U.S. DEPARTMENT OF ENERGY

Emissol

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Novel, Efficient, Low-Cost Technology for Direct Air Capture of CO_2 and its Removal from Low Concentration Streams

Project # DE-SC0020860

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24 February 2021

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Program Overview

- **Funding: DOE Phase I**.
  $256,086. Cost Share: 0

- **Project Performance Dates:**
  June 2020 to March 2021

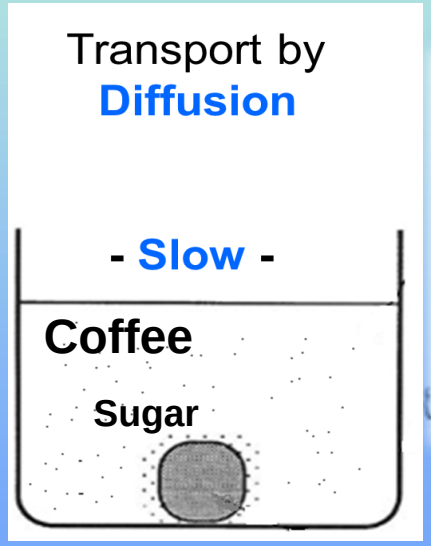
- **Project Participants**
  - Emissol (Lead)
  - Center for Negative Carbon Emission/ CNCE
  - University of Washington

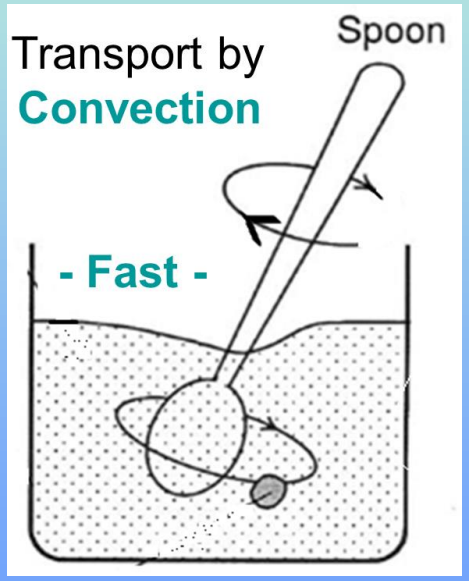
- **Project Objectives: A Contactor with Enhanced Mass Transfer (Lowers DAC Cost)**

