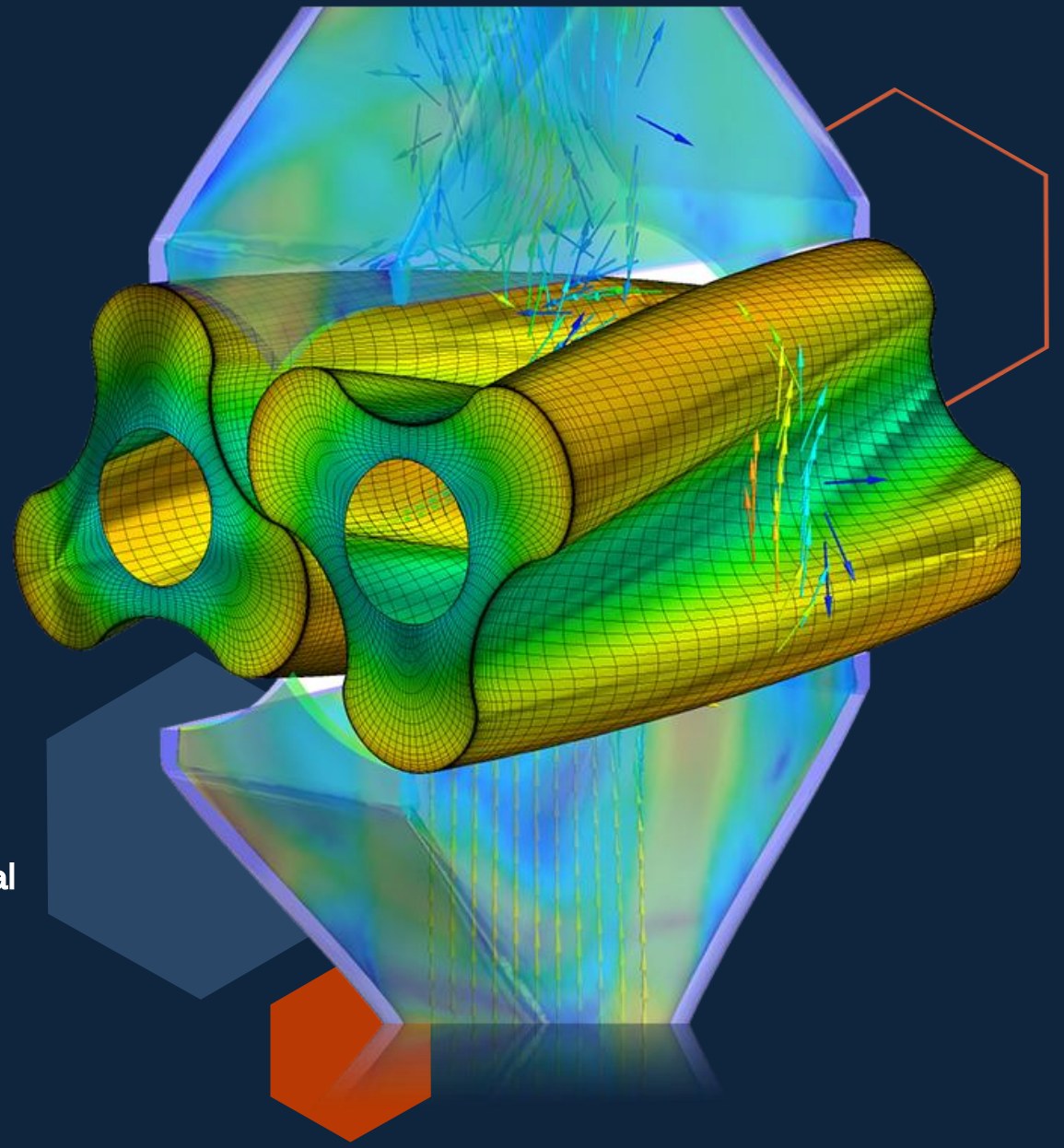
Mechanical Engineering Portfolio

Fernando Velez

R&D Mechanical Engineer

Specializing in Mechanical Systems, Computational Thermal & Fluid Analysis, and Advanced Materials Manufacturing Technology



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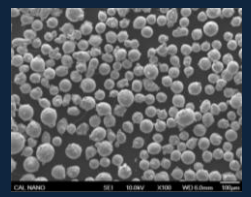
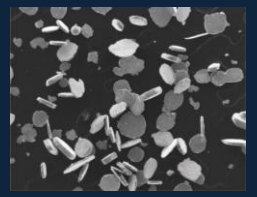
Cryogenic Materials

