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NOWRA



INFILTRATOR
water technologies



The Role of Onsite Wastewater Recycling in Sustainable Community Development

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Background:



- B.S./M.S. Chemical Engineering – Miss. State
- Ph.D. Chemical & Biomolecular Engineering - ND 
- Focus: clean water, renewable energy, sustainability
- 18 years bioenvironmental research 
- 13 years nanomaterials research in solar energy conversion and electrochemical energy storage



This presentation is:

- Philosophical but Applicable and Strategic
- Back to the Future! (forward-looking)

and is not:

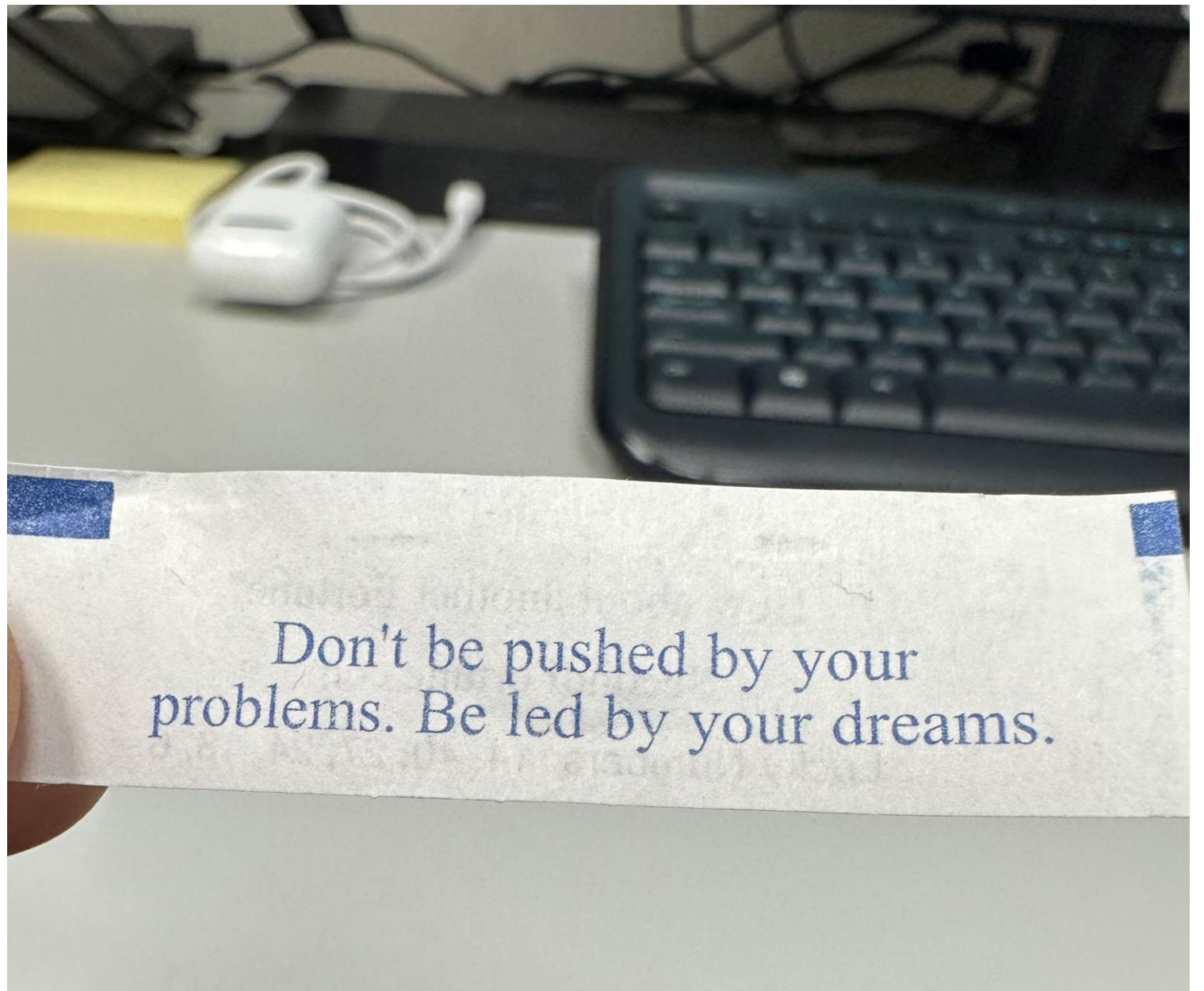
- promotional or solution-oriented

The comments and opinions made in this presentation are those of the presenter and not of NOWRA or the Mega-Conference sponsors.

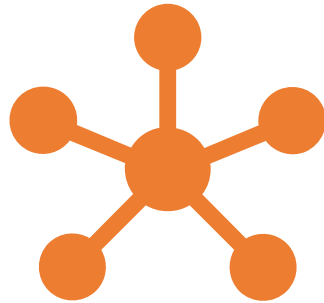
(read in deep, fast, disclaimer-guy voice)

Don't be pushed by
your problems, be
led by your dreams.

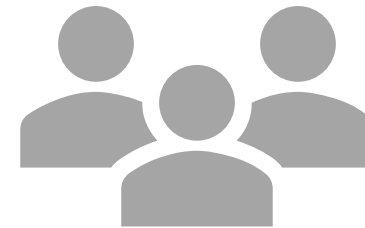
Ralph Waldo
Emerson



What is Environmental Justice?



Broad and Multidimensional



Context-Driven

What Does Environmental Justice Look Like?

Environmental justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.

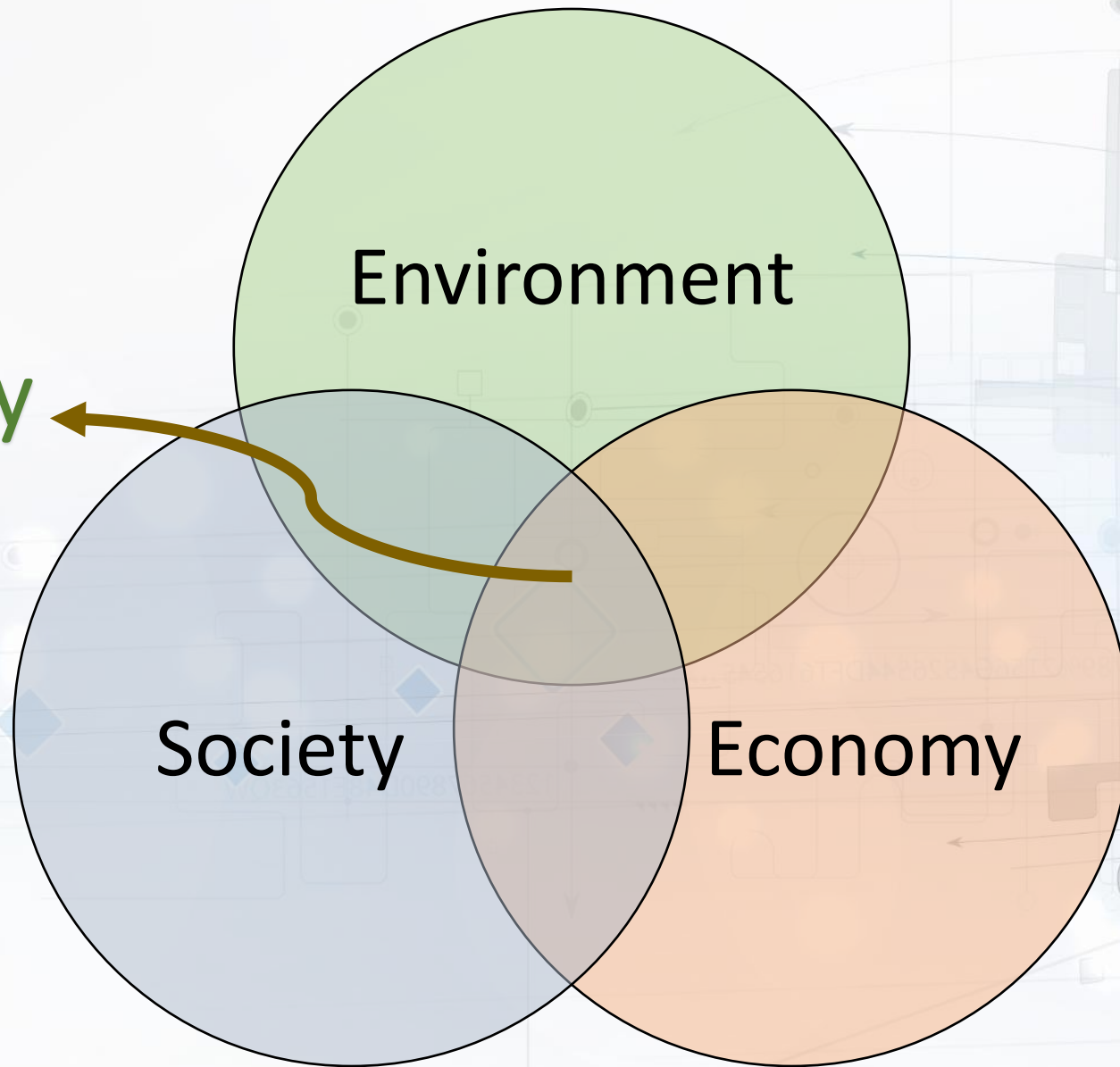
-U.S. EPA

What Does Environmental Justice Look Like?

Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies.

-U.S. EPA

Sustainability



Environment

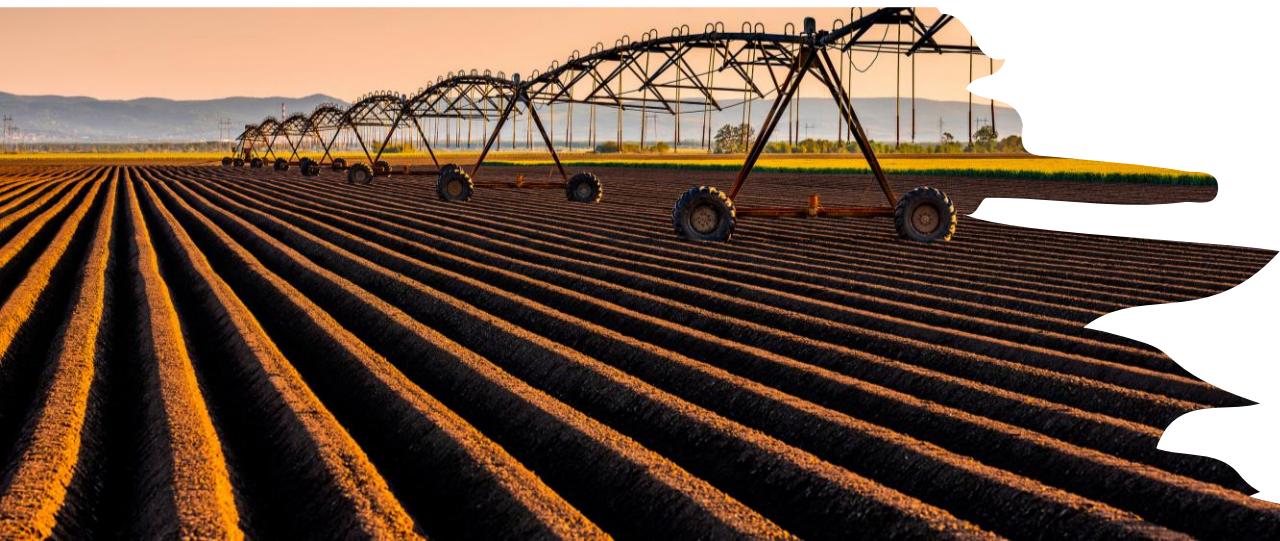
Society

Economy



Sustainable Communities





Resource
Interconnectivity



Resource Interconnectivity



SUSTAINABILITY...?



Sustainability is Context-Driven

Sustainable Technology Revolution



Back to the
Future

Environmental Justice



Sustainable Technology...

+

Access

Intersections of Sustainability & Access

Accessible

- Economical/Affordable
- Simple to Install/Operate
- Reliable Operation
- Robust Performance
- Minimal maintenance

Sustainable

- Minimal Power Consumption
- Renewable Energy Source
- Circular/Recycled Raw Materials
- Resource Recovery and Conversion
- Remote Monitoring and Control

Catalyzing Sustainable Community Development via Onsite Wastewater Resource Conversion & Recovery

Materials and Manufacturing
Recycler's Feedstock
Waste Opportunities
Sustainable Chains



Infrastructure
Development

Energy

Waste-to-Fuel

Anaerobic Digestion
Microbial Fuel Cell
Urea/Ammonia Fuel Cell
Urea/Ammonia Electrolysis

Wastewater
Resource
Conversion

Clean
Water

Fertilizer

Agriculture Resource

Lower Maintenance
Vanishing Septage
Circular Environment
Nutrient Mitigation

Water Treatment

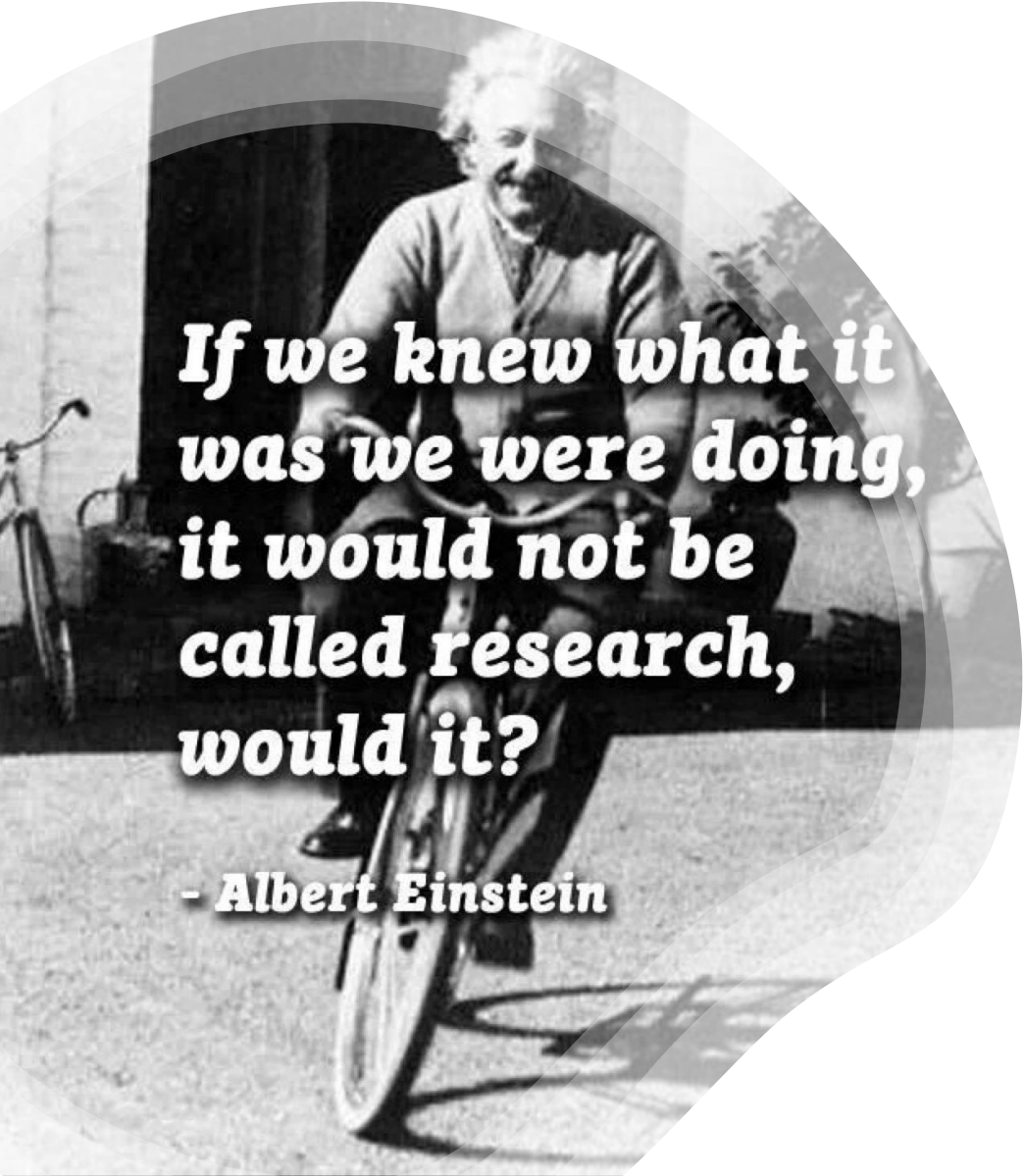
Economical at BAT
Flexible Footprint
Renewable Powered
Aquifer Return

What does the road to
sustainable and accessible
technologies look like?

