An effective and efficient treatment of the wastewater in the large commercial scale is becoming a challenging issue of the present. This status is due partially to the low efficiency of most of the practiced technologies in removing contaminants produced by human and industrial wastes. Therefore, the demand for an effective and efficient water treatment technology is of dire need to society. For example, the existing technologies are found to be insufficient as far as the treatment of a rapidly growing number of newer contaminants of pharmaceuticals, dyes, leachates, and several other industrial chemicals. In addition, a renewable and inexpensive method of energy production along with the contaminant degradation will be much beneficially optimized technology.

**Project Objectives**

1. To develop a general technique to synthesize an effective and novel photocatalyst:
   - Photocatalyst 1 for contaminant degradation under various experimental conditions
   - Photocatalyst 2 for hydrogen production (renewable energy)
   - Photocatalyst 3 for dual purpose

2. Evaluation of overall efficiency of photocatalysts 1, 2, and 3 synthesized for above specified purposes

**Methodology**

- Preparation of TiO$_2$/Pt film on glass slide for continuous degradation
  - Clean Glass Slides with Ethanol
  - Spray TiO$_2$/Pt solution on Glass Slide
  - Air-Dry for 15 Minutes
  - Oven calcination @ 500°C

- GC/MS measurement of the amount of H$_2$ produced
  - Flowchart of GC/MS measurement includes:
    - Injector
    - Gas Chromatograph
    - Mass Spectrometer

**Results and Discussion**

- General Kinetics of photocatalytic degradation (radiation field effect)
  - The degradation of a pollutant on the catalyst surface is described by Pseudo-first-order kinetics as given by Langmuir-Hinshelwood scheme:
    \[ R_A(C_A, T) = -\frac{dC_A}{dt} = \frac{k_{ad}k_CT_A}{1 + k_{ad}C_A} \]
  - Langmuir-Hinshelwood scheme is modified under the effect of radiation field. Therefore, the photocatalytic degradation of pollutant in water on the surface of TiO$_2$ film under the radiation field is:
    \[ R_A(C_A, T, \varphi) = -\frac{dC_A}{dt} = \frac{k_{ad}k_CT_A}{1 + k_{ad}C_A} \]
  - Pollutants are present in very low concentration in waste water (C$_A$<<1)
  - This differential equation can be solved for C$_A$ by integrating it
    \[ \int dC_A = -k_{ad}k_CT_A \int dt \Rightarrow \ln C_A = -k_{ad}k_T\varphi t + c \]
  - Applying initial condition: @ t = 0, C$_A$ = C$_{A0}$ implies C = C$_{A0}$
    \[ \ln C_A = -k_{app}\varphi t \Rightarrow \ln C_A = -k_{app}(1-e^{-\varphi t}) t \]
    \[ C_A = C_{A0} e^{-k_{app}(1-e^{-\varphi t}) t} \]

**Conclusions and Future Work**

- Suspension based photocatalytic degradation in a batch process versus coating-based continuous process can be compared.
- Coating-based continuous process for waste water treatment can be suggested for large scale commercialization.

**References**


**Acknowledgements**

I would like to thank Department of Chemical Engineering for giving me this space to learn. I would also thank my colleague Ms. Sabrina Hurlock for helping me in modeling the reactor in radiation field. I would like to thank College of Engineering, Water Center, and the entire body of the Tennessee Technological University.