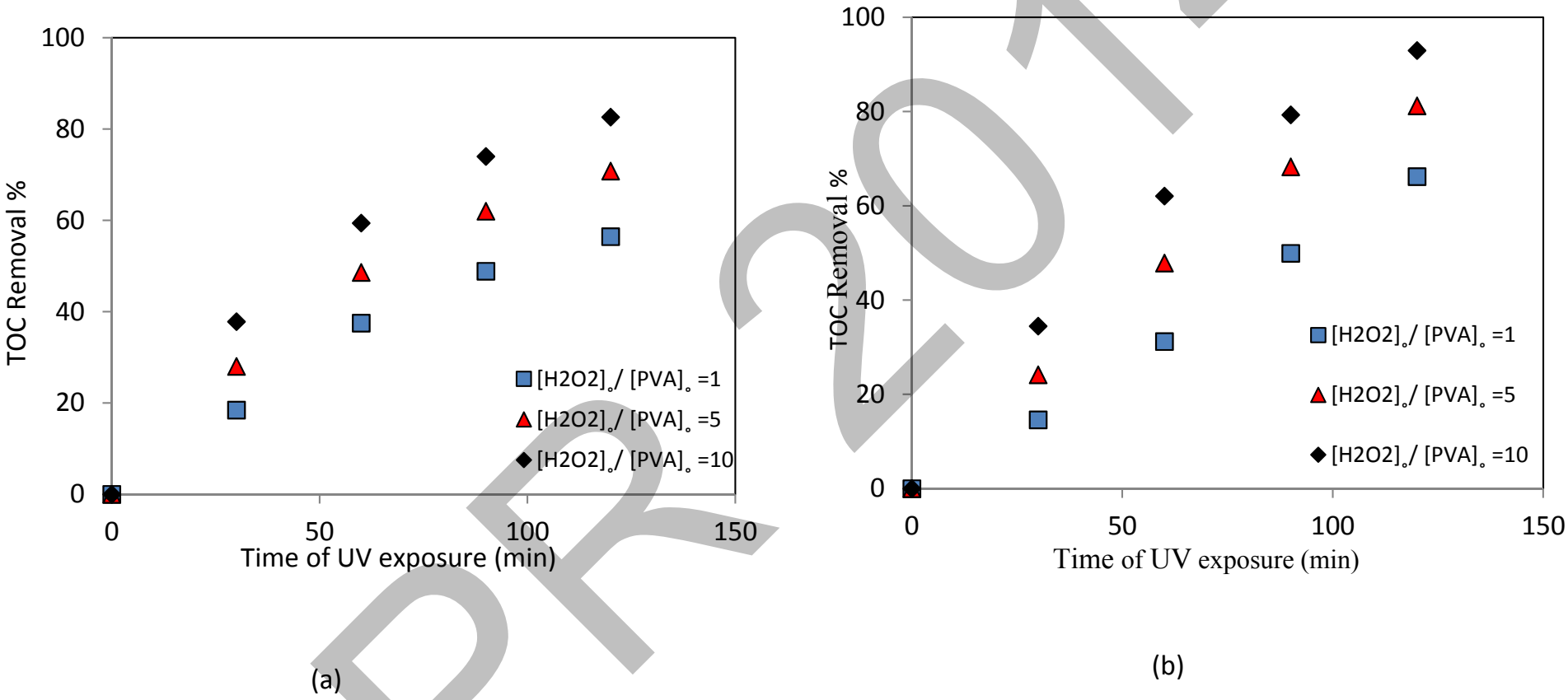


The effect of H_2O_2 dosage on the TOC removal during fed-batch UV/H_2O_2 process, $[PVA]_o$= **500** mg/L, $[H_2O_2]_o$/ $[PVA]_o$ mass ratio of 0,1,5,10, 15, H_2O_2 dripped into the system in stepwise manner