Mechanical & Structural Engineering

- [Material Design] Media Design
- [Fundamental] Parameters
- [Functional] Reactor Design
- [FEA, CFD, Dynamic] Modeling & Simulation
- [Mechanical/Structural] Prototyping
- Experimental Trials
- Refinement & Optimization

Accessible and Sustainable Technology through
High-Resolution Research & Development

A black and white photograph of Albert Einstein riding a bicycle. He is wearing a light-colored sweater and dark trousers. The image is framed within a semi-transparent, rounded rectangular shape.

***If we knew what it
was we were doing,
it would not be
called research,
would it?***

- Albert Einstein



Success in research is often knowing what to do when you don't know what it is you are doing!

ALL STARS

- **Cost**
- Performance
- Footprint



PROCESS INTENSIFICATION

OTHER KEY PLAYERS

- Robustness & Reliability
- Simple Installation/O&M
- Remote Monitoring



Innovation Enables Access to
Sustainable Technology

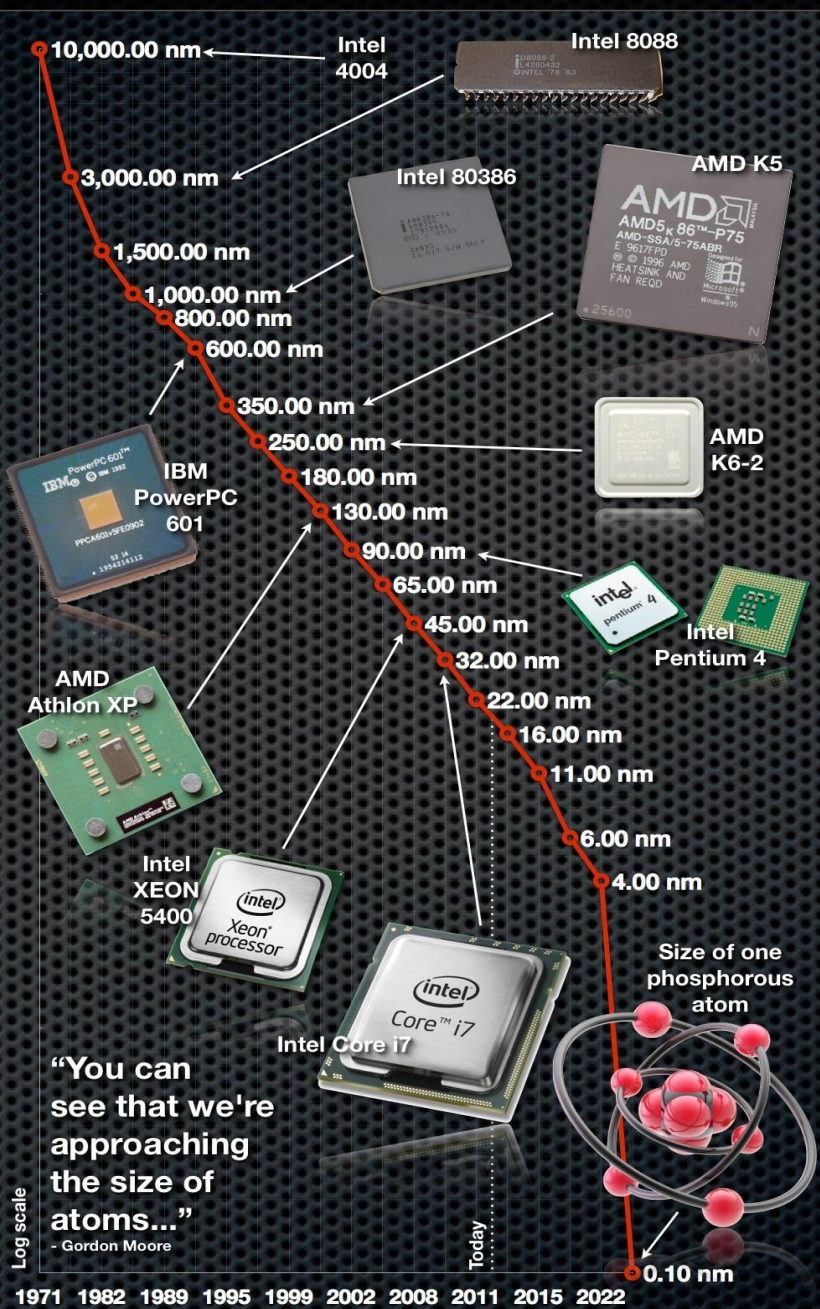
**Onsite
Wastewater
Treatment &
Recycling:**
Product
Development
Perspectives

Differentiated approach to R&D
organically differentiates solution
strategies and product design



How small can a transistor be?

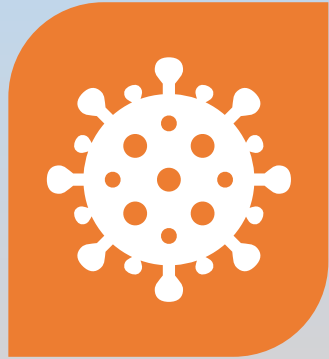
The evolution of microprocessor manufacturing processes



High Resolution R&D Integrates High Definition into Products and Solutions



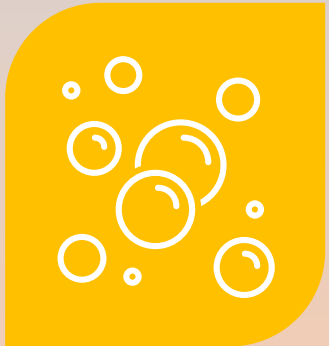
Process Intensification in Advanced Onsite Wastewater Treatment & Recycling



