



# How to scale a water disinfection technology for plant factories

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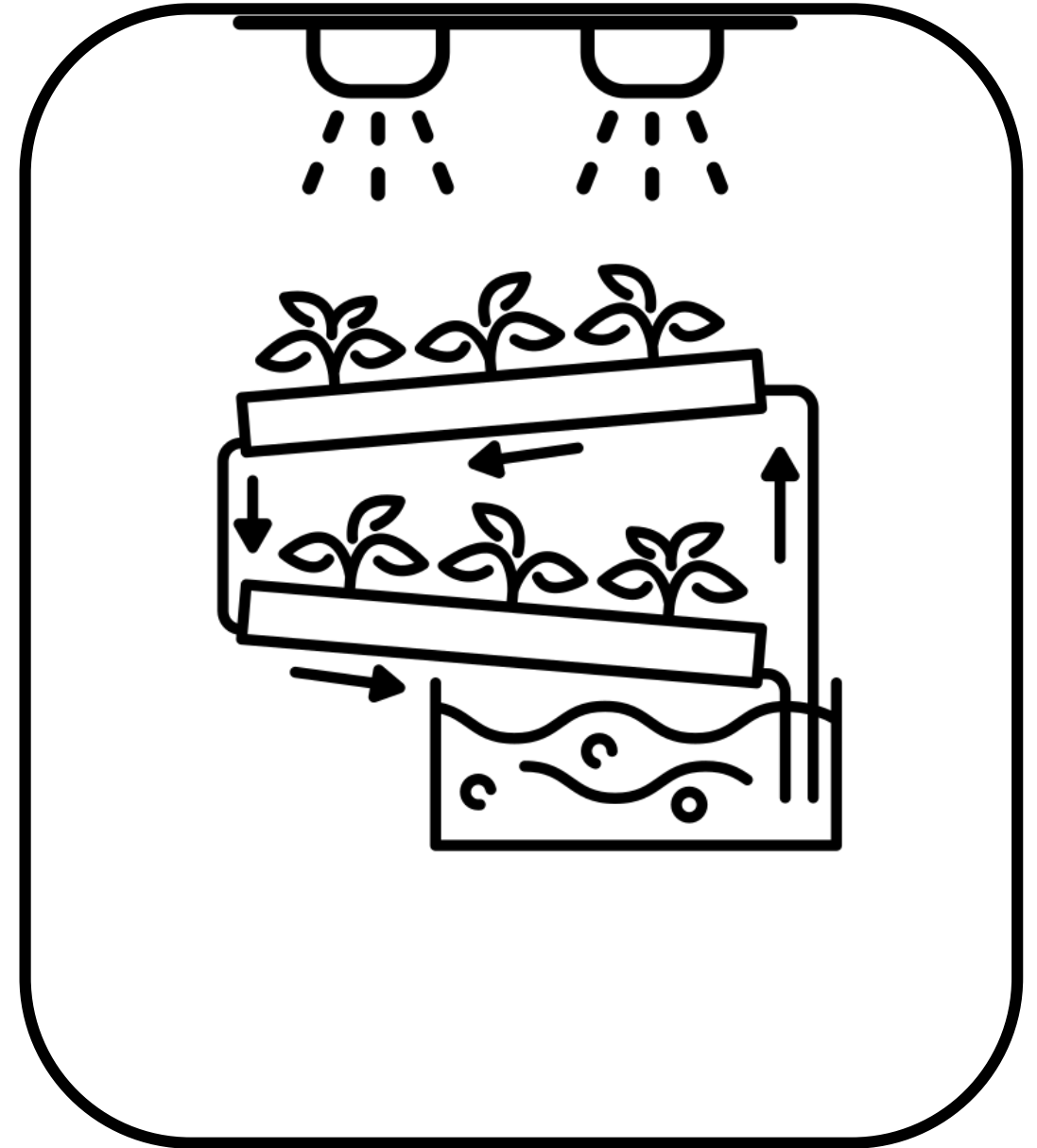


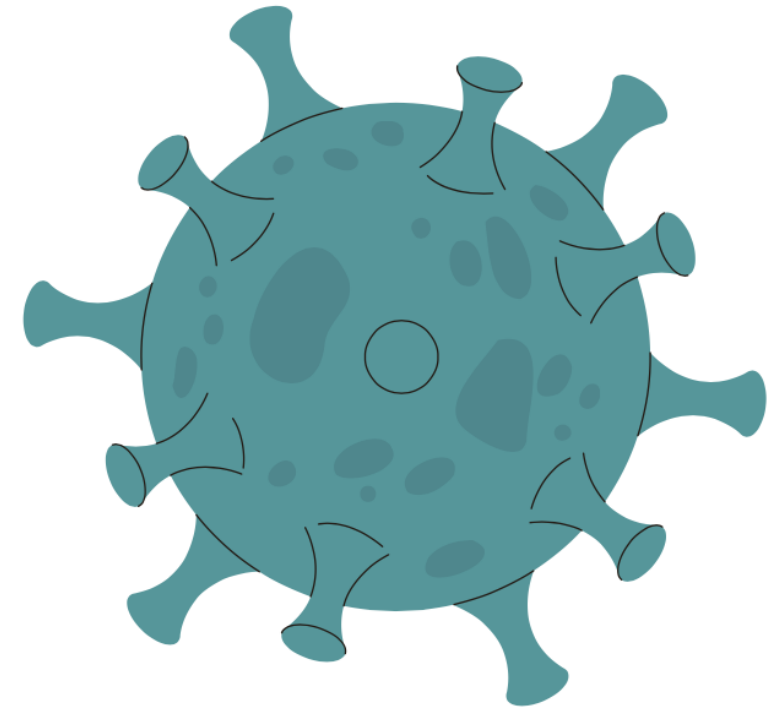
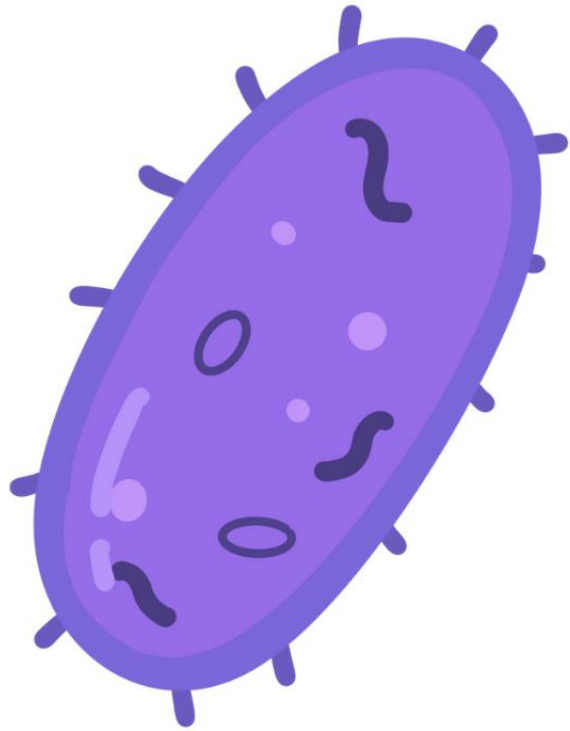
## Variables in plant factories

# Plant factories with artificial lighting

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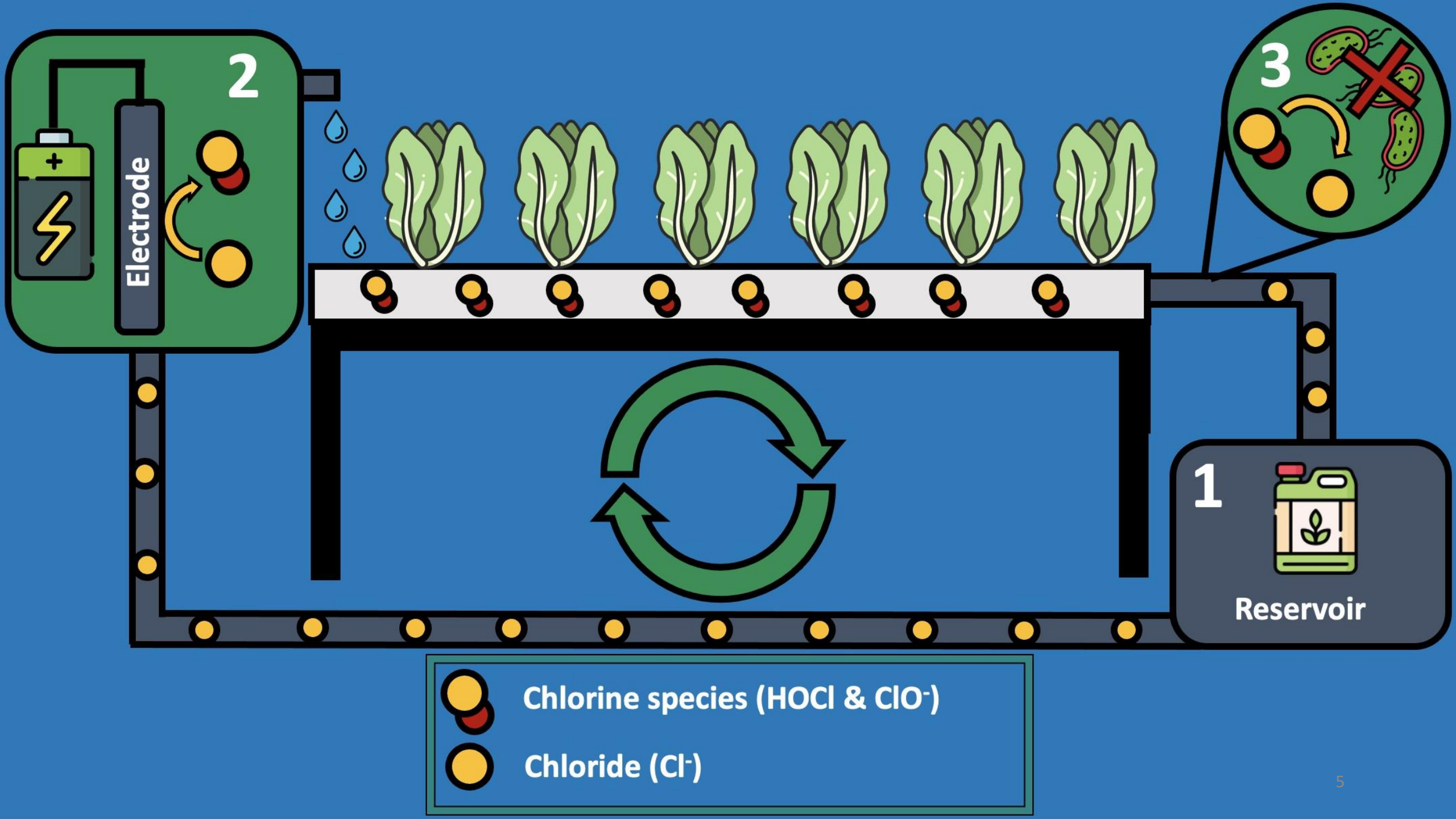
- Isolated
- Control environmental conditions
  - Light
  - CO<sub>2</sub>
  - pH
  - EC/nutrient levels
  - Hydroponic (soiless)
  - Vapour pressure
  - ???