- Cal Nano advances cryogenic metal milling technologies to industrial grinding for commercial production of polymer-based materials
- New R&D engineering efforts in industrial machinery, cryogenic line retrofitting, and particle size reduction methods
- New customers, material processing demand, operating procedures, safety standards, and infrastructure

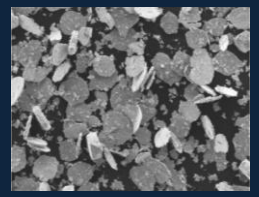
Metallic Powder Morphology



As received
(Spherical GA powder)



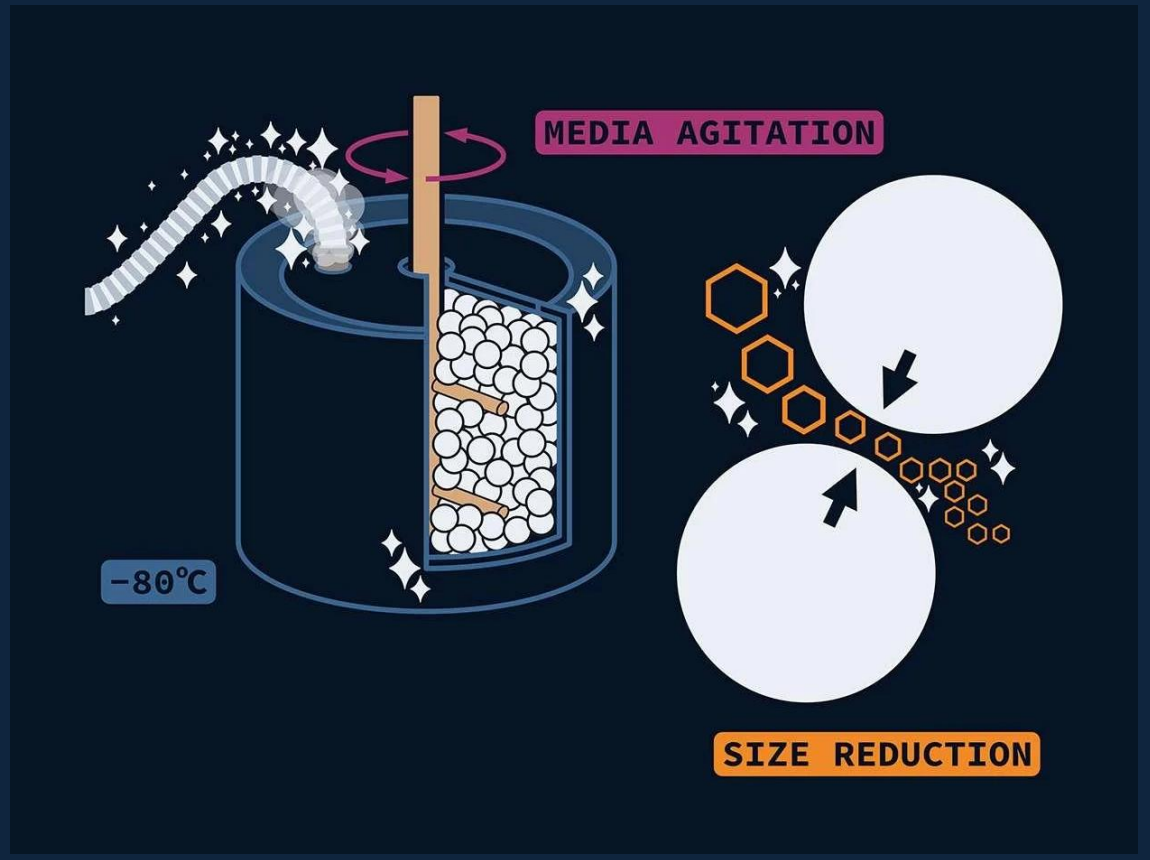
Flattening
(1-2 hrs.)



High Aspect Ratio
Flake
(3-7 hrs.)

Agglomeration
(8+ hrs.)