**MEDIA
DESIGN**



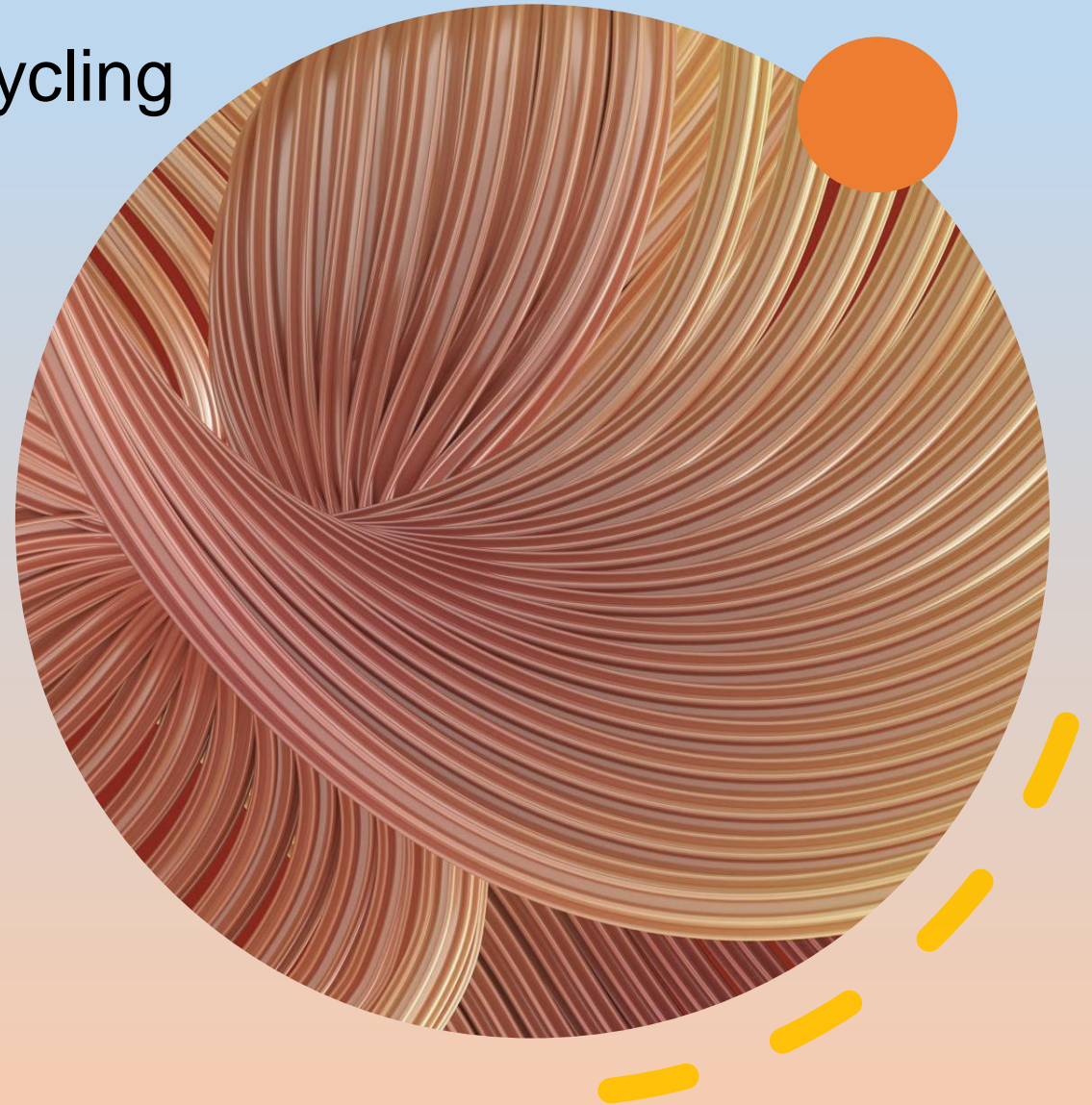
**REACTOR
FLUID
DYNAMICS**



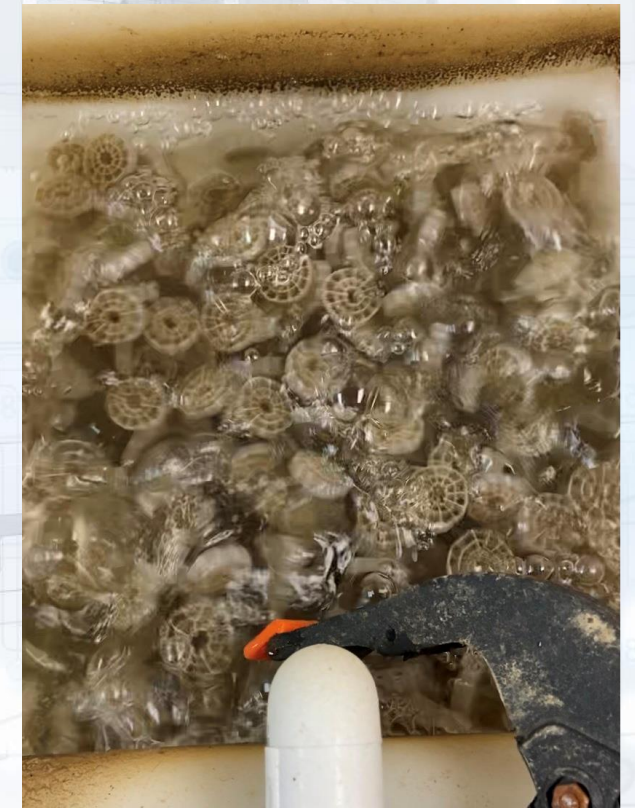
**AIR DELIVERY
AND O₂
TRANSFER**



**BIOLOGICAL
SOLIDS
REDUCTION**



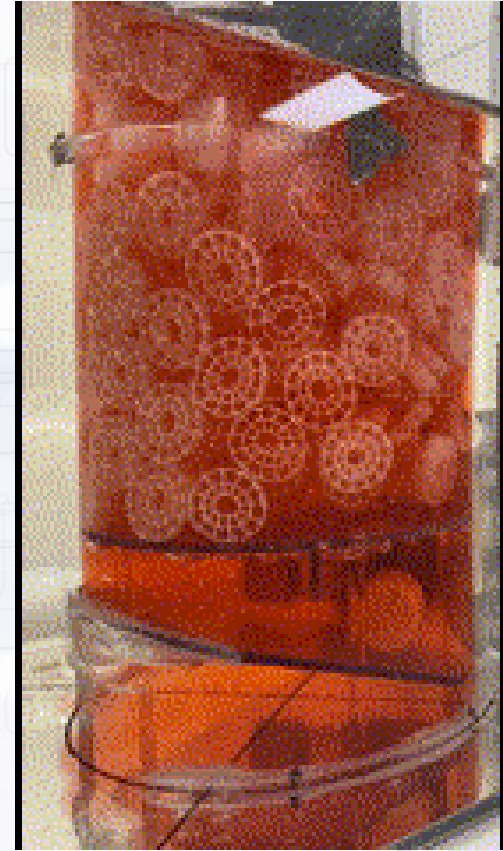
MEDIA TYPE & DESIGN



REACTOR FLUID DYNAMICS