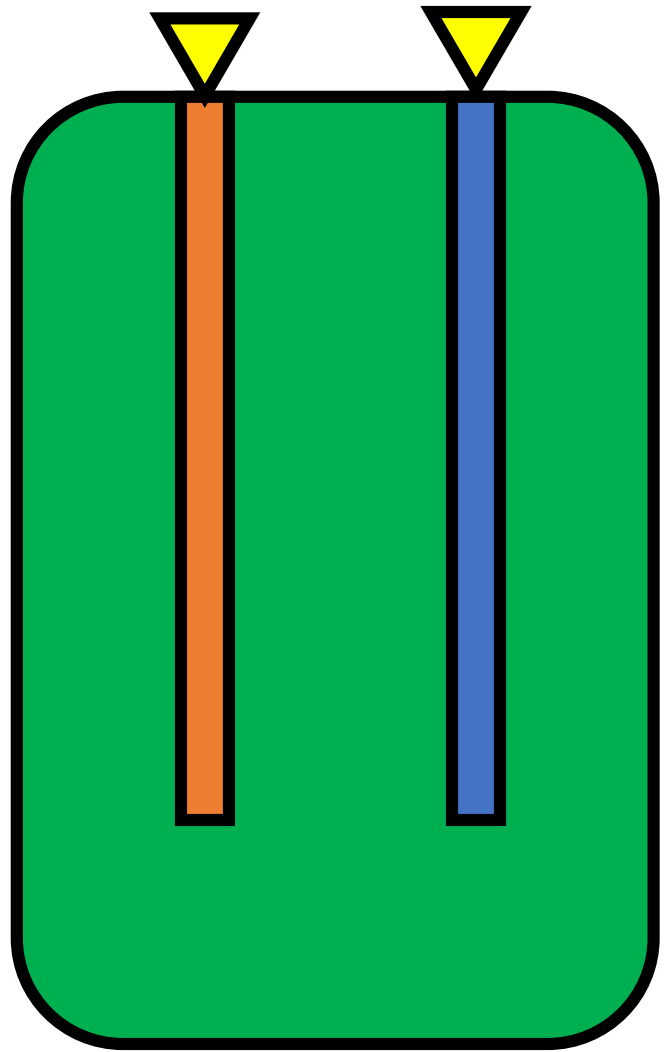
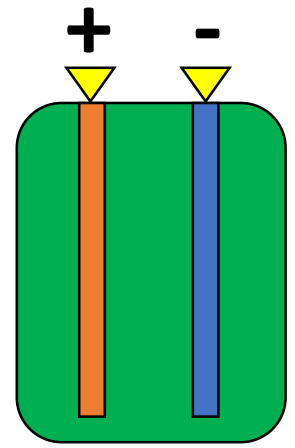
## Pathogen issues

- Bacteria
- Fungi
- Viruses

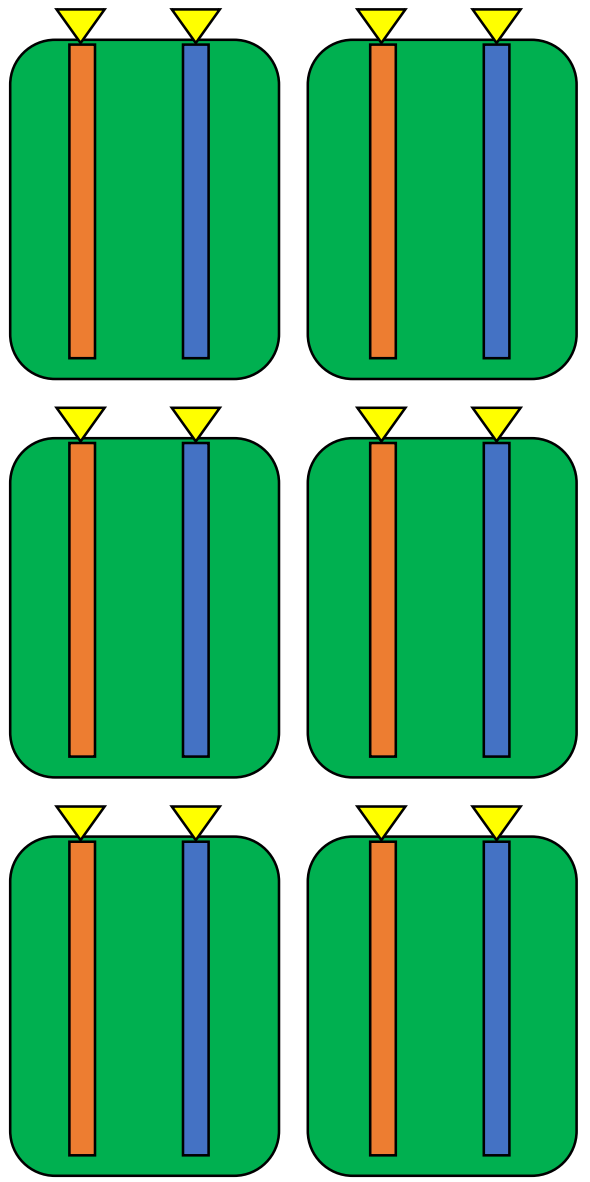




Scaling?