Technology Background

Diffusion *vs.* Convection

Slow *vs.* *Fast*





➔ **Devise a Novel Contactor Having Convective Mass Transfer*!***

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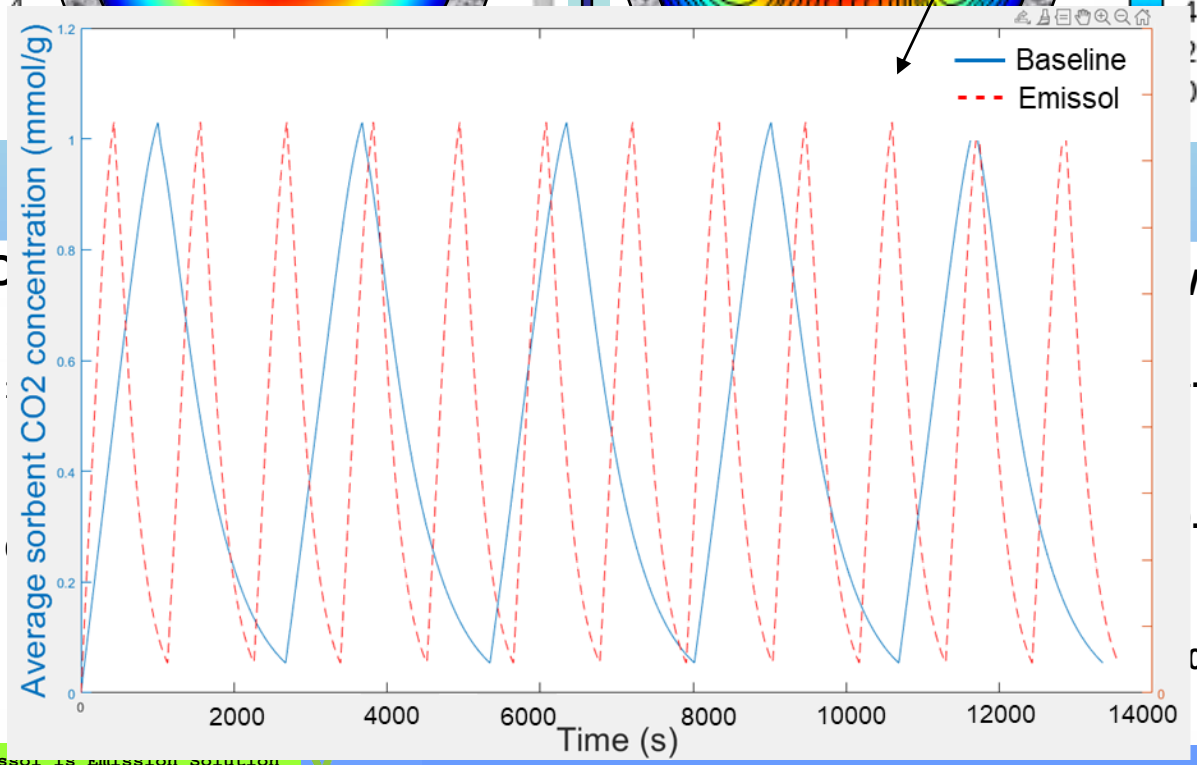
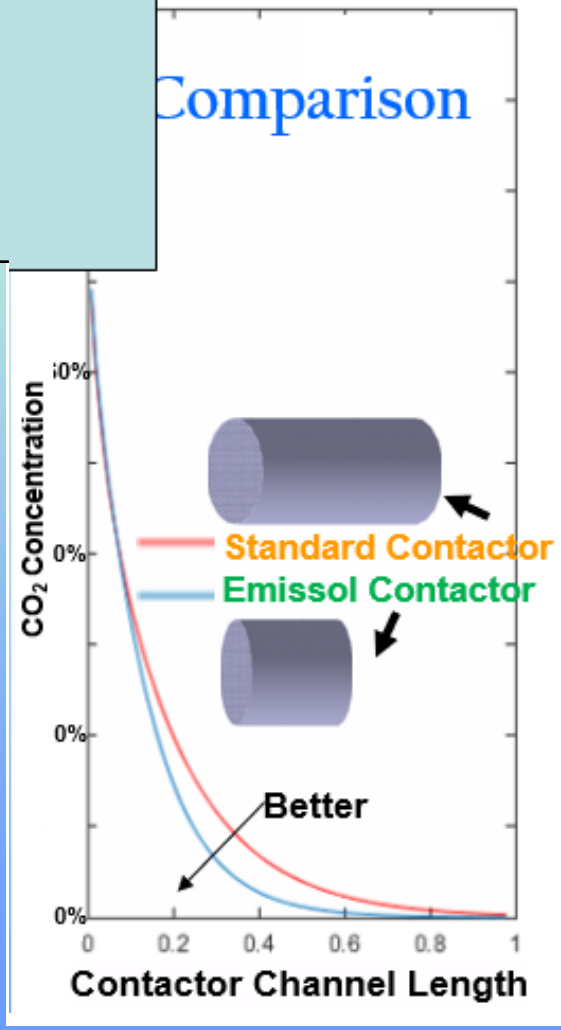
CO_2 Transport in Contactors: Emissol vs. Standard

Novel Contactor Enables

1. **Faster CO_2 adsorption/ desorption (e.g., ton-CO_2 /m^3/s)**
2. **Contactor Downsizing**:
   Reduced Sorbent Use (OpEx ↓ , CapEx ↓)
   Major Impact on DAC Techno-Economics
3. **Reduced pressure drop**
4. **Reduced pumping time**
5. **Reduced desorption energy**
6. **Improved heating efficiency**





Technical Approach/Project Scope

Technical Approach

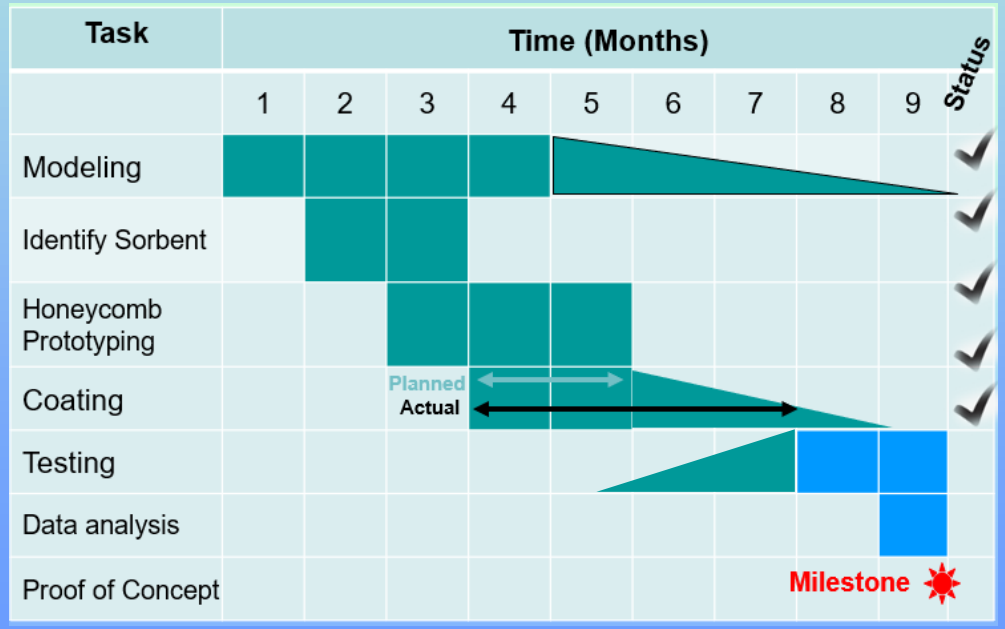
- **Computational Modeling CO2 transport to/ from sorbent, cycle**
  - Compares novel contactor with standard one.
  - Most recent literature, (e.g., Jones (2017); Patton (2004); Kulkarni (2012); Lackner, (2019))