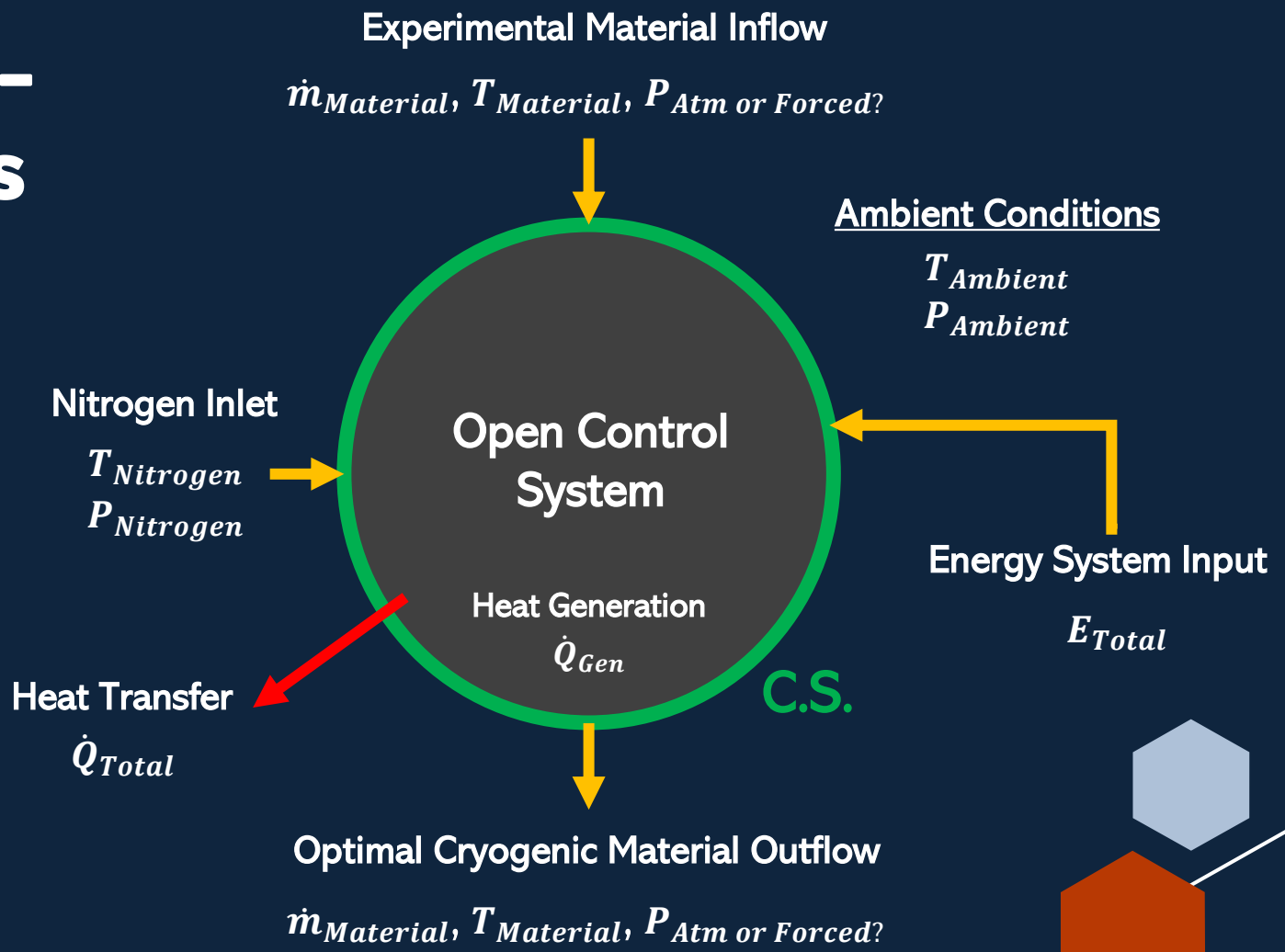
Cryogenic Metal Milling & Processing



Cryo-milling: low temperature ball milling process of various materials results in finer particles sizes and enhanced material properties

Thermodynamics – Cryogenic Hybrids

- Liquid in cryogenic ball milling replaced by cryogenic gas in polymer grinding
- Technology requires new engineering design
- Polymer-based materials operate at distinct glass transition temperatures
- Greater control of polymer particle size reduction



Mechanical Engineering Methodology

Step 1: Material Reactivity

Considerations:
- Hybrid Machine Performance
- Natural/Forced Flow
- Maximum Feed Rates
- Heat Development
- Material Heat Mitigation

Computational Analysis
- CAD, FEA, CFD
- Accurate?