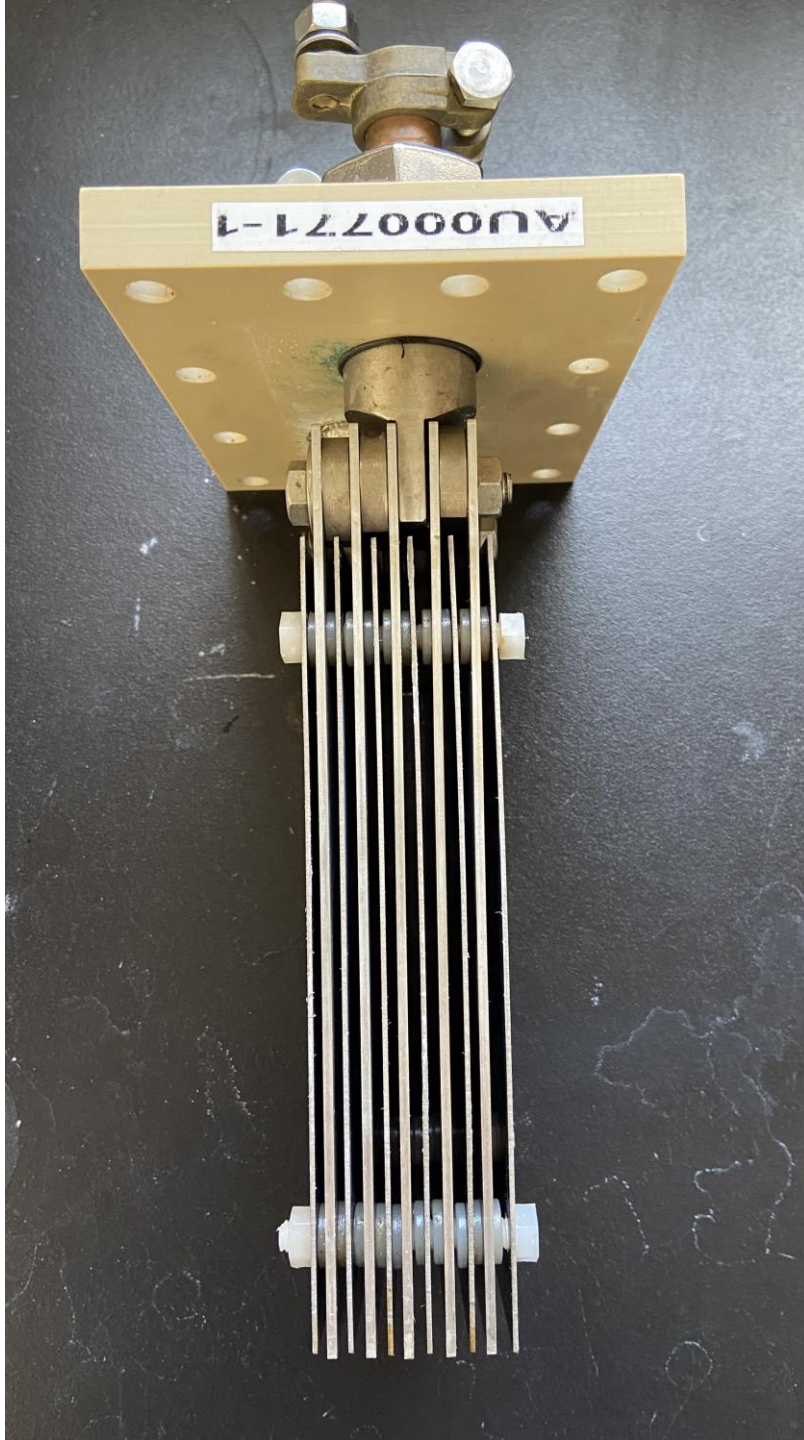
OR



# Experiment #1: electrode spacing



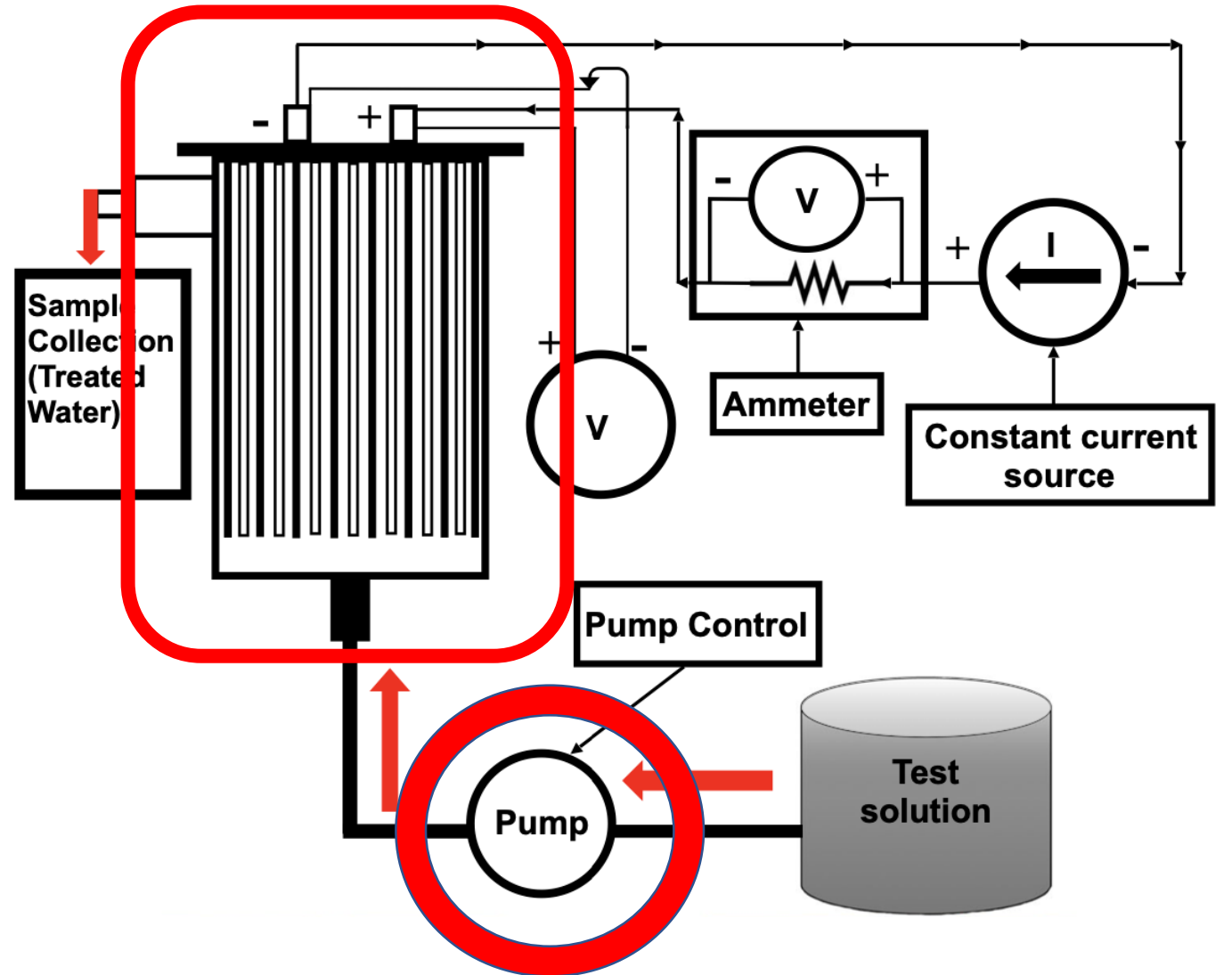


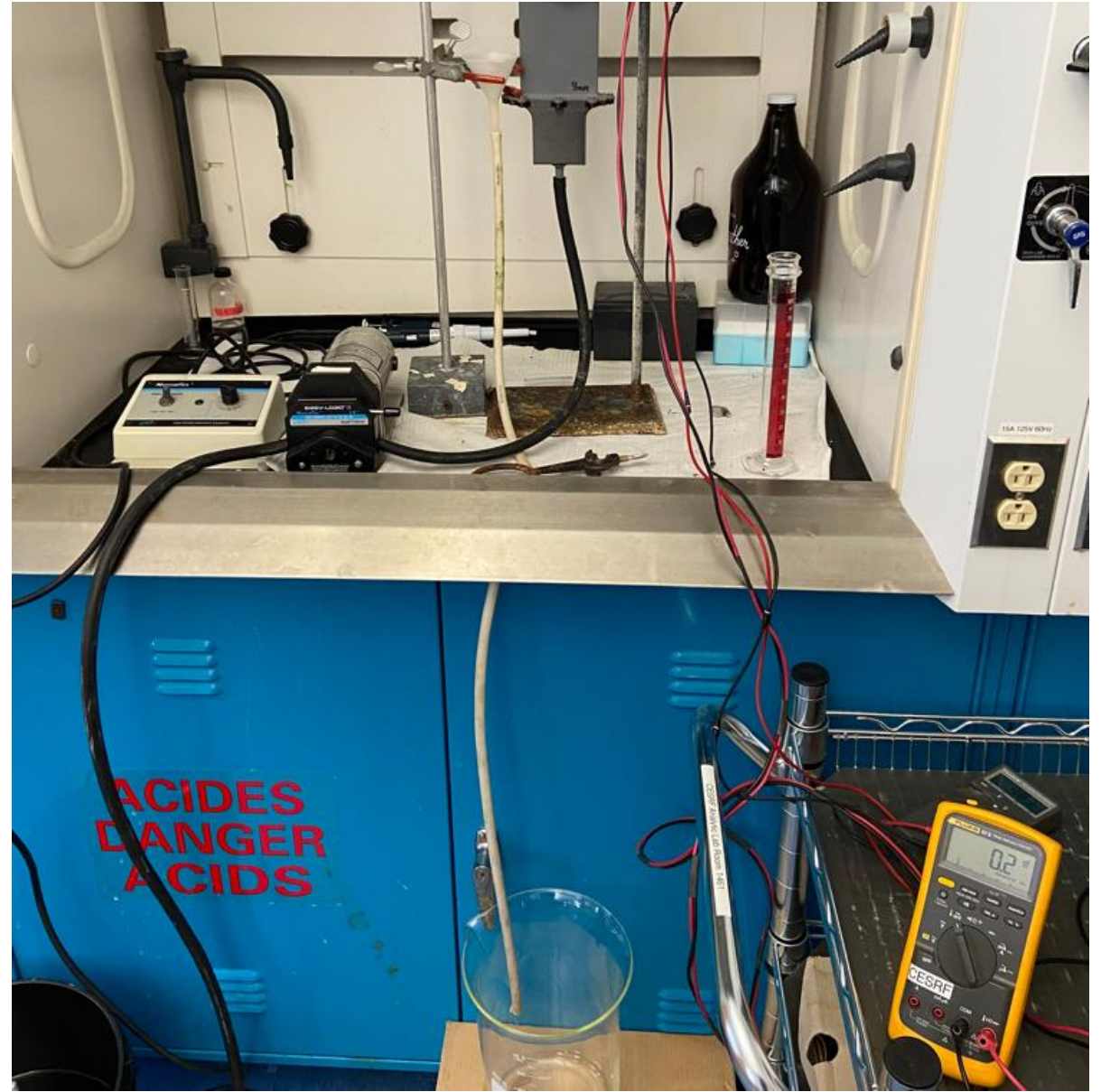


# Factors tested

- Response variable pathogen inactivation
- Response surface analysis
  - Electrode spacing
  - Current density
  - Contact time/flow rate