- **Experiments**
  - Compared sorbent-coated contactors in full cycle
  - Compare energy consumption, other attributes/ functions

Project Success Criteria

- Downsized contactors
- Reduced pumping power (pressure drop)
- Reduced thermal energy for desorption
- Faster cycles

➔ Reduced DAC Costs (CapEx, OpEx)



Project Success Criteria

- Proof of Concept / Reduced DAC Cost

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Team and Facilities

Team

- Emissol, Sr. Consultant
- UW
- CNCE

Equipment

- FTIR, IRGA, TGA, others, …

Principal Investigator

M. Masoudi, Ph.D.

Consultant

Professor Balakotaiah

R&D Engineer

A. Sader

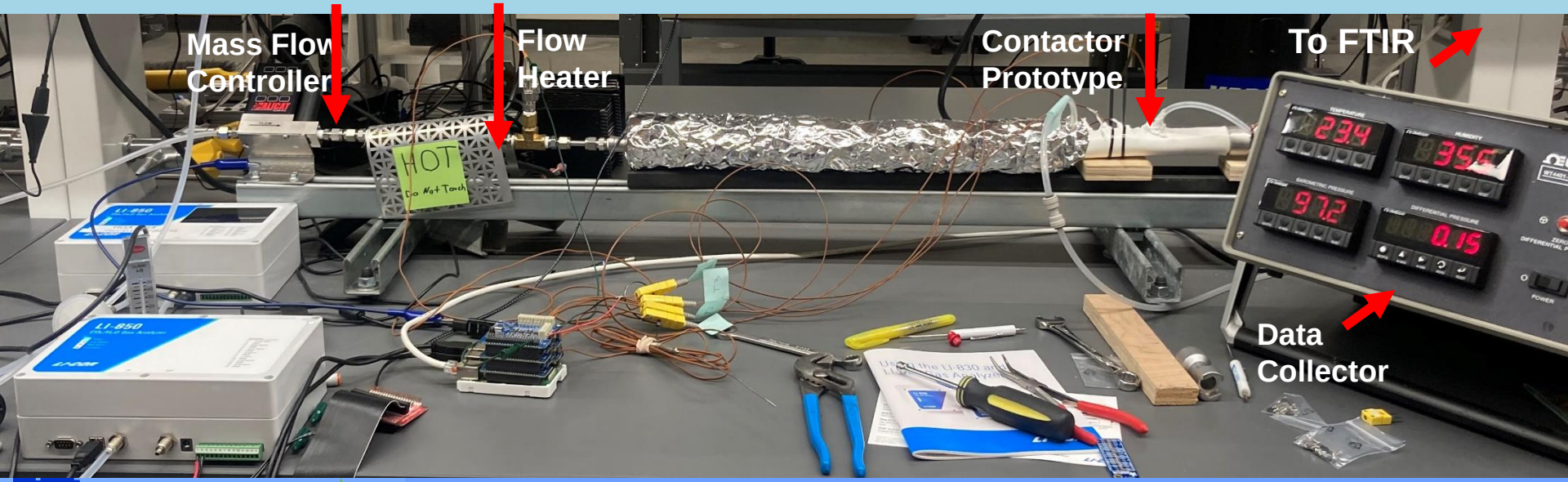
R&D Engineer

E. Tegeler

ASU Arizona State University

Engineering | Center for Negative Carbon Emissions (CNCE)

