Novel Algae Technology for CO_2 Utilization

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DOE Webinar

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Overall Objectives

- **Develop a novel algae based technology for efficient CO2 capture from coal power plant flue gas**
- **Utilize algae to make products to cut CO2 capture cost**

- **Project Team:**
  - **Helios-NRG, LLC**
  - **University at Buffalo, The State University of New York at Buffalo (UB) - Subcontractor**

Challenges to be Addressed

- **Impact of contaminants on algae can be significant**
  - **12% CO_2 (300x the ambient conc)**
  - **Flue gas SOX, NOX**
  - **Heavy metals typically toxic - can affect survival & growth**
- **All downstream applications require dewatering**
- **Is it feasible to generate additional high value products under the conditions of interest?**

Phase1 Objectives

- **Identify algae species capable of handling flue gas contaminants and achieve high CO2 capture**
  - Post FGD: 12% CO2
- **Advance performance of the DeAqua technology for dewatering**
- **Validate high value co-product synthesis by the algae**
- **Conduct preliminary process & economic analysis**

Algae Species Selection

- **Primary criteria for selection:**
  - Amenable to high CO_2
  - Handle flue gas SOX, NOX
  - Heavy metal tolerance
  - High usable energy content
  - Potential for co-products
- **Evaluated several strains over the last 6 years**
- **Promising species selected for this project**

Major Contaminants Induce Significant Change in Algae Environment

- **Acid gases in flue gas decrease pH**
- **Prior project advanced technology to handle 12% CO_2+SOX+NOX**
- **But what is impact of other contaminants in flue gas?**

Prior Helios Work on Heavy Metal Impact

- **Investigated algae for water remediation**
- **Template contaminants for organic & inorganic species**
- **Significant potential to remove template heavy metal**

Heavy Metals in Coal Flue Gas

- **Several heavy metals present in flue gas**
- **As, Hg and Se were selected for present project**
- **These will be added in solution since gas phase addition is infeasible**

Post FGD Flue Gas Example

Metals	Conc(ppb)	PEL (mg/m3)
As	78.9	0.01
Cd	15.2	
Co	16.2	
Cr	131.5	
Cu	132.5	
Hg	10.1	0.01-0.1
Pb	54.6	
Ni	252.9	
Se	10.1	0.2
Zn	445.0	5