# Methods

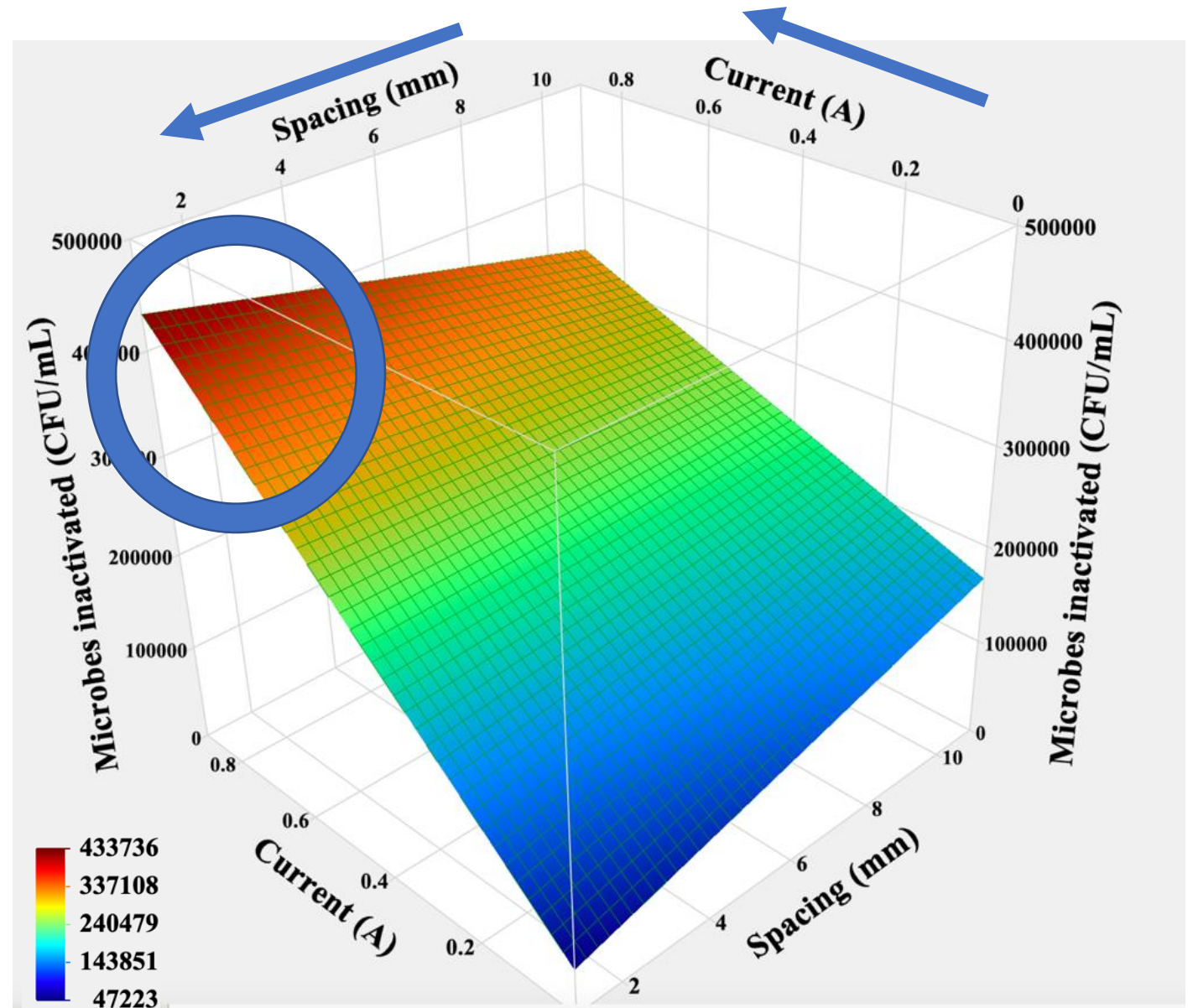






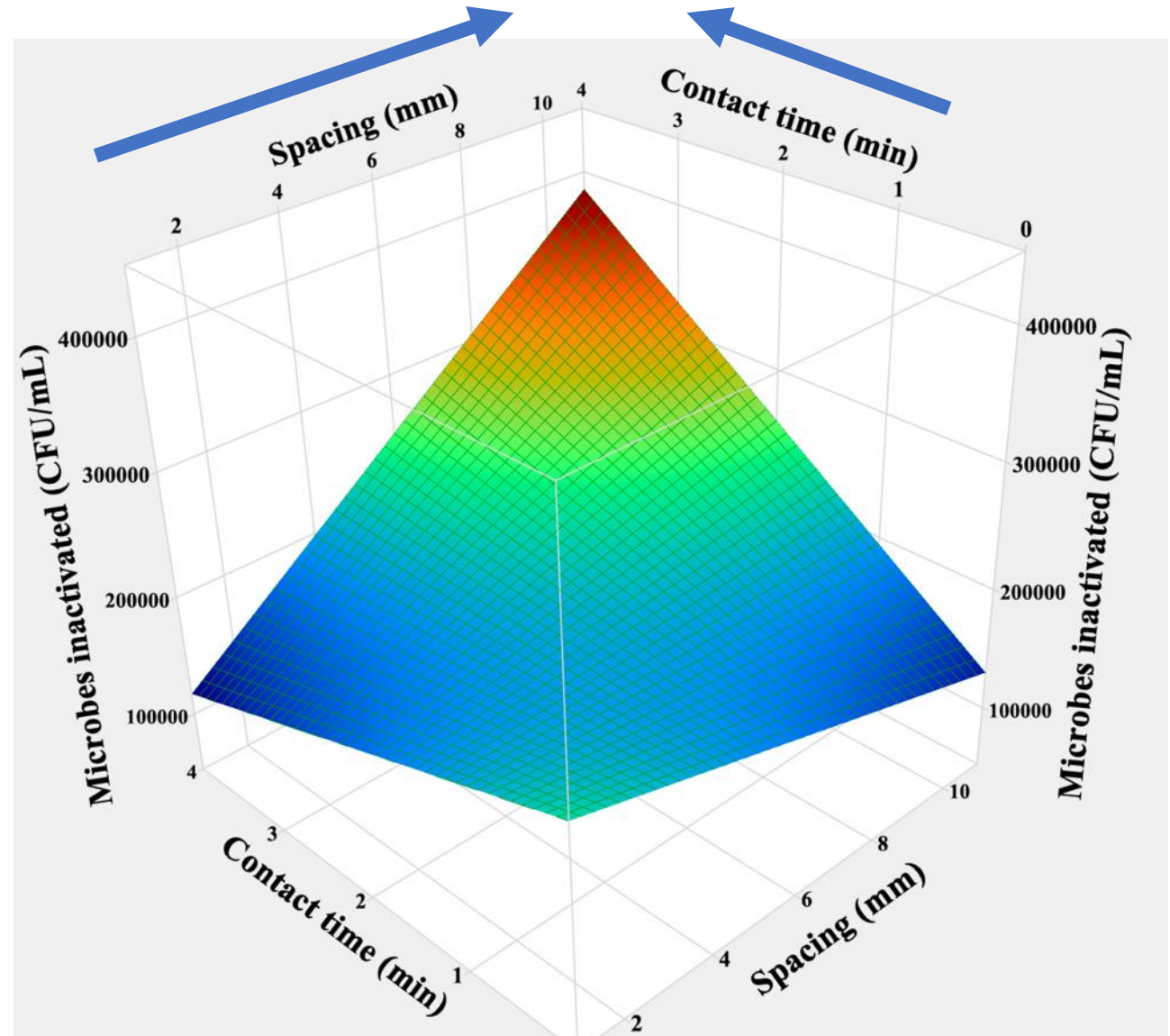
## Spacing x Current

- Increasing current will kill more pathogens
- Decreasing electrode spacing kills more pathogens



## Spacing x Contact time

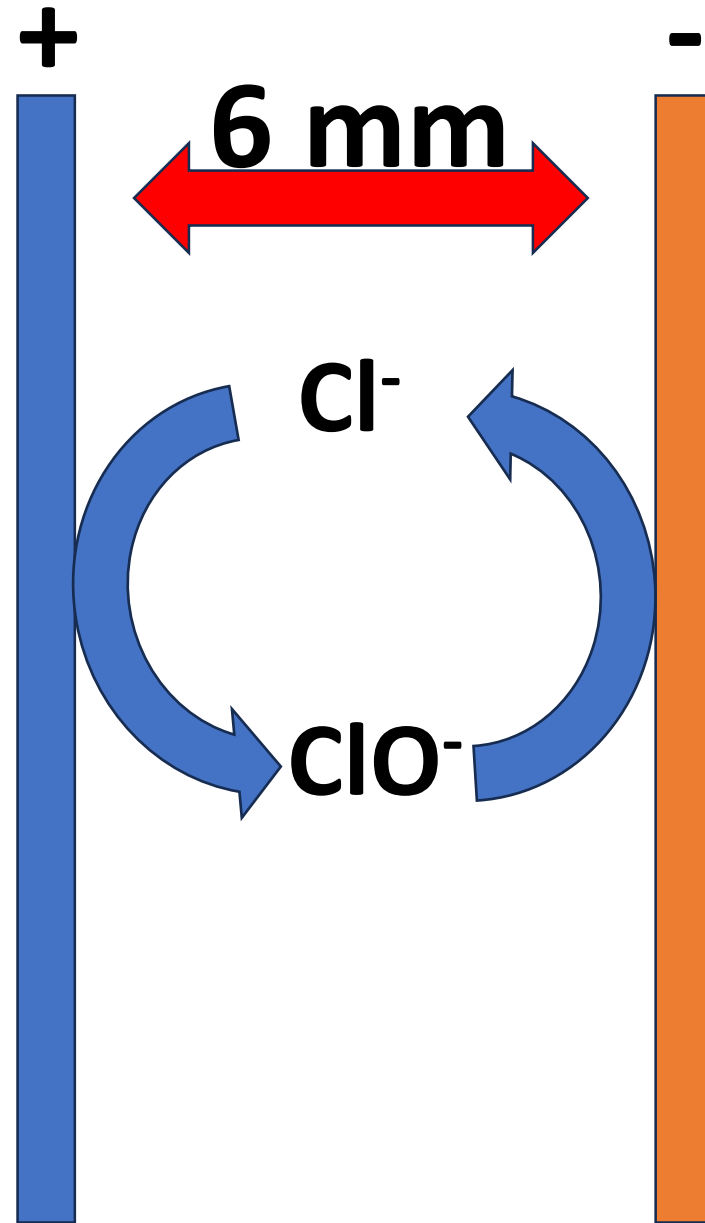
- Slowing down the flow rate kills more pathogens
- Increasing electrode spacing kill more pathogens



# What's happening?







Experiment #2:  
Flow cell  
comparison

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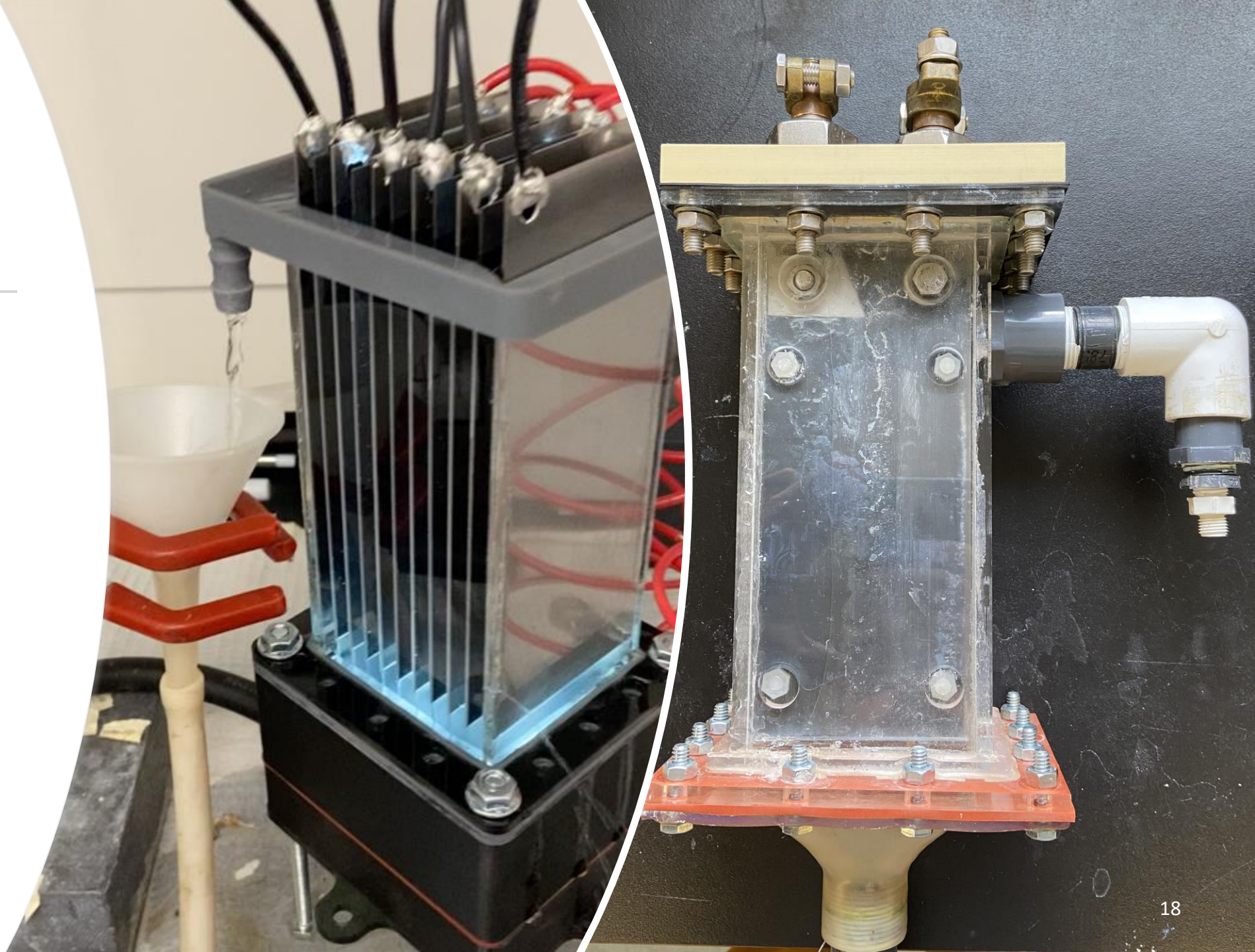
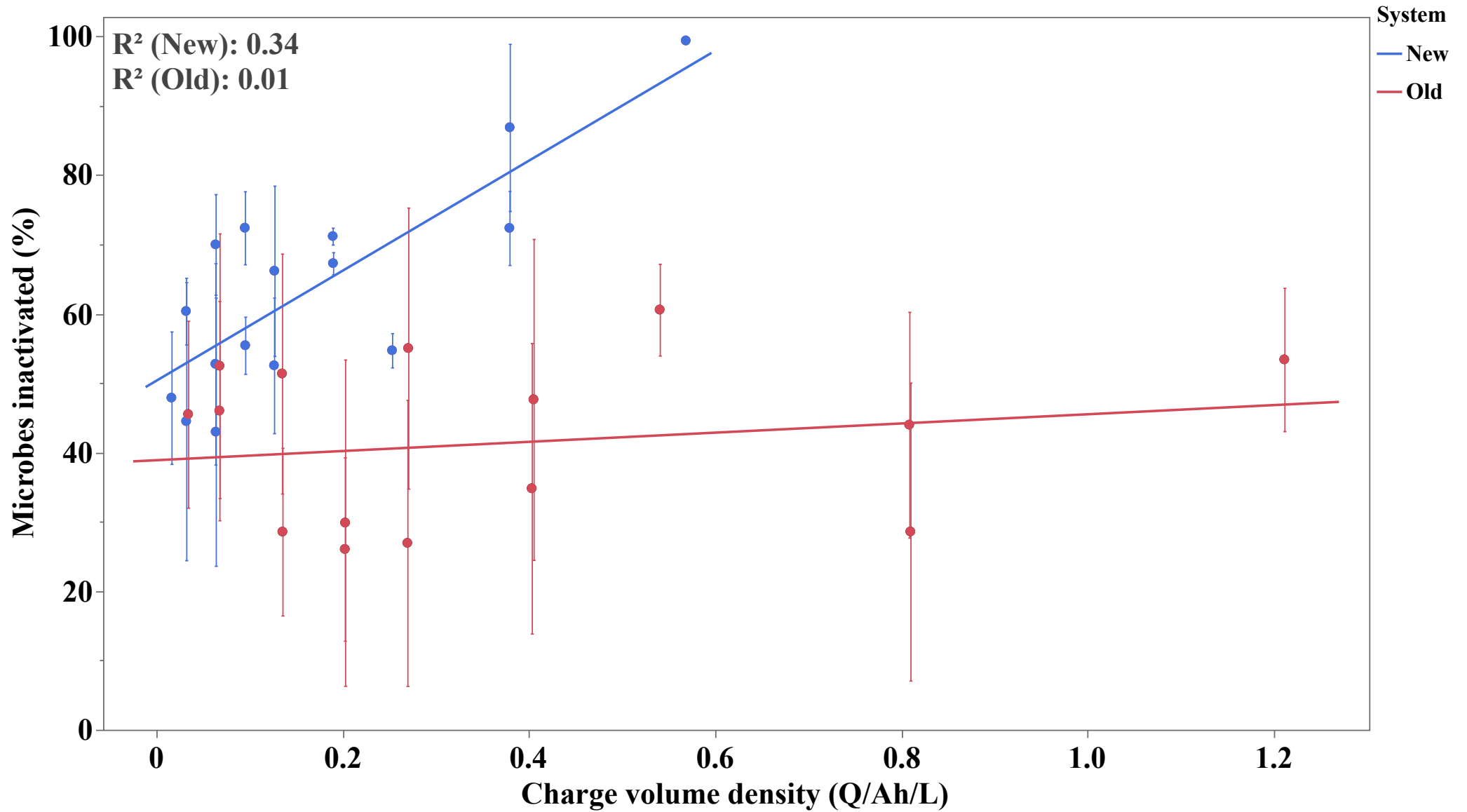