UNIVERSITY of WASHINGTON



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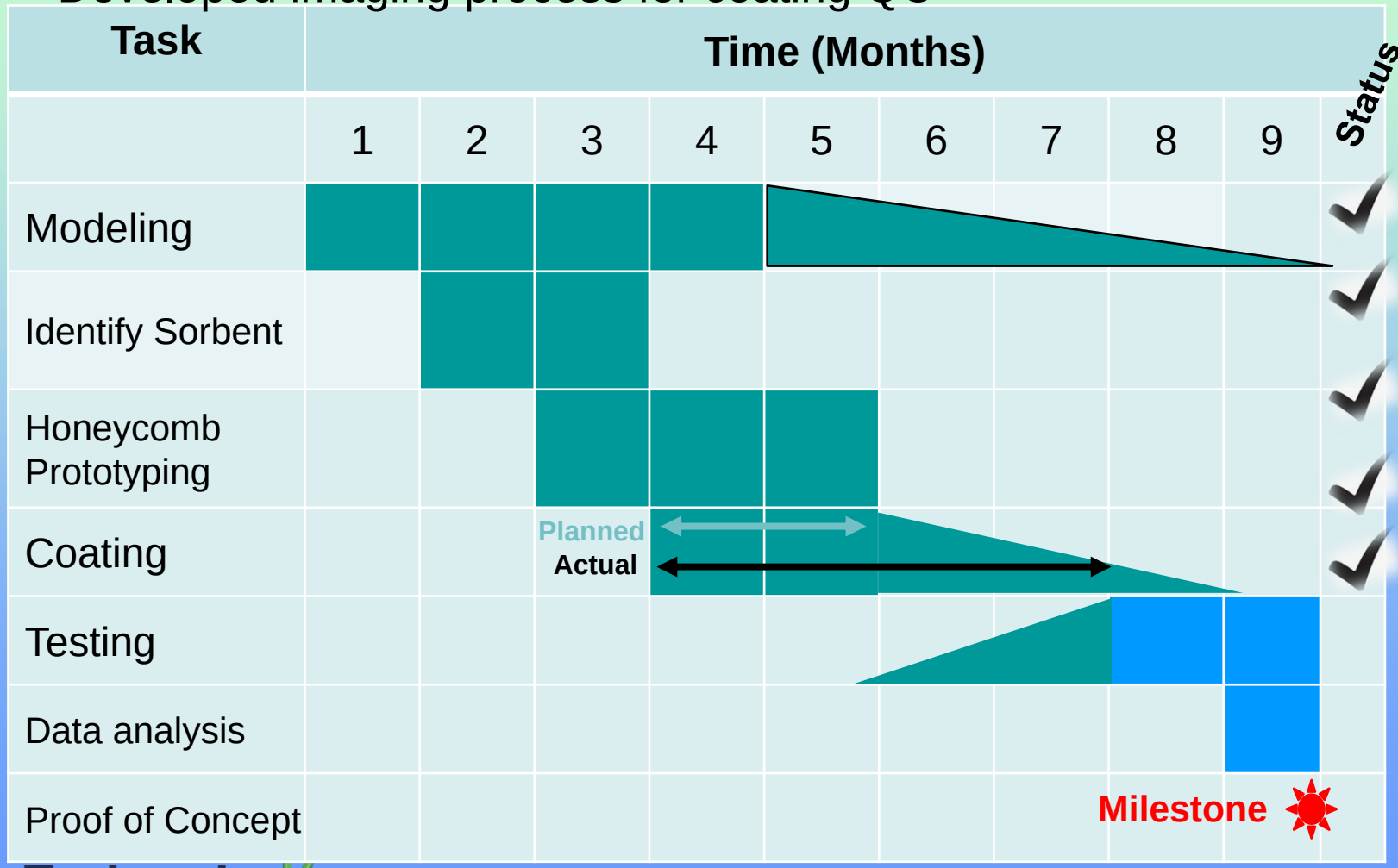
Project Progress, Current Status