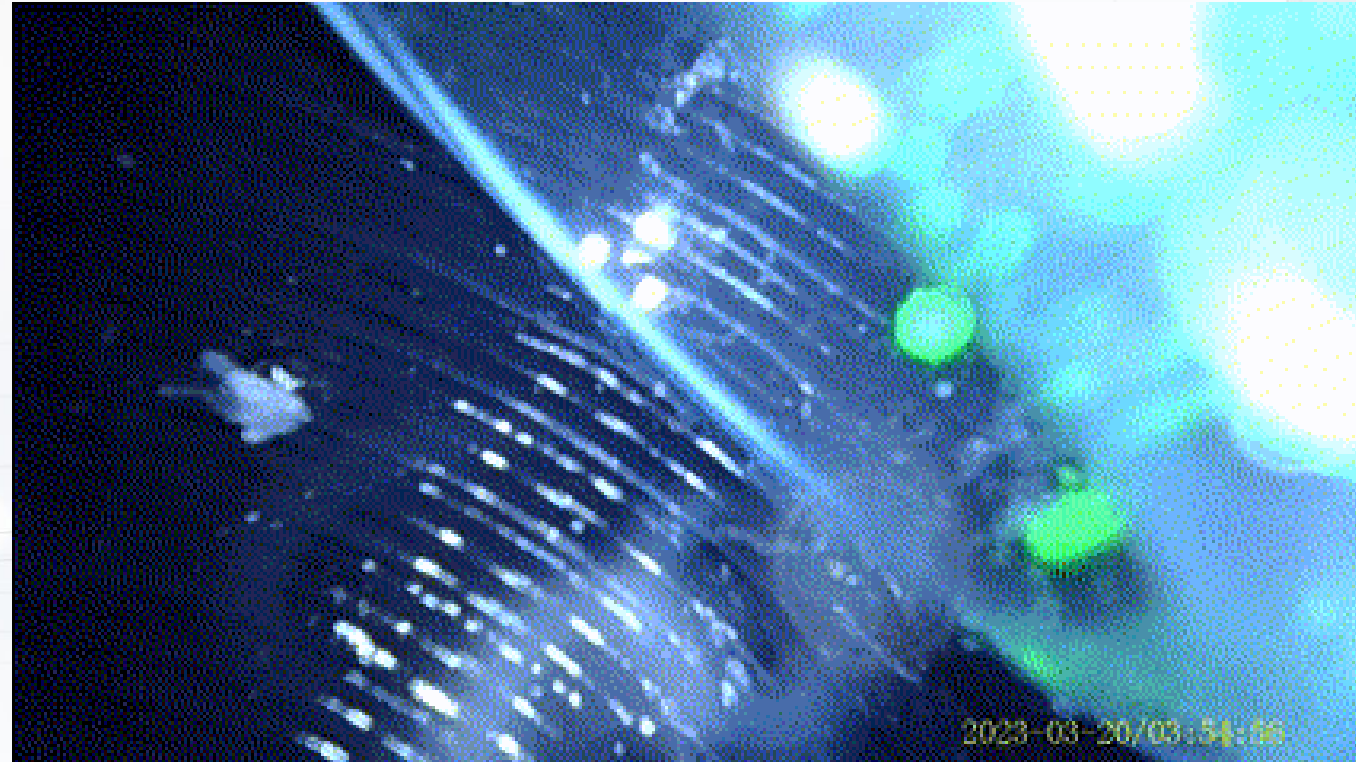


Dye Injection



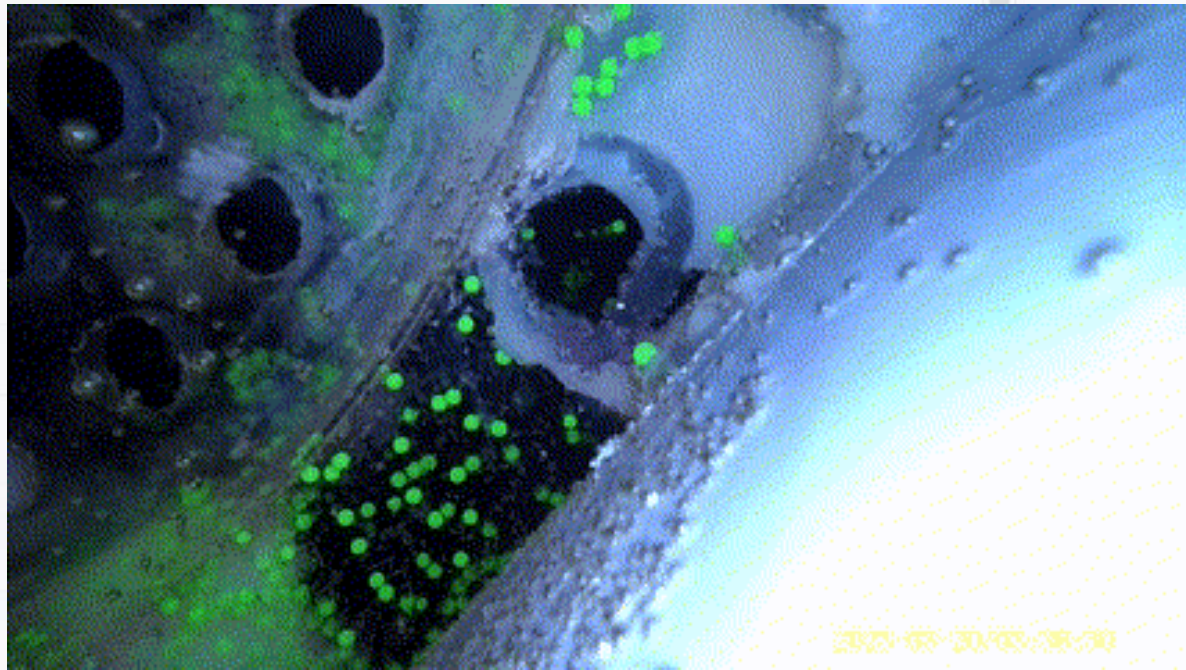
7 minutes

REACTOR FLUID DYNAMICS

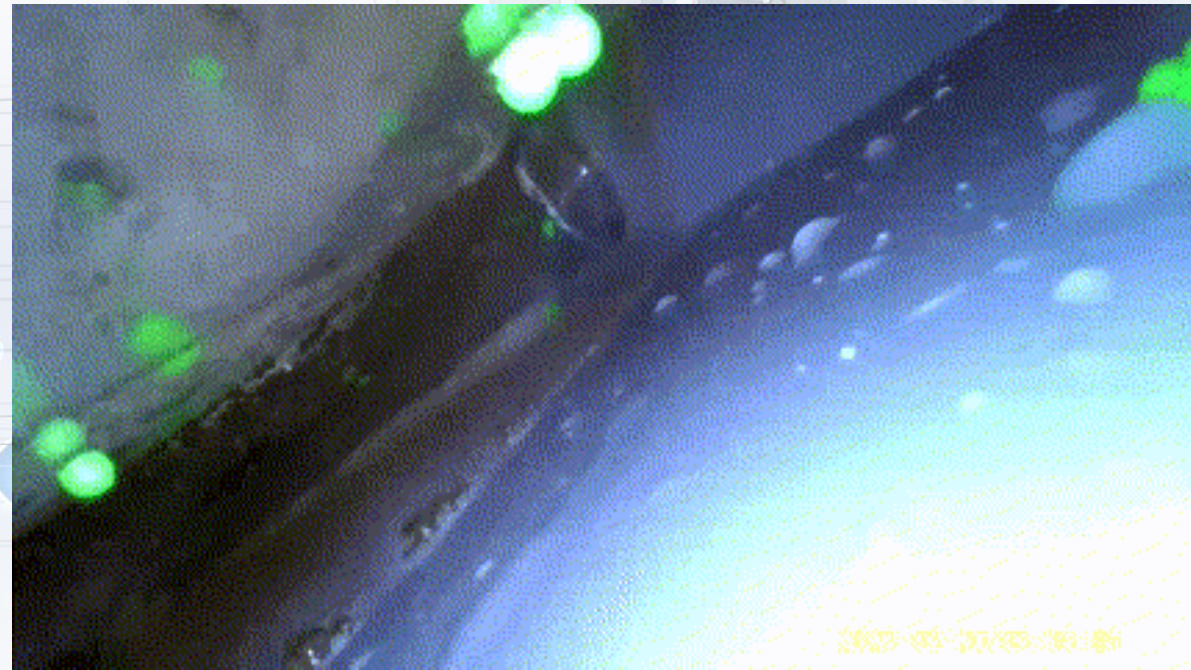


Bottoms Recirculation

REACTOR FLUID DYNAMICS

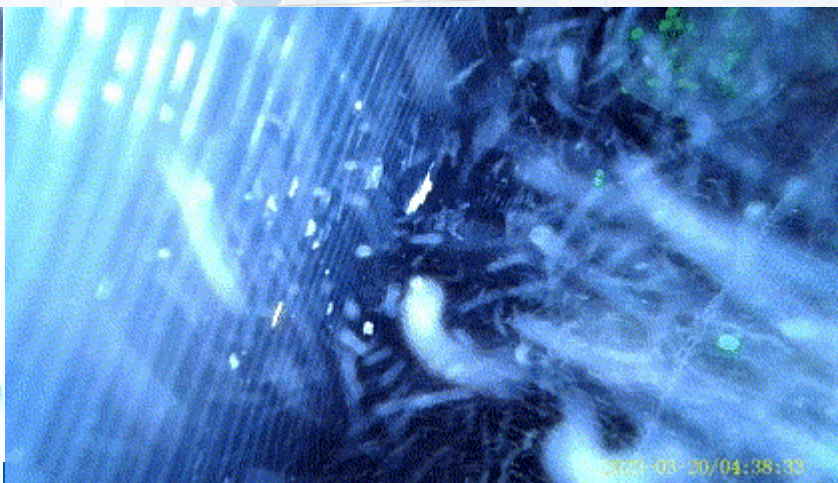
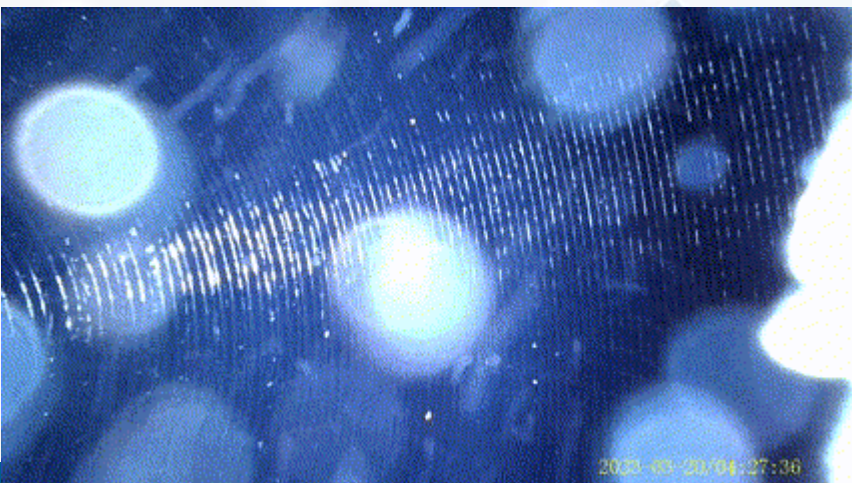