Table 2: Characteristics of each electrochemical flow cell

<b>System type</b>	<b>Characteristics</b>	<b>Value</b>
New system (6 mm spacing)	Number of anodes	5
	Number of cathodes	6
	Solution volume (between electrodes)	468 cm <sup>3</sup>
	Active anode area	780 cm <sup>2</sup>
Old system (2 mm spacing)	Number of anodes	6
	Number of cathodes	5
	Solution volume (between electrodes)	380 cm <sup>3</sup>
	Active anode area	1353 cm <sup>2</sup>

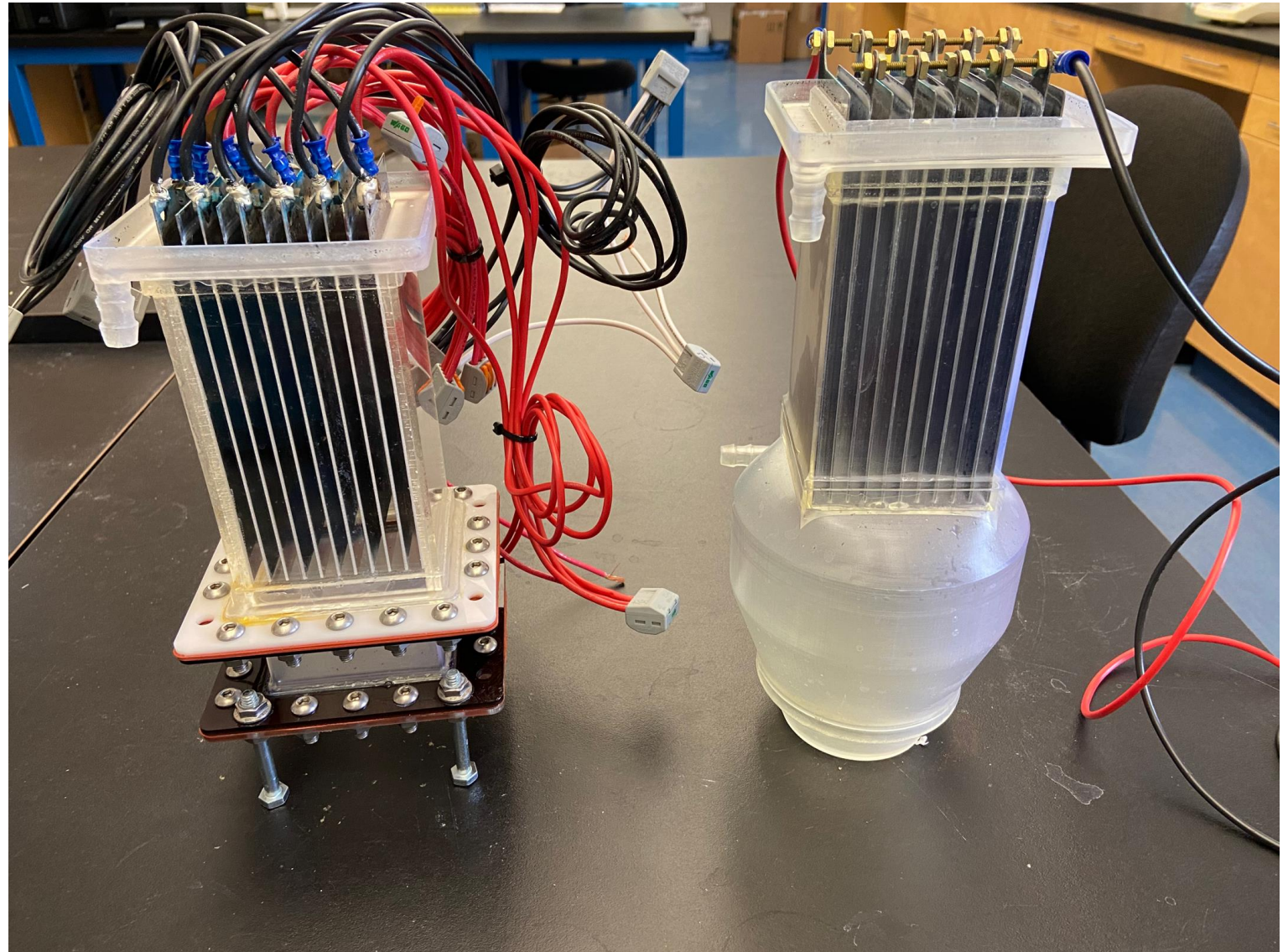
$$Q = \frac{C}{V} = \frac{A \times h}{V}$$

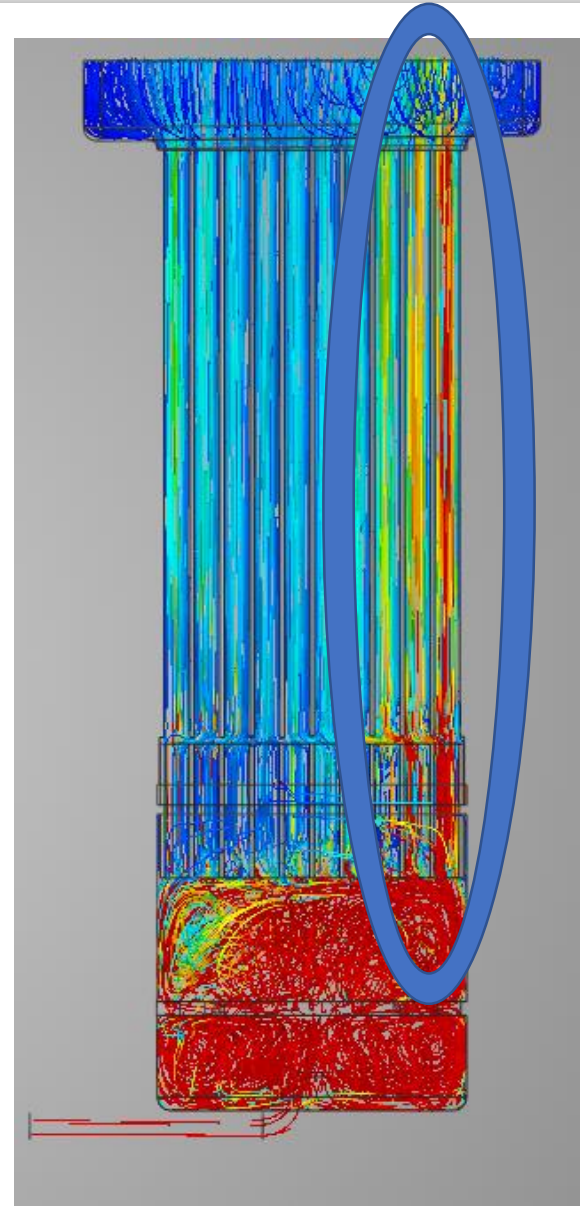
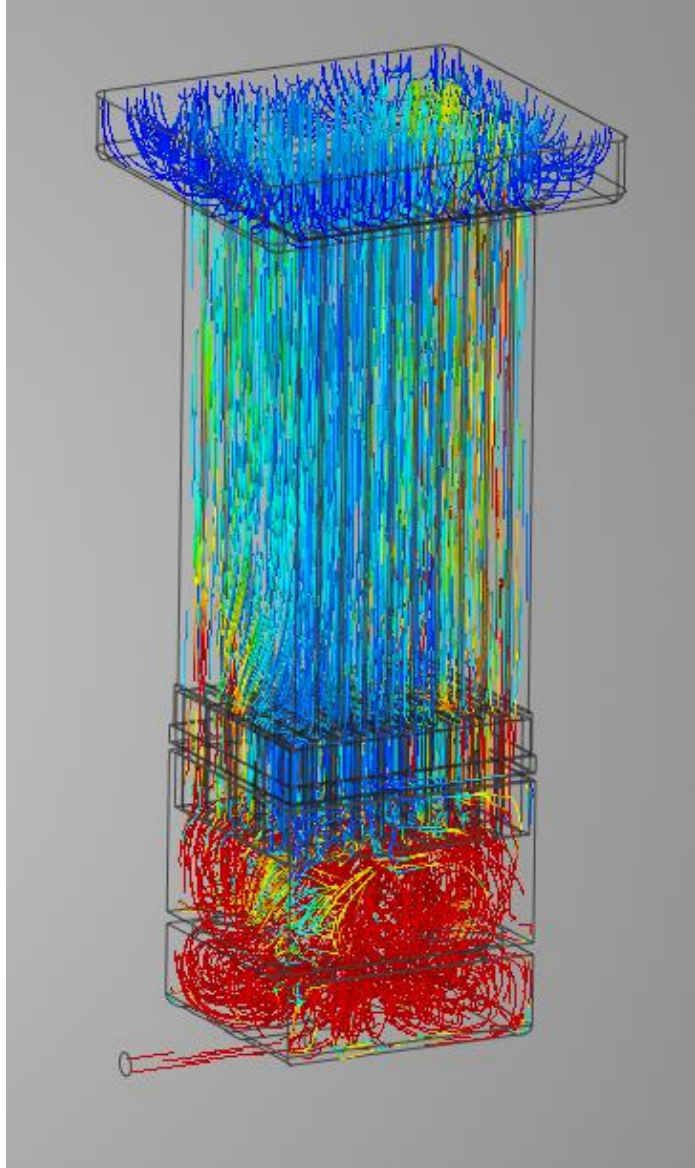
*Q = charge volume density (Ah/L)*