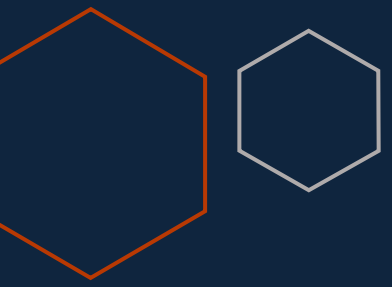
Experimental Data Collection
- Thermocouples, Pressure Sensors, Flow Meters, Etc.
- Data Acquisition in Harsh Environments

Step 2: Nitrogen Retrofitting

Considerations:
- Optimal Material Temperatures/Pressures
- Applicable Nitrogen Phase-States
- Ideal/Non-Ideal Conditions in System
- Control Volume Analysis of Combined Properties
- Mass Flow Rates

Nitrogen Material Testing
- Prototyping & Experimentation
- Harsh Environmental Factors
- Material Reaction to Nitrogen

Step 3 Cryogenic Material Processing



Considerations:
- Analysis of Experimental Data
- Particle Size Sample Testing
- Cryogenic Sampling & Quality Testing
- Material Glass Transition Temperatures

Desired Material?

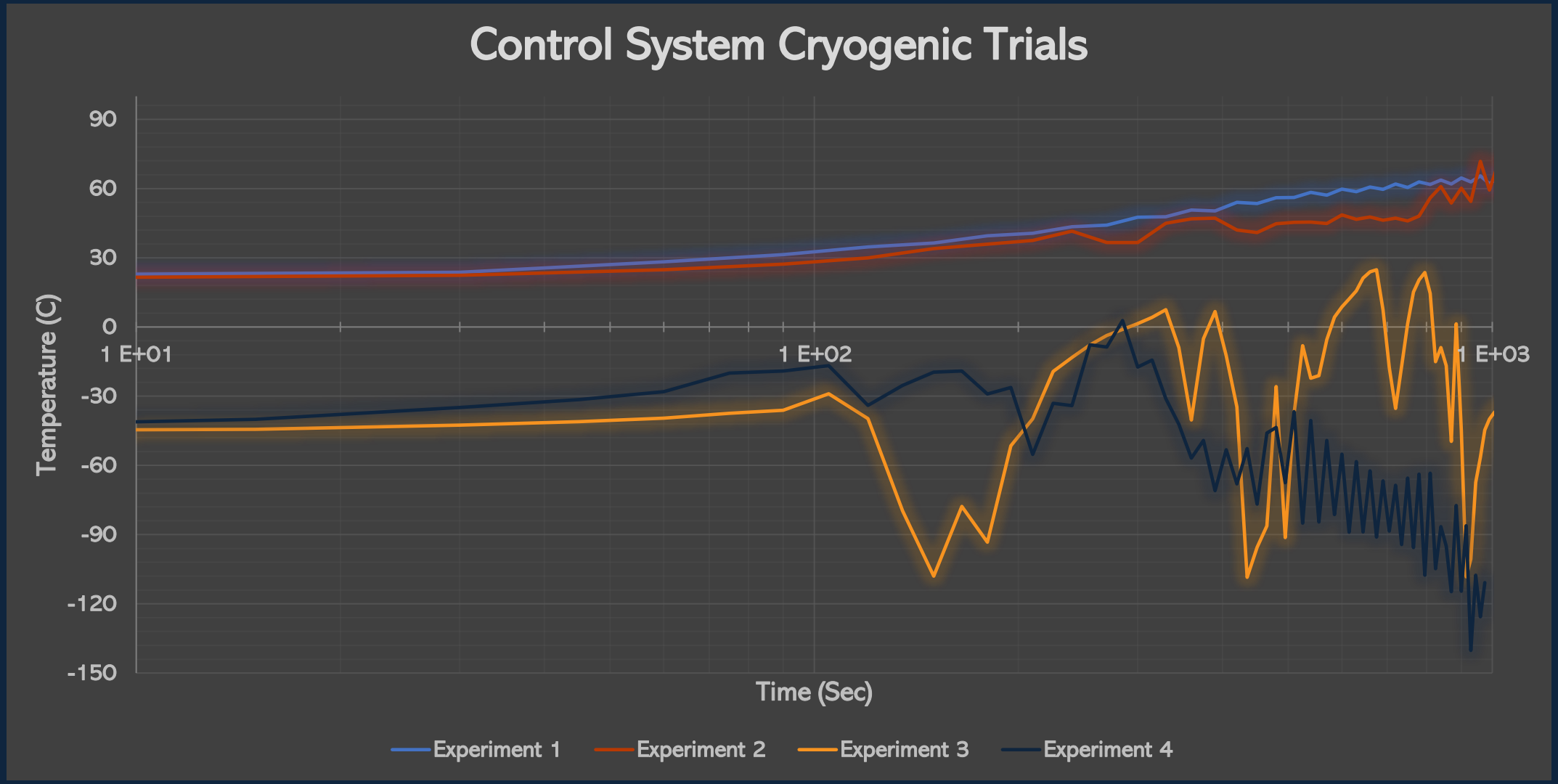
No

Iterative Optimization
- Subcomponent Redesign, Nitrogen Phase-State Adjustments, Thermodynamic Calculations, Etc.