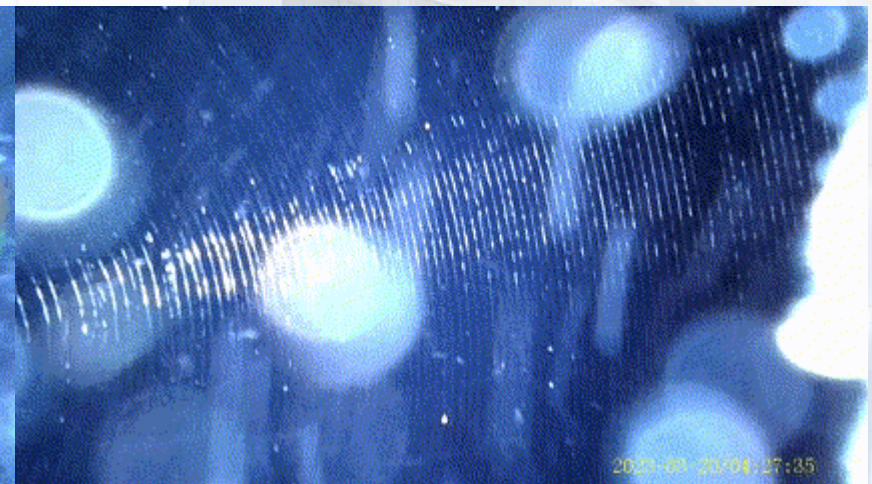
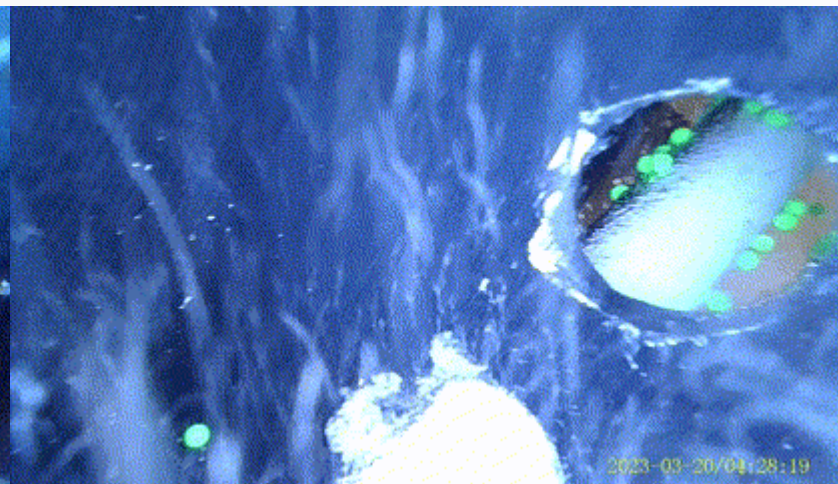
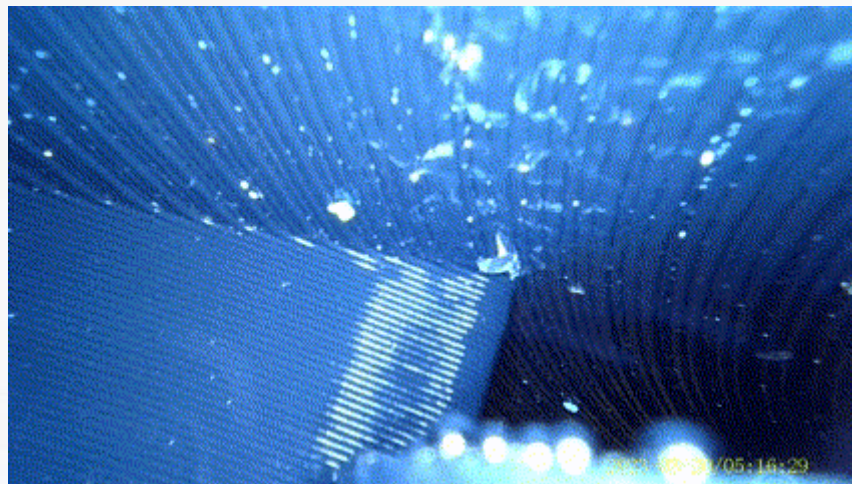


Settled Sludge Removal

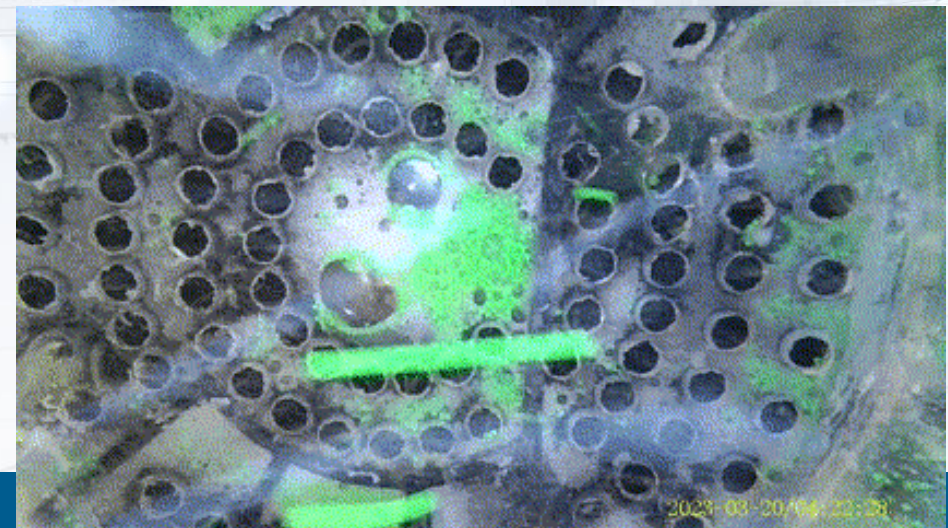
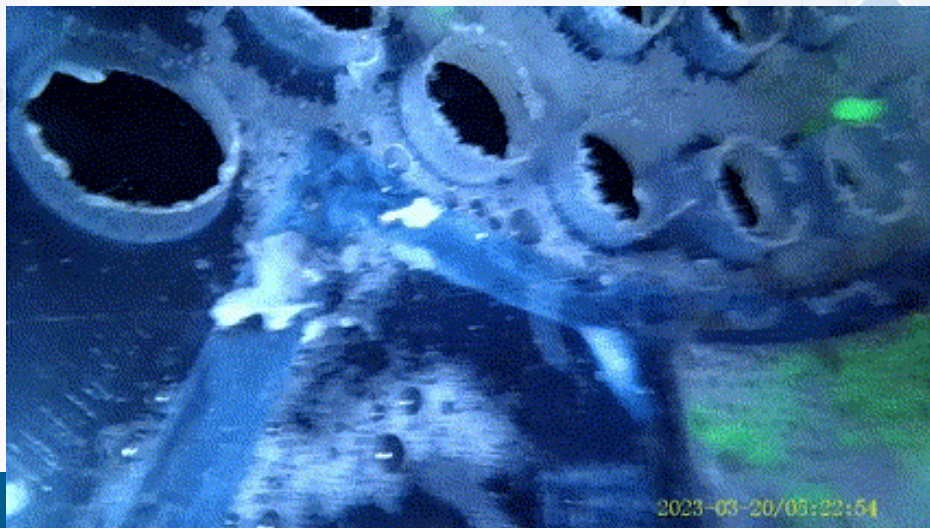
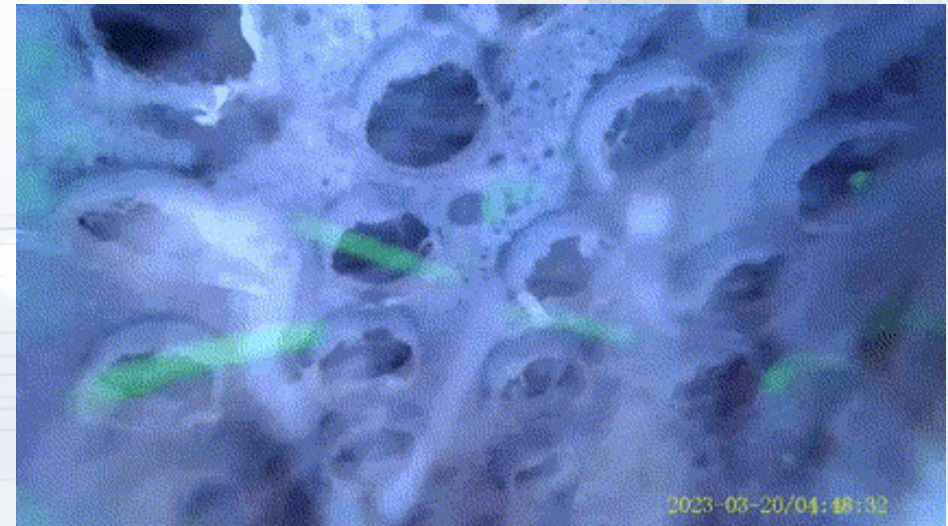
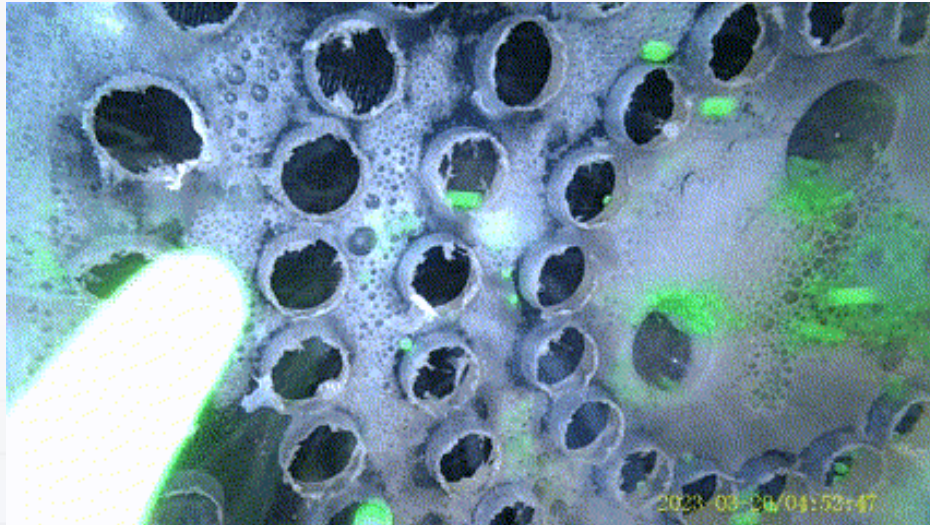


