UV/Chlorine Advanced Oxidation Process (AOP) for Destruction of Neonicotinoid (NNT) Insecticides

Taylor Bradley (REU Student), Teng Zeng, PhD (Mentor), William Mitch, PhD (Advisor)
June 2015-August 2015

Background:
Urban storm water runoff has become a breeding ground for Neonicotinoid (NNT) insecticides. Conventional water treatment calls for a UV/Hydrogen Peroxide system, but it is not as energy efficient as chlorine is expected to be. This research tested the efficiency of a UV/Chlorine AOP system in degrading NNT's.

Research Questions:
1. Is the UV/Chlorine AOP a feasible and effective treatment in wastewater treatment plants?
2. Will the UV/Chlorine AOP system be more effective in NNT removal compared to the UV/Hydrogen Peroxide AOP system?

Scope:
- Run three experiments for both, Chlorine and Hydrogen Peroxide, varying the concentration.
- Analyze samples using LC-MS/MS capabilities
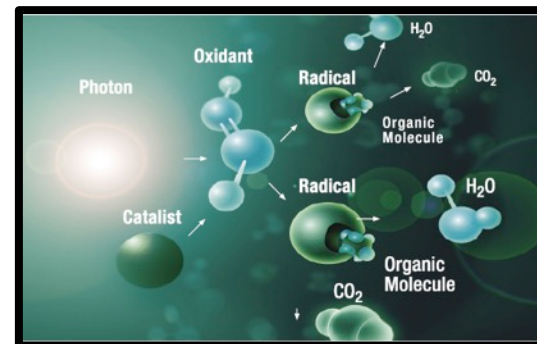- Use Excel to graph the degradation of each NNT and kinetics of each reaction
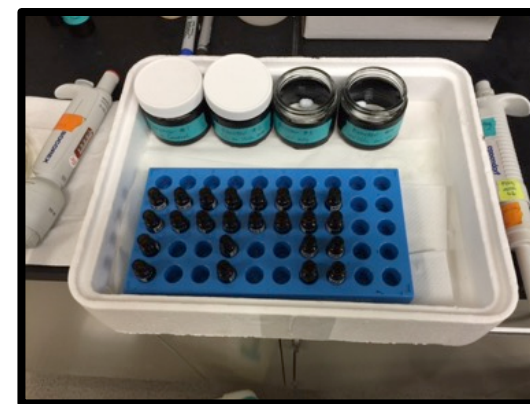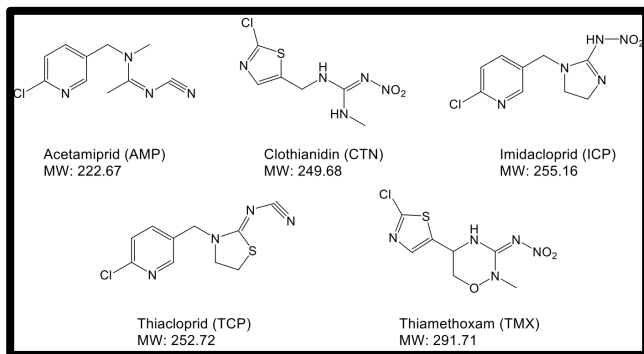

Figure 1: *UV AOP system*

Figure 2: *Experimental Sampling Tray*

Figure 3 *NNT Structures that were studied*

Preliminary Conclusions:

- The reaction is faster when there are higher concentrations of chlorine.
- Chlorine is more efficient in degrading the NNT's that will degrade (ICP and CTN)
- ICP could be self-degrading which is why it's the most commonly used

Future Research:

- Lengthen experimental time of AMP and TCP
- Adding a catalyst to see if the chlorine system is more efficient
- Capturing the true kinetics of each reaction.
- Figure out what about the structures prevent them from being reactive under UV light.
- Consider testing any Disinfection-by-products of the reactions.

Results:
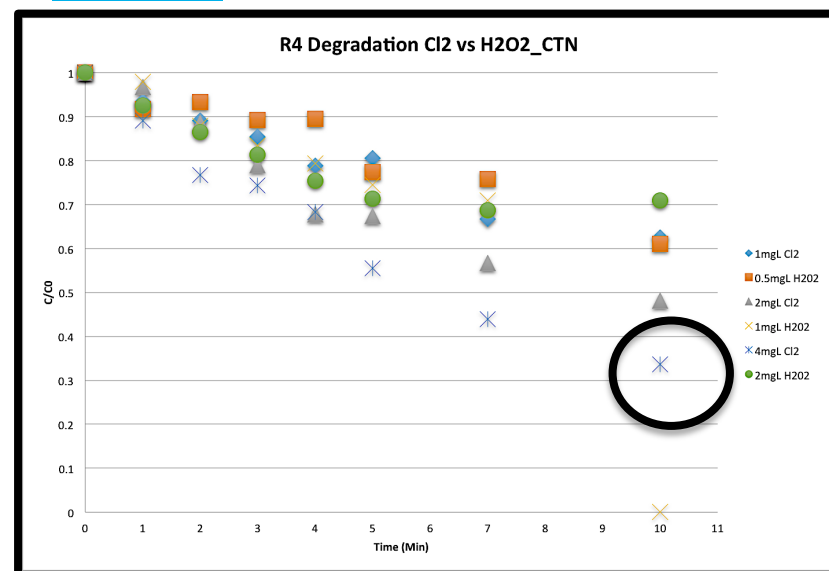
Figure 4: *Graph of Degradation of CTN UV/Chlorine vs. UV/Hydrogen Peroxide. 4mgL of Chlorine degrades the best.*
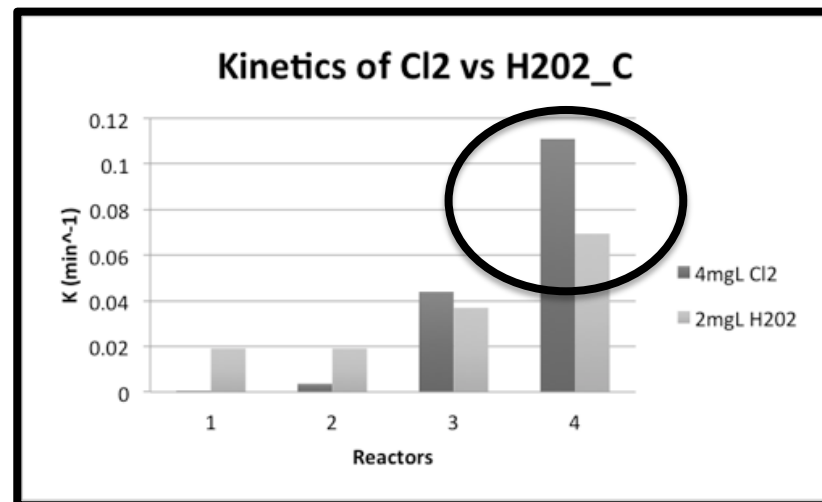
Figure 5: *Graph of rate constants for experiment C, Chlorine vs. Hydrogen Peroxide, showing the Chlorine system is favorable.*

2