# Experiment #3: Vortex addition

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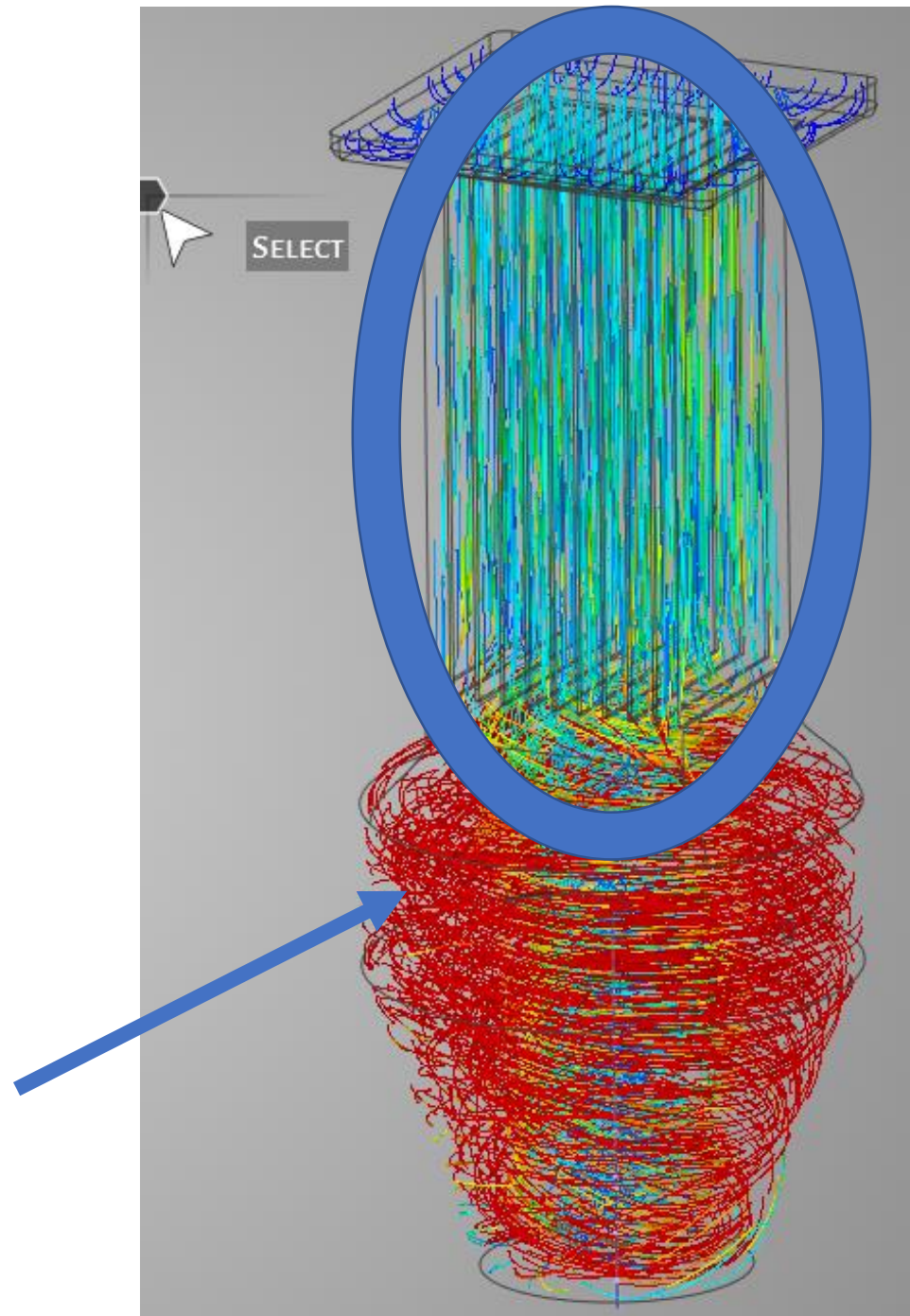




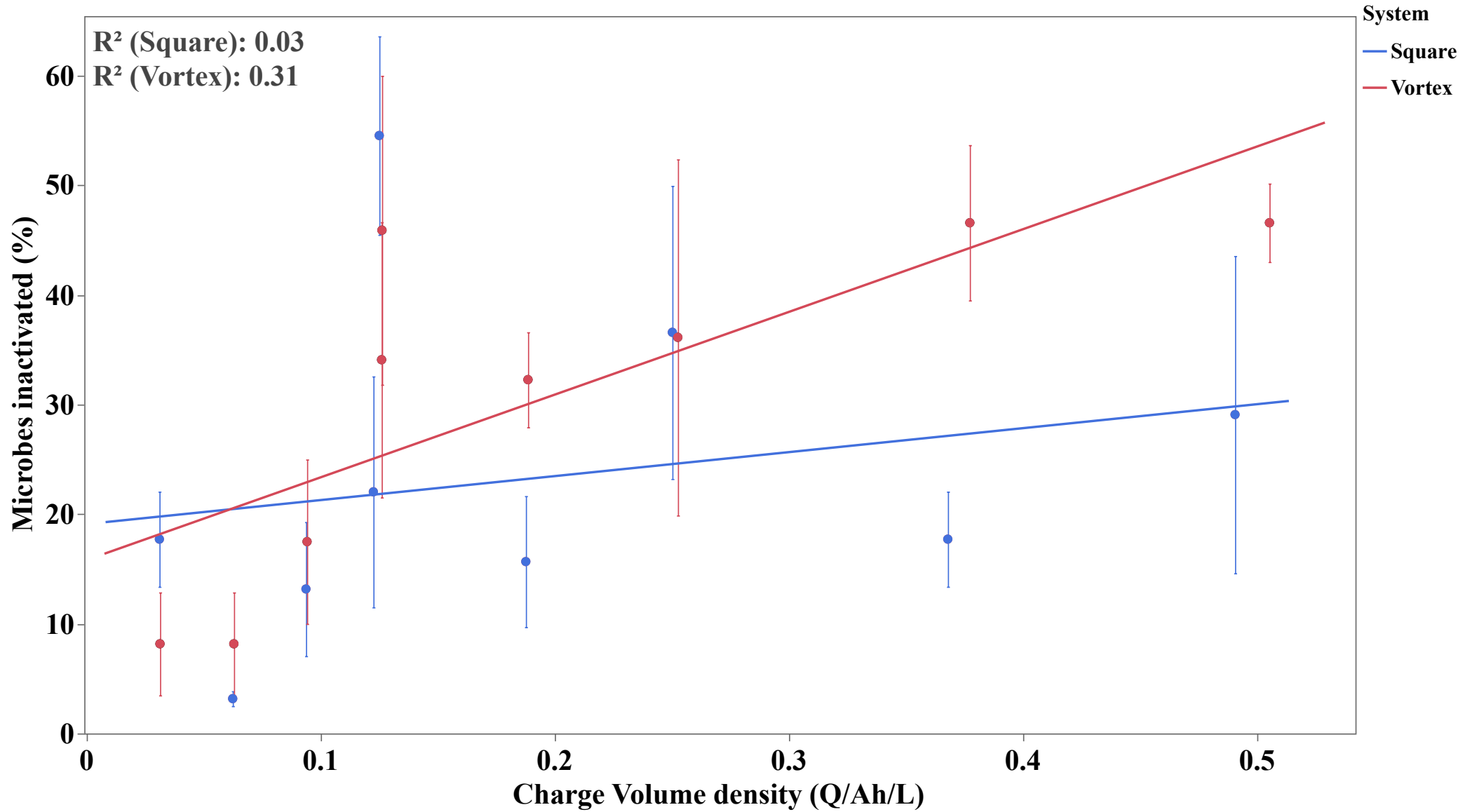


# Homogenizing flow

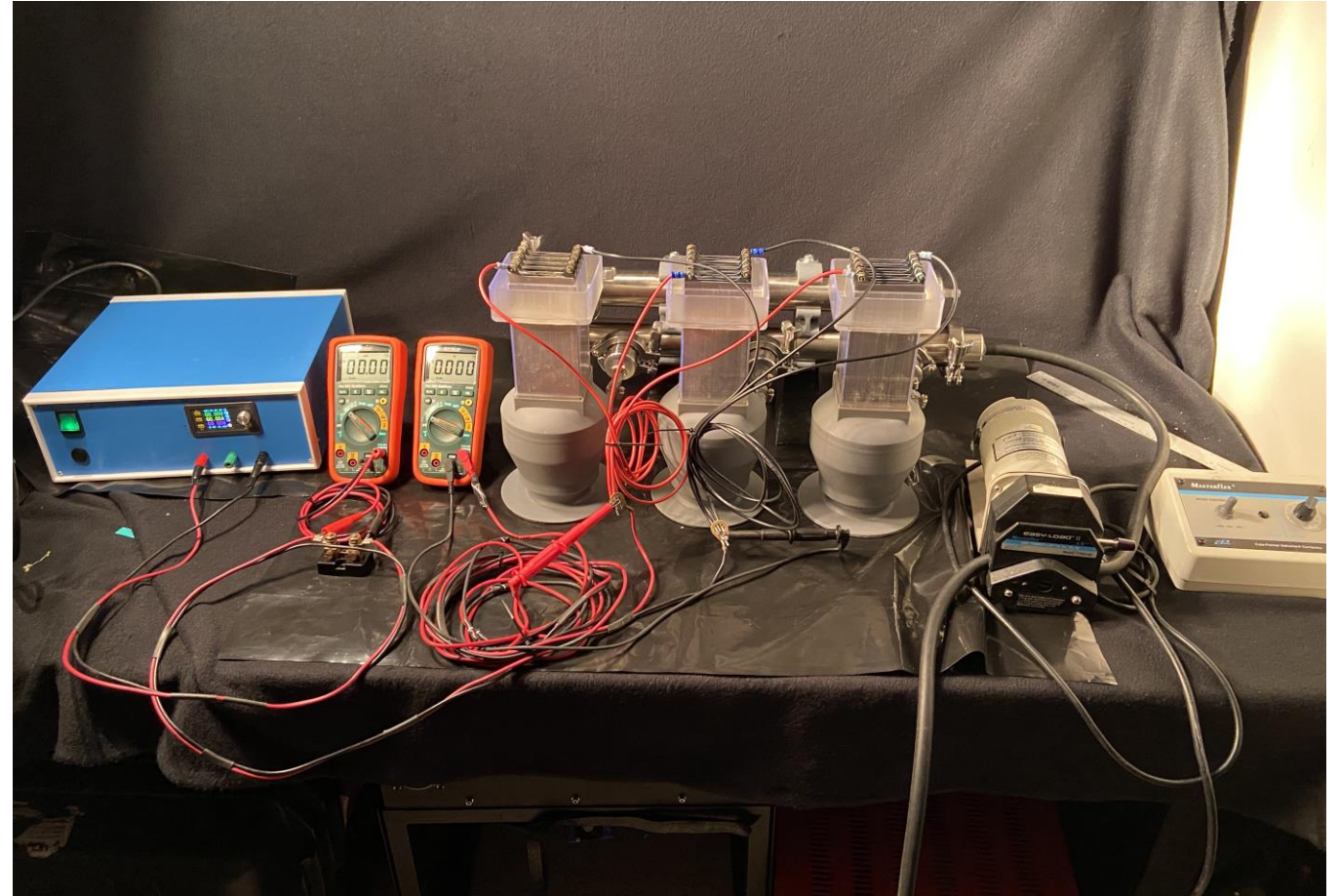
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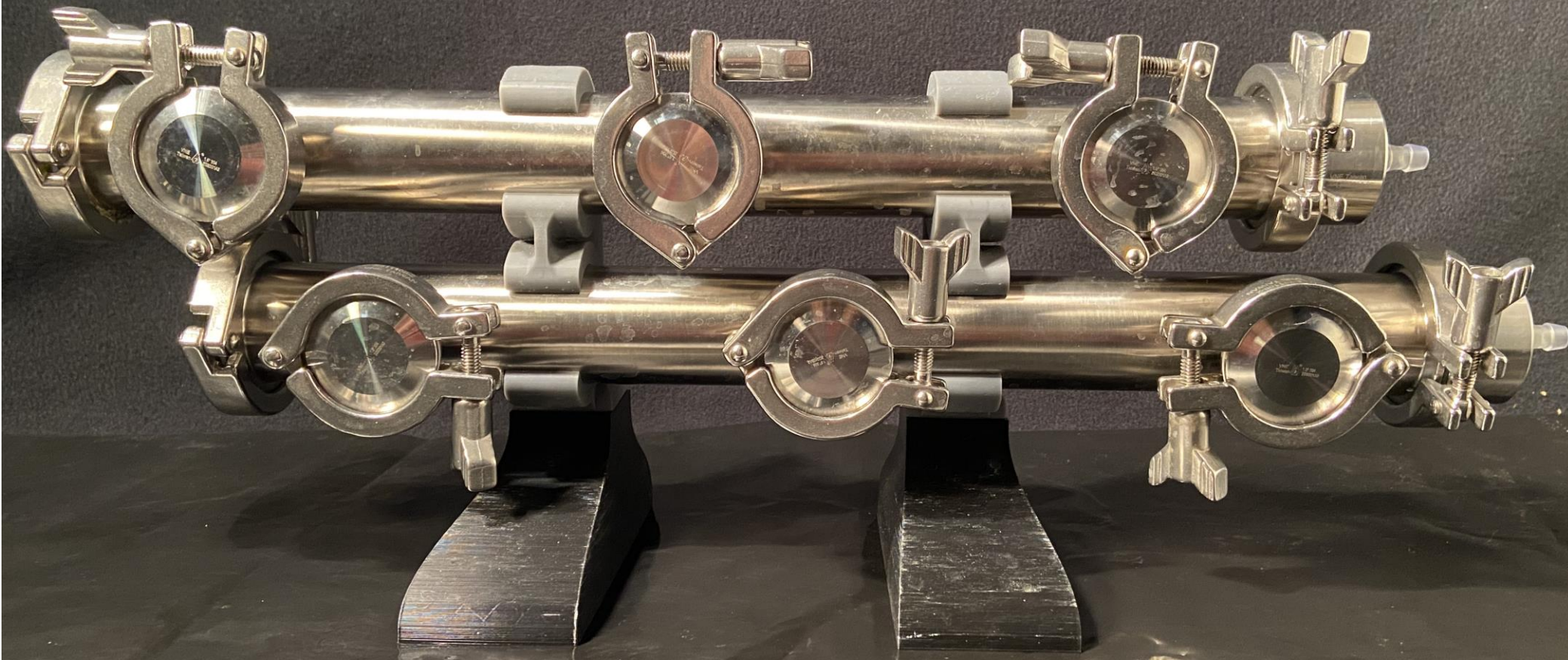