Floating Sludge Removal

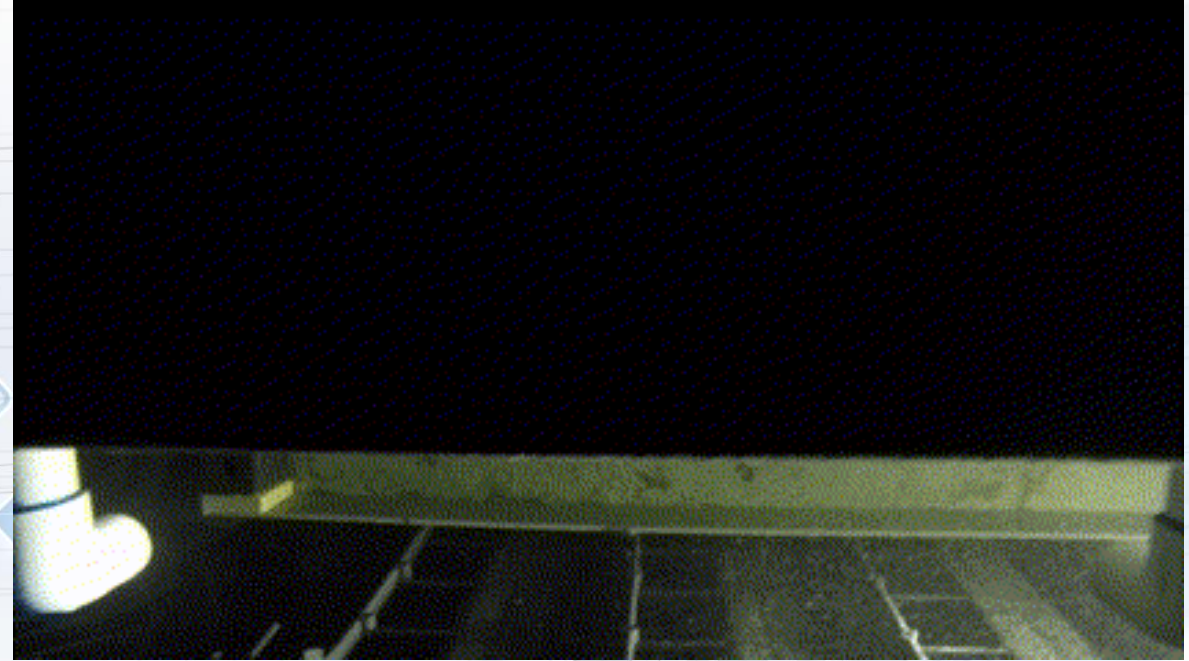
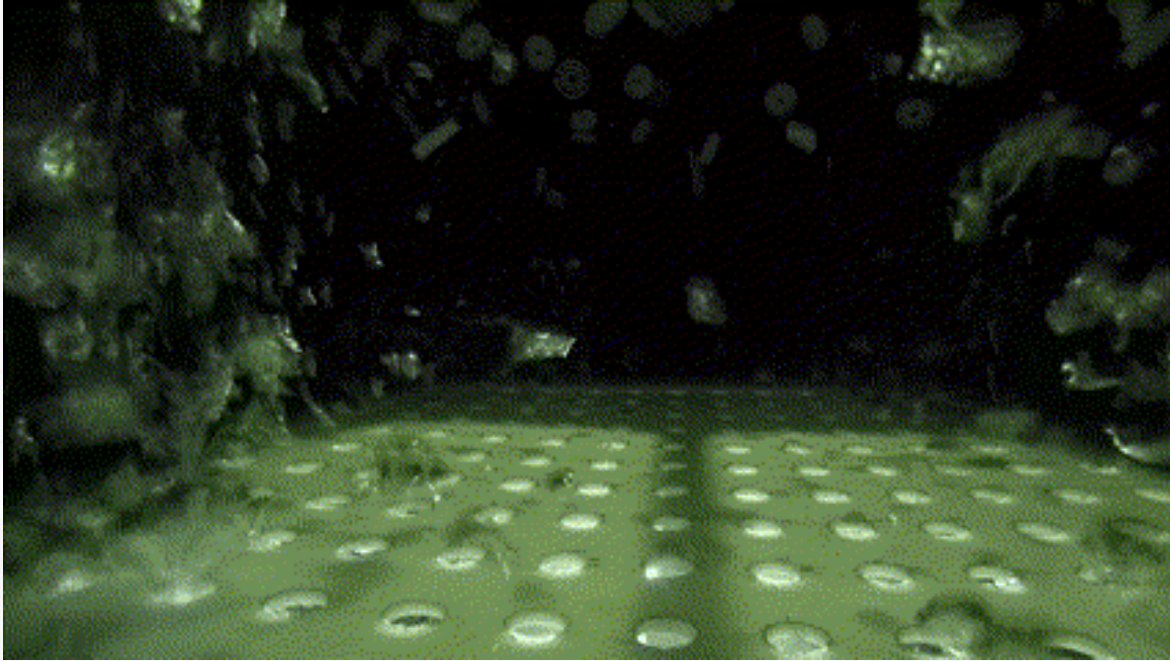
REACTOR FLUID DYNAMICS



