Project 8

- **Title:** Efficacy of Plasma Removal of Oil Molecules in Water-**ECCL Aerospace**
- **PI:** John Foster/Mark Kushner—The University of Michigan
- **Need and Relevance:** Industrial recycling of water reduces operating costs and protects environment
- **Goals:** Test efficacy of plasma induced chemistry to mineralize oil in solution
- **Approach:** Determine effectiveness two reactors at oil removal; model decomposition chemistry
- **Outcomes/Deliverables:** Test data-decomposition and efficiency
- **Project Duration, Budget:** 12 months / $90,000

Need and Relevance

- In many chemical processing plants, there is a need to recycle water owing to the overall expense of delivery and pretreatment of new freshwater.
  - recycling also reduces the disposal cost of processed water (post treatment and ultimate sewer delivery).
  - Protects the environment
- Plasma based water treatment technology features advanced oxidation of organics in solution without the need for consumables which could result in significant cost savings
- It is possible that plasma treatment can address suspended oils and fats in water advanced oxidation which could enable either recycling or reduced sewer pretreatment costs

Goals

- The goal of this effort is to investigate the efficacy of plasma water purification systems for the removal of oils and fatty molecules in process water in batch and once through configurations.
  - Two sources of water will be evaluated. First will be process cleaning water which will also contain microbials in addition to other hydrocarbons
  - second will be in process generated water that contains mostly oils and fatty molecules.
  - Additional effort will be to evaluate a design for a road mobile testing unit capable of 10,000 gallons per day that can be used to gather real time data at water sources.

Approach

- The general approach is to use ECCL Aerospace Services test samples as the feed water for two water reactors: the dielectric barrier discharge (DBD) underwater plasma jet and the packed bed water reactor.
  - We will analyze water before and after processing using liquid chromatography and chemical oxygen demand (COD) methods.
  - We will determine the evolution of the concentration of oils in solution as a function of treatment time.
- The goal is to optimize the reactors in both batch and once-thru mode to determine which approach is most effective.
- Modeling of both systems will be used to help determine reaction mechanisms and methods to optimize the reactors.
  - We will also use global modeling to predict decomposition rates to investigate the decomposition mechanism.
  - Multi-dimensional modeling will be used to determine the plasma dose delivered.
- We will also investigate plasma induced precipitation and subsequent filtering as an alternative pathway for cleaning the water for recycling.

Outcomes/Deliverables

- The chief deliverables from this effort are test data and modeling results.
  - We will document the decomposition efficiency of both reactors to assess power requirements.
  - We will also provide data on reactor effectiveness as a function of organic load.
  - We will also complete a preliminary, join design of a road mobile system

Project Timeline and Duration

Task / month	1	2	3	4	5	6	7	8	9	10	11	12
Test feed water with reactor 1/modeling	x	x	x	x								
Test feed water with reactor 2/modeling				x	x	x	x					
Reactor optimization and potential downselect							x	x	x	x		
Final optimization and production of final report									x	x	x	x

Project Budget

Item	Cost
Student stipend	$ 70000
Supplies	$ 5000
Purchased services	$ 0.00
Equipment	$ 10000
Travel	$ 5000
Project total*	**$90,000**

*C-PEAB leadership recommends not to exceed $40,000/year unless discussed with IAB