Accomplishments

- Developed own coating process
- Developed imaging process for coating QC



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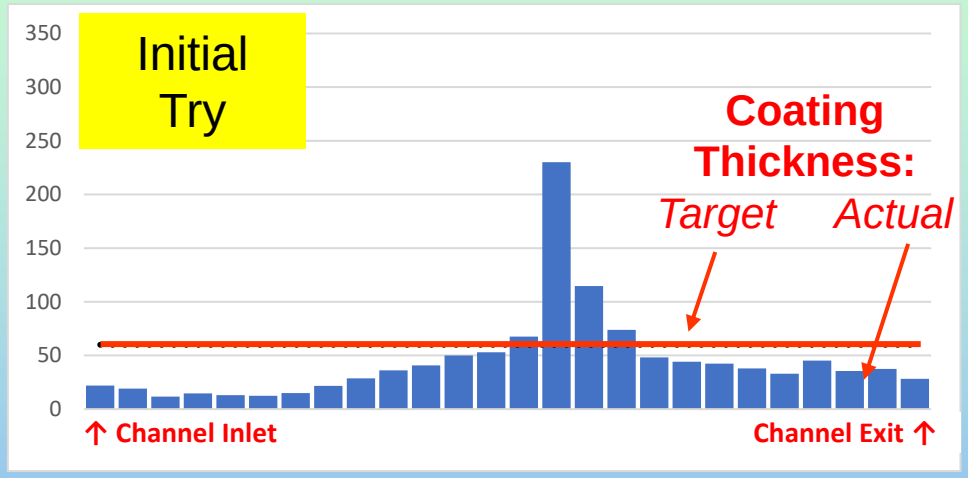
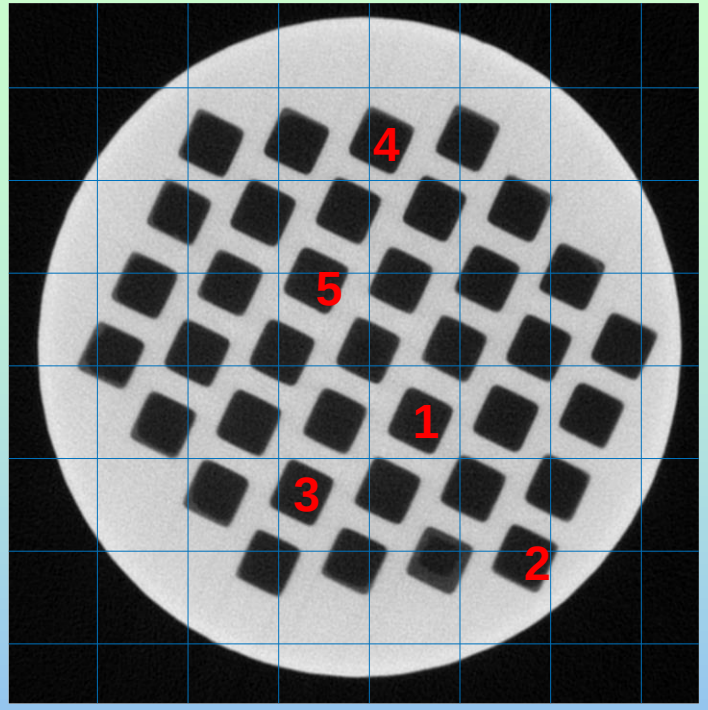
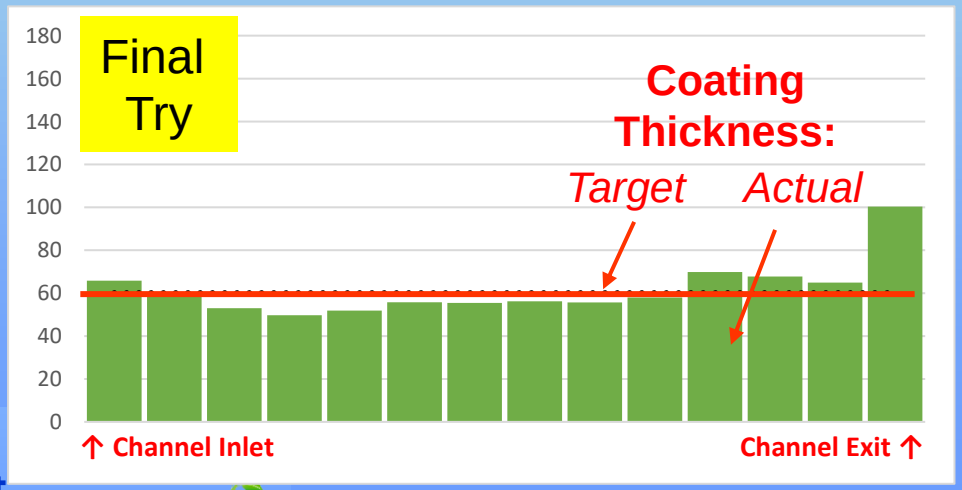
Accomplishment: Developed Micro-Image Controlled Coating

- **Quality Coating is Essential**
- Micro-images of Coating in One Channel: from channel inlet to exit







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Opportunities for Collaboration

Collaboration Opportunities

- Low-Cost Manufacturing Techniques for Contactor
- Testing in Real Environment
- Cycle/ Process Optimization
- Scale up
- Other collaborations

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Questions Welcome *!*

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