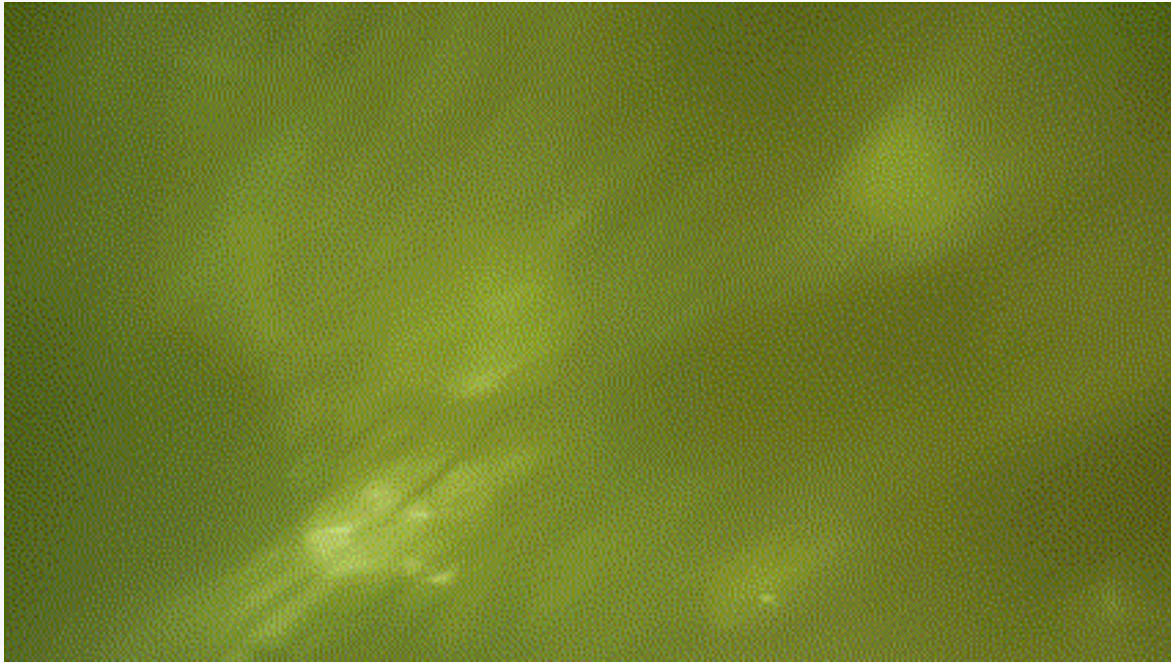
REACTOR FLUID DYNAMICS



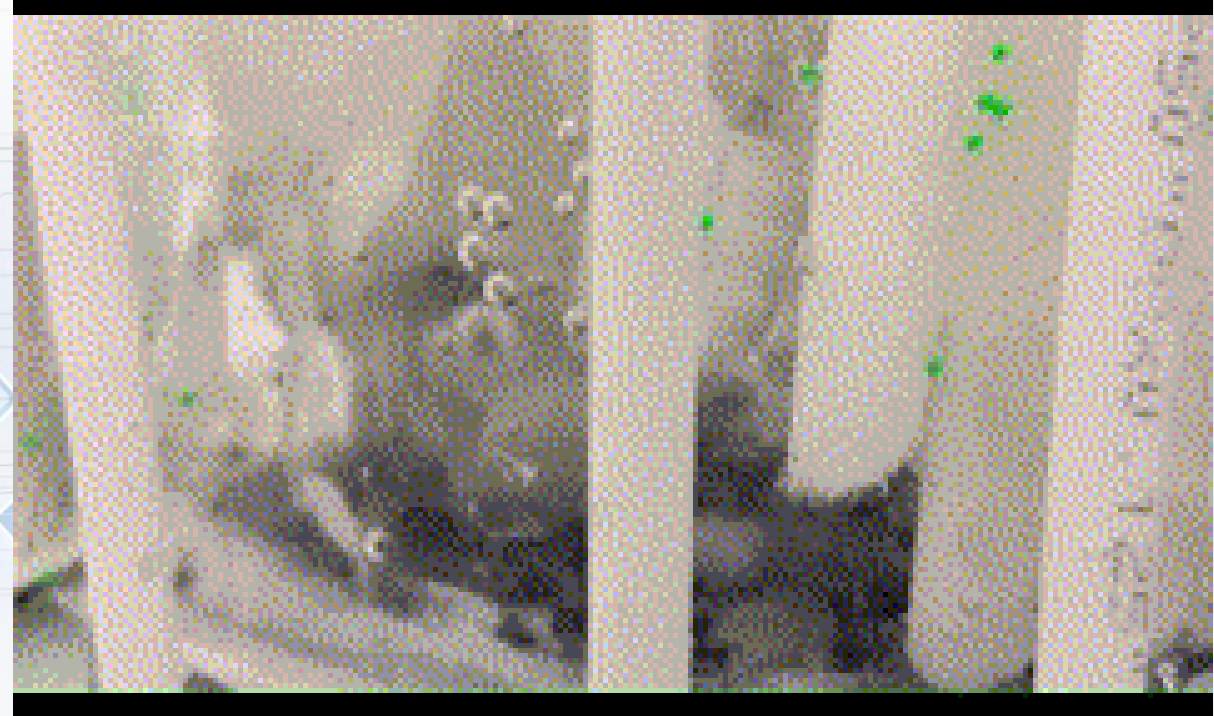
REACTOR FLUID DYNAMICS + AIR DELIVERY AND O₂ TRANSFER



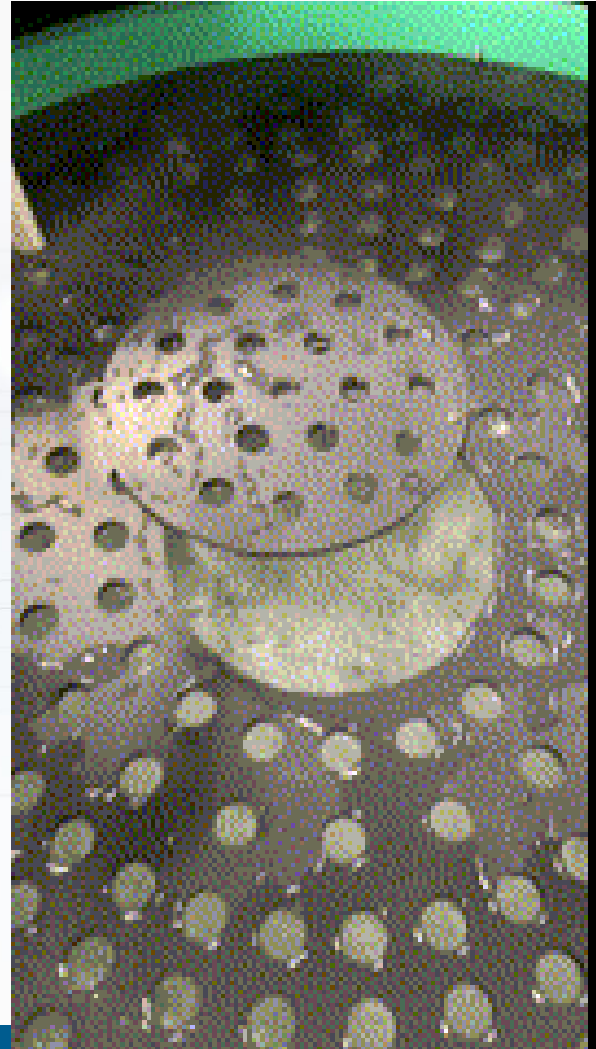
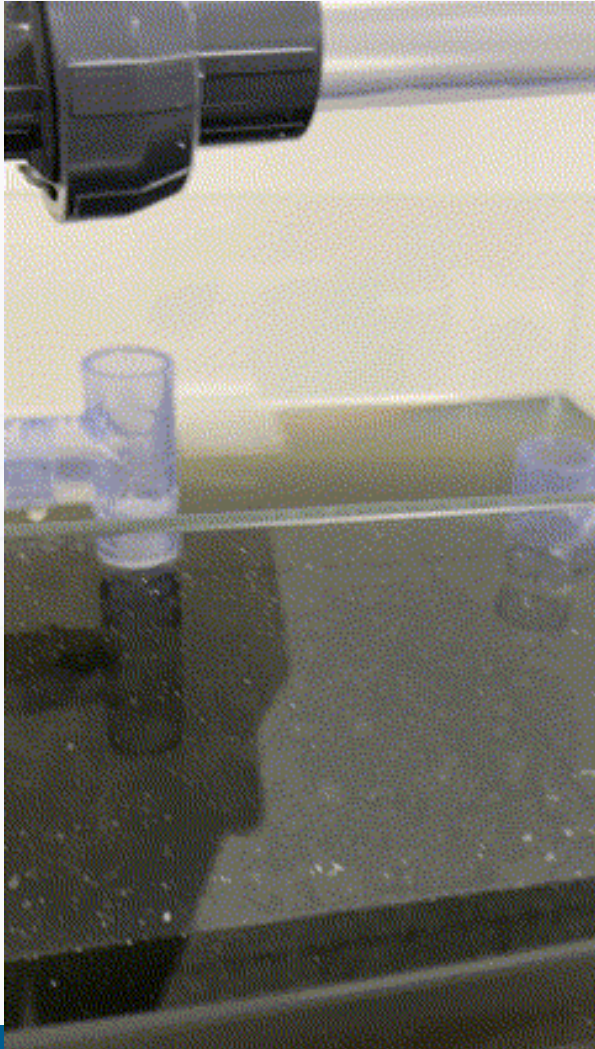
REACTOR FLUID DYNAMICS + AIR DELIVERY AND O₂ TRANSFER



Process and Reactor Design



Process and Reactor Design



Summary

The Road to Environmental Justice **for The Future is Paved With
Sustainable and Accessible Technology**

Summary

The Road to Sustainable and Accessible Technology is Paved with High-Resolution Product Solutions through Process Intensification



Thank You!

Questions

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