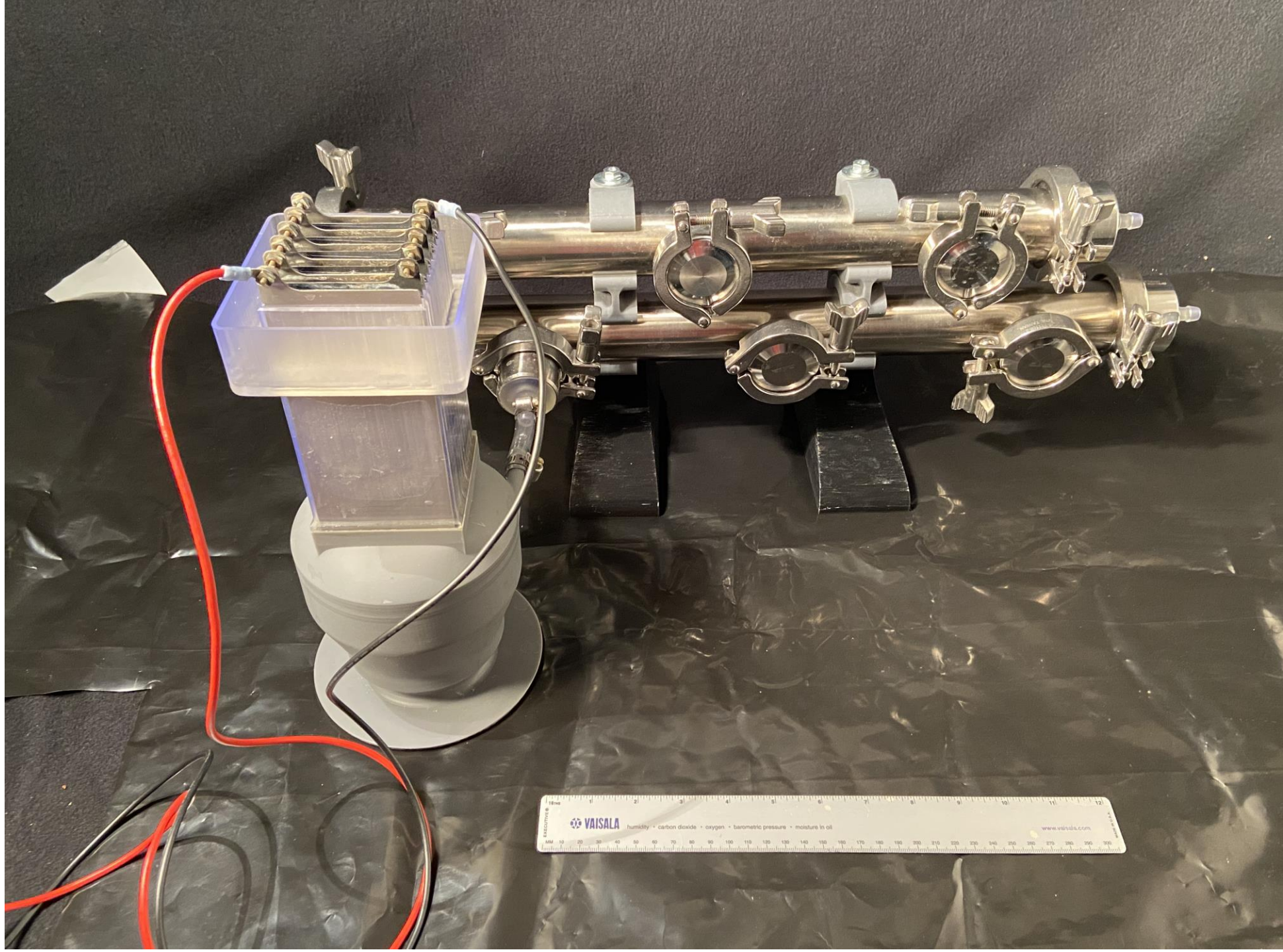




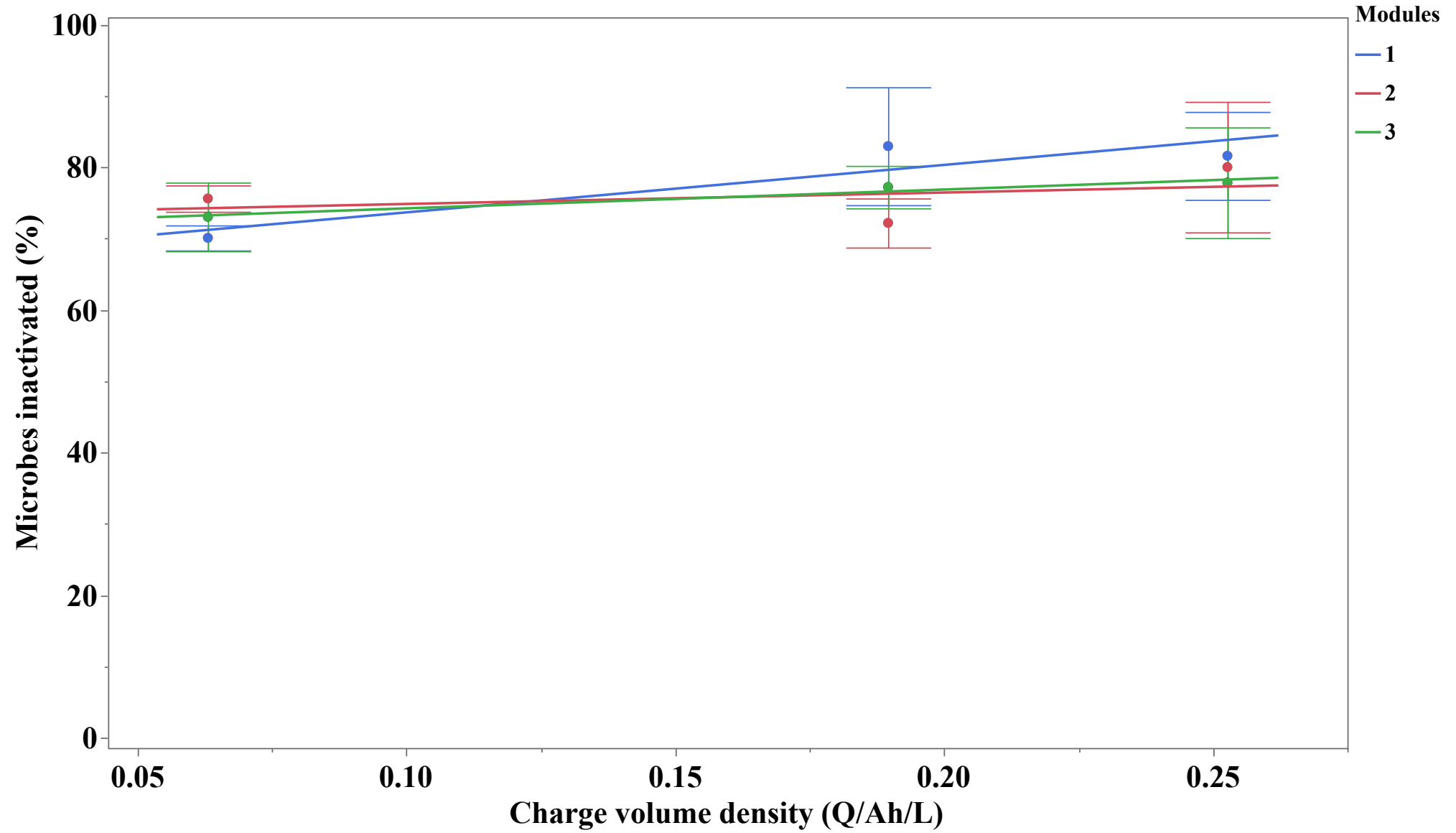
Experiment #4:  
Testing  
scalability







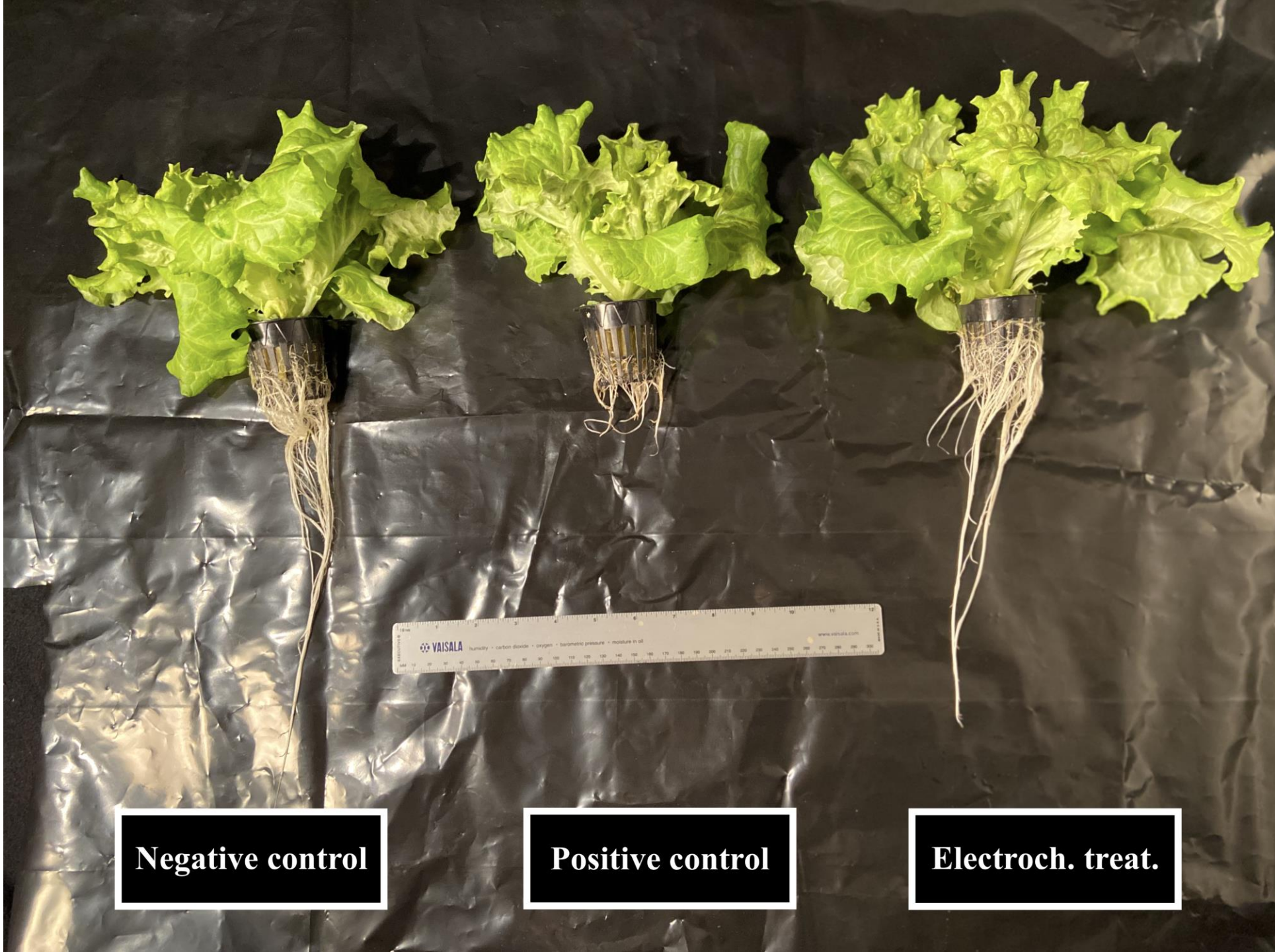




# Experiment #5: Preventing pathogenicity in lettuce

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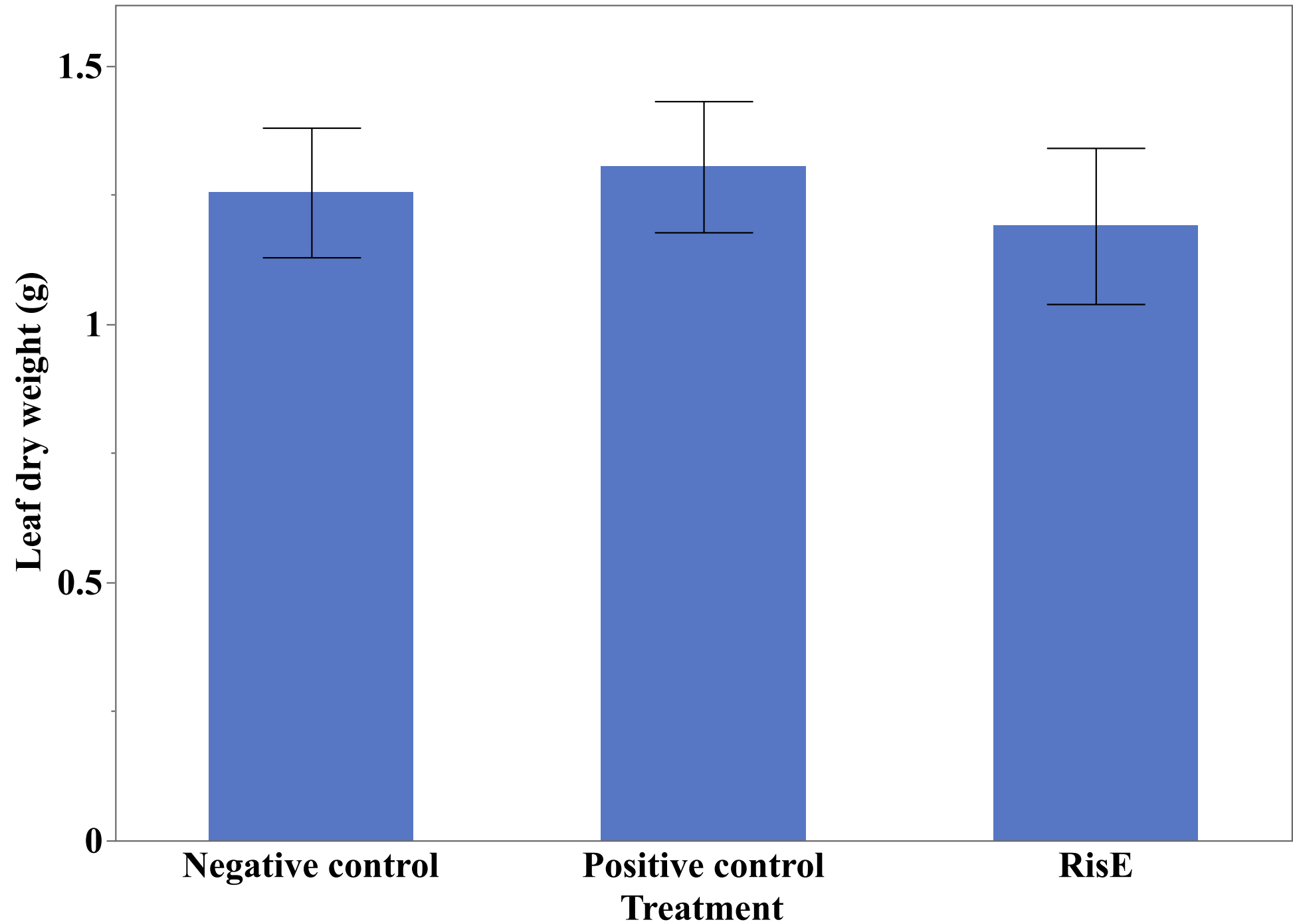