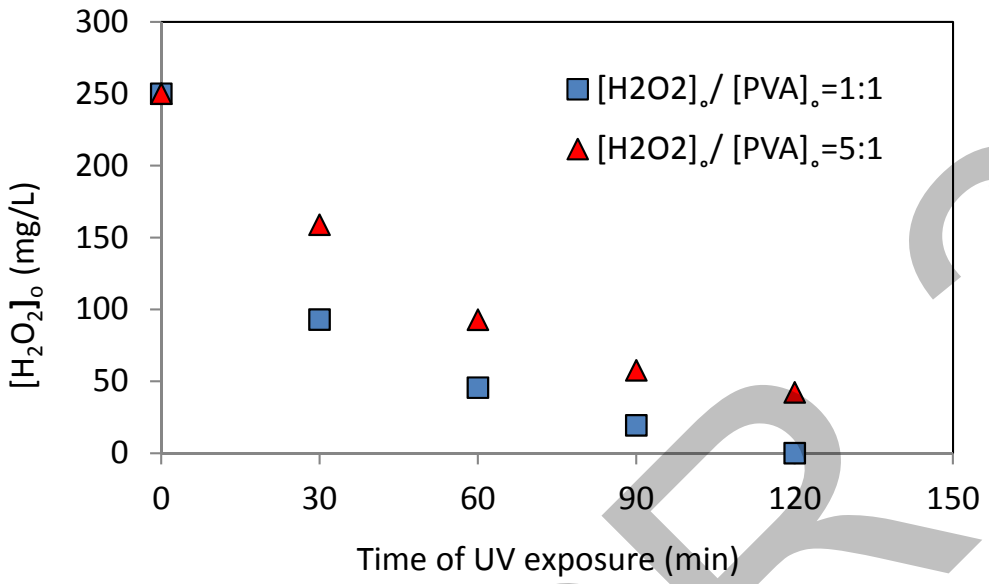
Molecular weight variation during fed-batch UV/H_2O_2 process, $[PVA]_o$= **500** mg/L, $[H_2O_2]_o$/ $[PVA]_o$ mass ratio of 1,5,10, H_2O_2 dripped into the system in stepwise manner

Results and Discussion

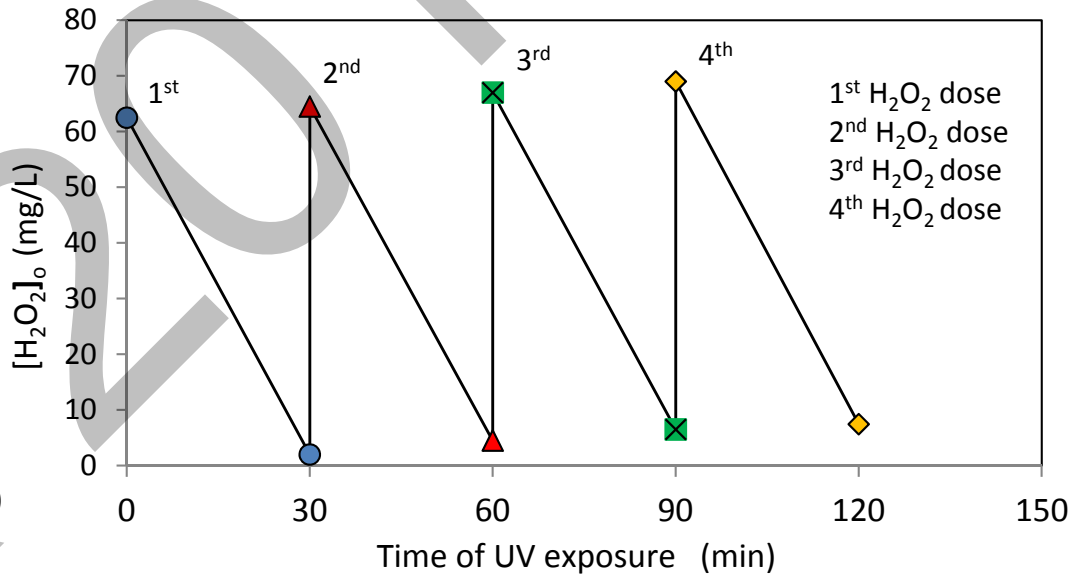


The effect of H_2O_2 feeding strategy on the TOC removal during batch and fed-batch UV/H_2O_2 process, $[PVA]_o$= **50** mg/L, $[H_2O_2]_o$/ $[PVA]_o$ mass ratio of 1,5,10.
(a) one shot of H_2O_2 poured at the beginning of the experiment
(b) H_2O_2 dripped into the system in stepwise manner

Results and Discussion



a)



b)

H_2O_2 variation during batch and fed-batch UV/H_2O_2 process, $[PVA]_o$= **50** mg/L, $[H_2O_2]_o$/ $[PVA]_o$ mass ratio of 1,5.
(a) one shot of H_2O_2 poured at the beginning of the experiment
(b) H_2O_2 dripped into the system in stepwise manner

Concluding Remarks

- It is technically feasible to degrade PVA in aqueous solution by UV /H_2O_2 process.
- For aqueous solution of 500mg/L PVA (Mn=130,000 g/mol), H_2O_2/PVA mass ratio of 10, 87 % TOC removal was achieved. Accordingly, 91% decrease in the number average molecular weight.
- H_2O_2 feeding strategy has a great effect on polymer degradation and TOC removal.
- 92% TOC removal of 50mg/L PVA solution for dripping H_2O_2 compared to 83% TOC removal for dumping one single shot.

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Thank You.