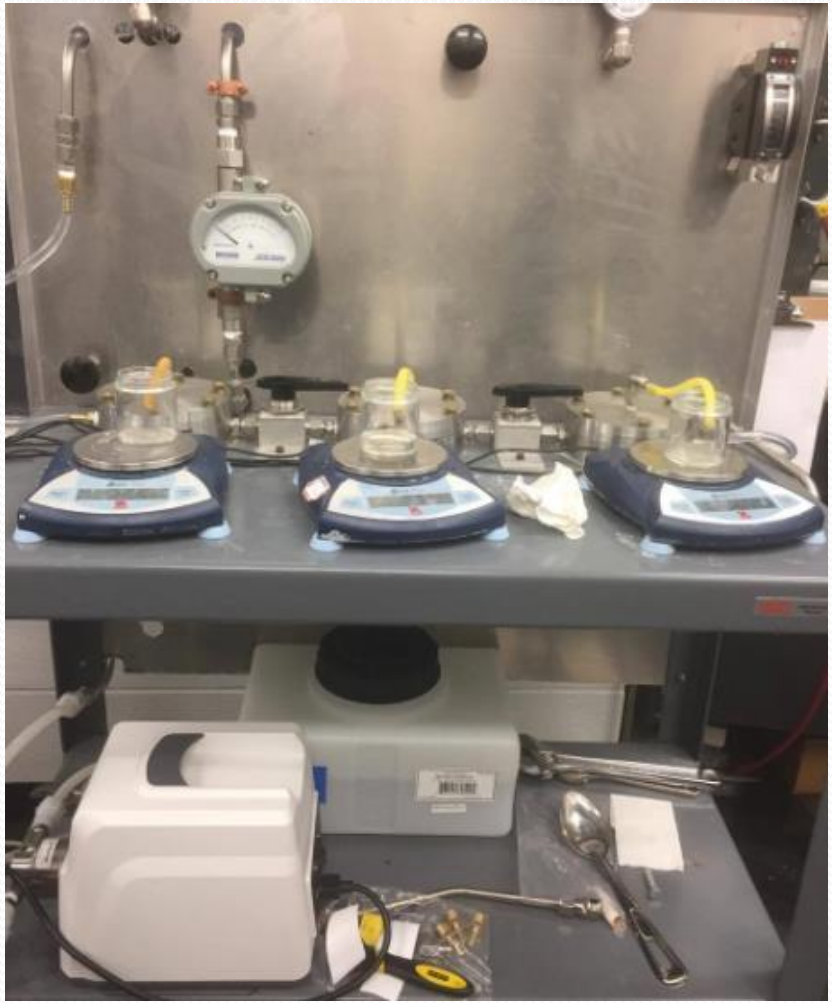
CO_2 Capture with MSC Process

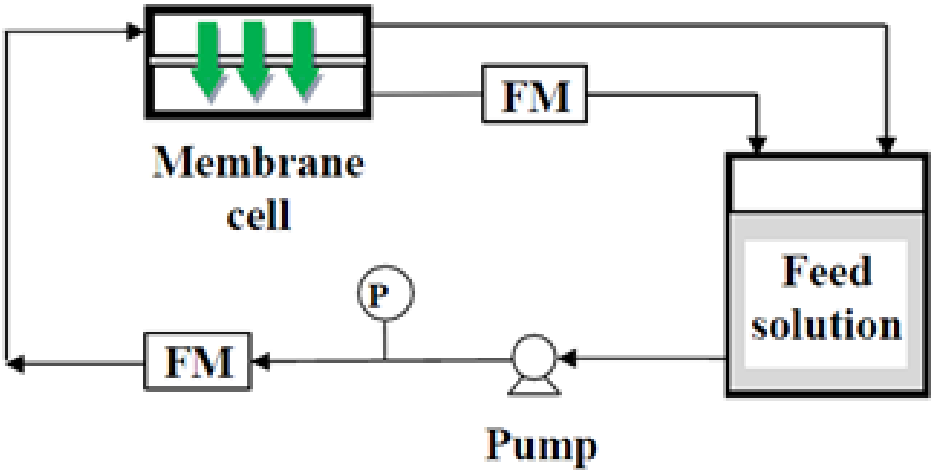
- **Stable concentrations**
- **Design can be optimized**
- **Continuous Process**
- **High CO_2 capture efficiency possible**
- **Present project aims to test MSC stability in presence of contaminants via batch tests**

Dewatering

- **Challenges:**
  - 300X increase in algae concentration needed
  - Huge water burden makes dewatering energy & capital intensive
- **Helios Approach:**
  - Process designed to minimize energy & capital
  - Enable 300x concentration increase
  - Technology for each stage tailored to its strength
  - Development initiated in prior projects
- **Benefits:**
  - High water recycle
  - Continuous process
  - High solids loading in product
- **Key Issues:**
  - Kinetics
  - Fouling

Cross Flow Test Facility for Membrane Testing





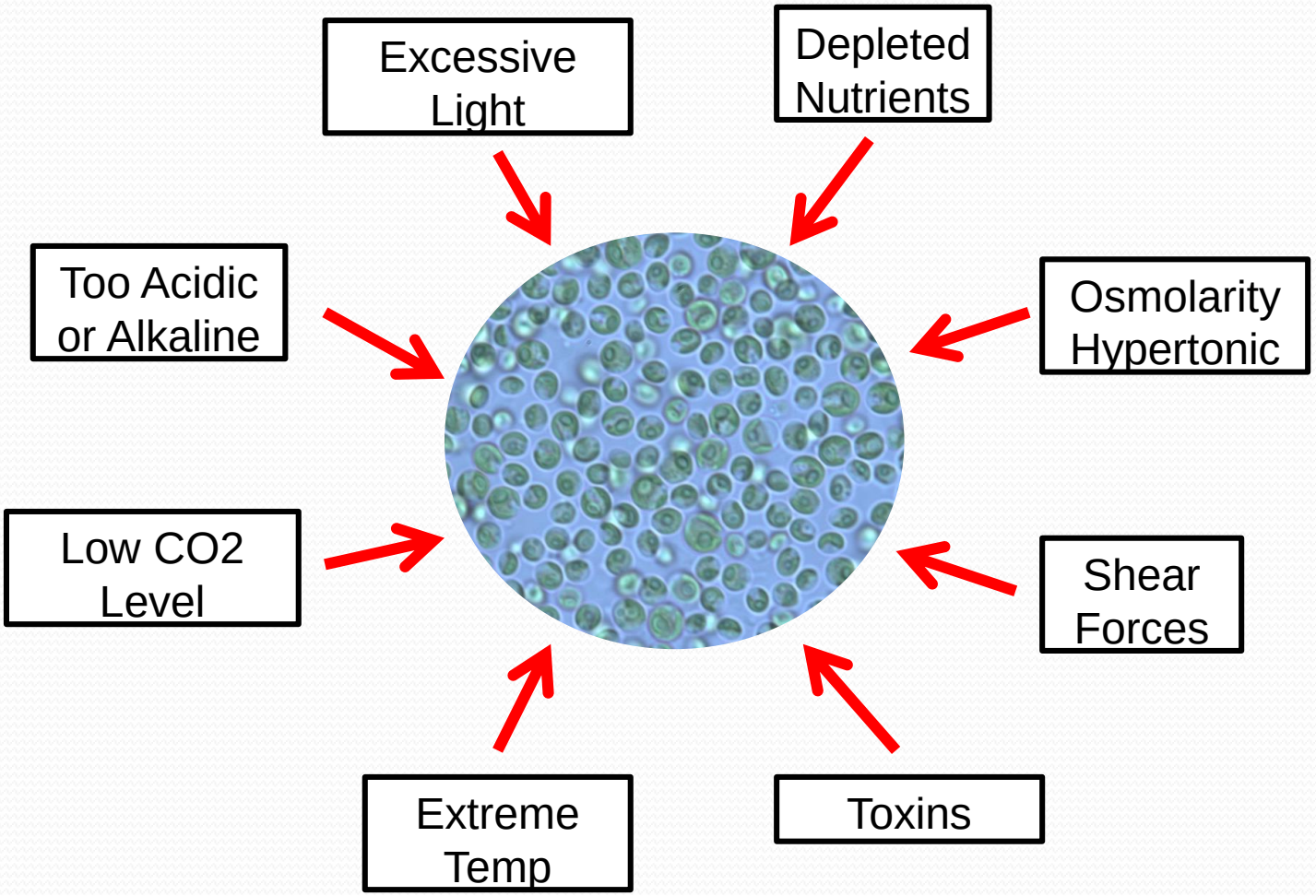
Three high pressure cross-flow filtration cells available for permeance experiments

Membrane Module and Testing

Exampled commercial membrane module (top) and its housing (bottom)

Membrane modules will be connected to the cross flow filtration system through flexible tubing for the fouling tests.

Algae Stress Factors



Summary

- **Project builds on significant prior work**

- **Overall the project is making good progress & on track**