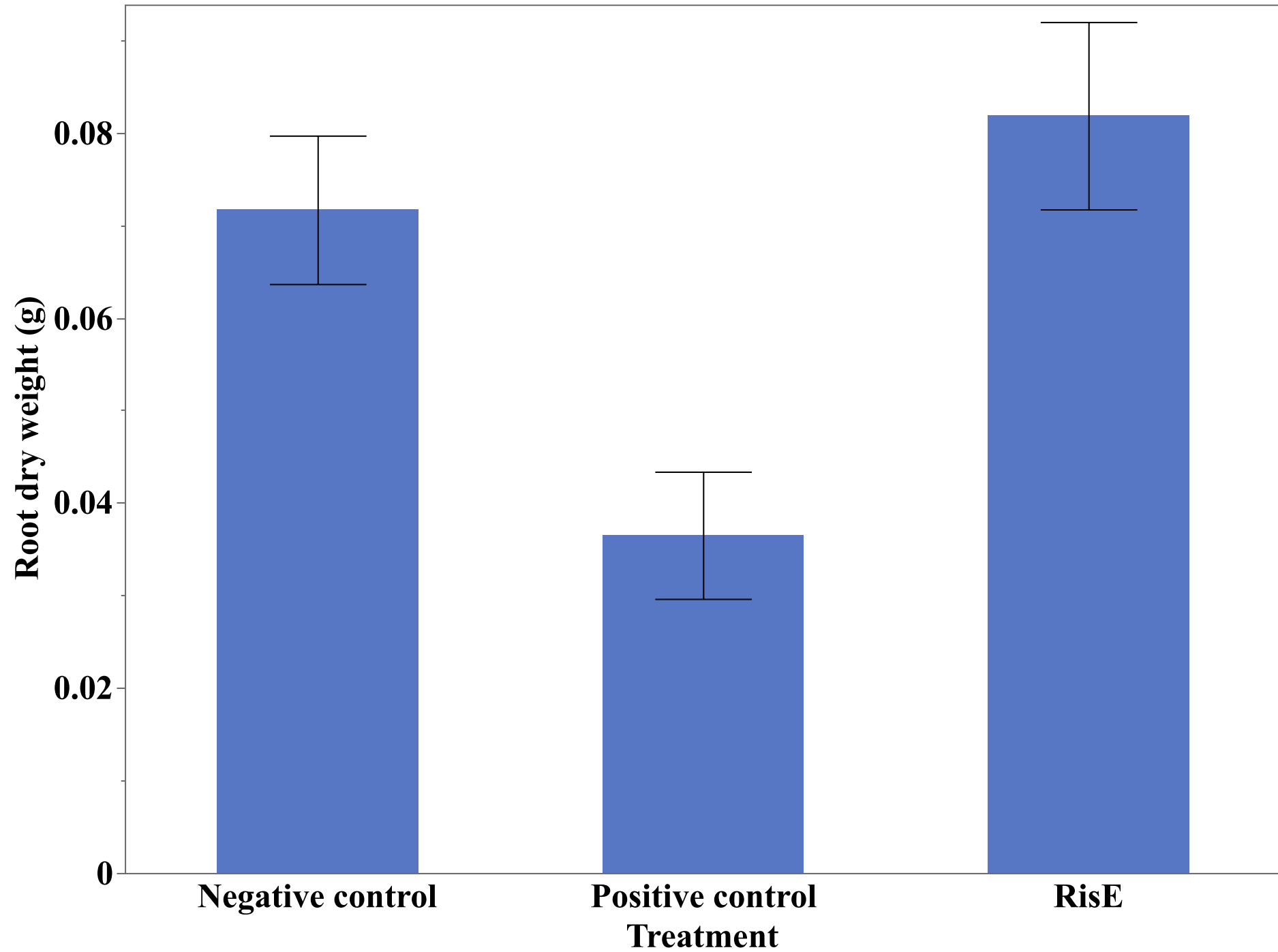
**Negative control**

**Positive control**

**Electroch. treat.**







# Conclusion

- Spacing electrodes could be increased
- Adding a vortex at base increased inactivation rates
- Pathogenicity from *Pythium* sp. can be avoided using electrochemical water treatment

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