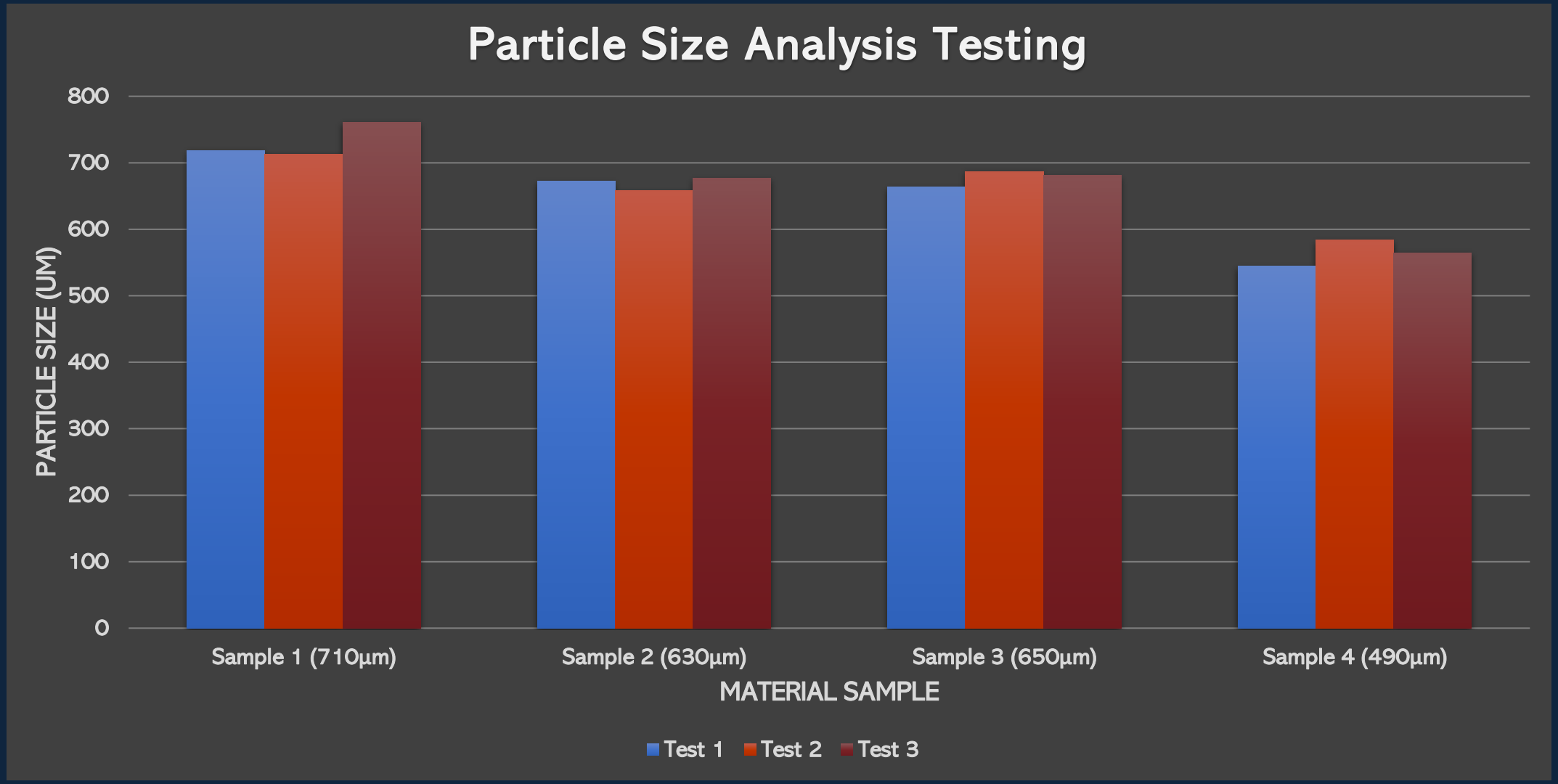
Yes

Industrialize Process
- Source Applicable Equipment, Develop Supply Chains, Scale Production, Standardize Procedures, Etc.

Achieving Cryogenic Temperatures



Particle Reduction Results



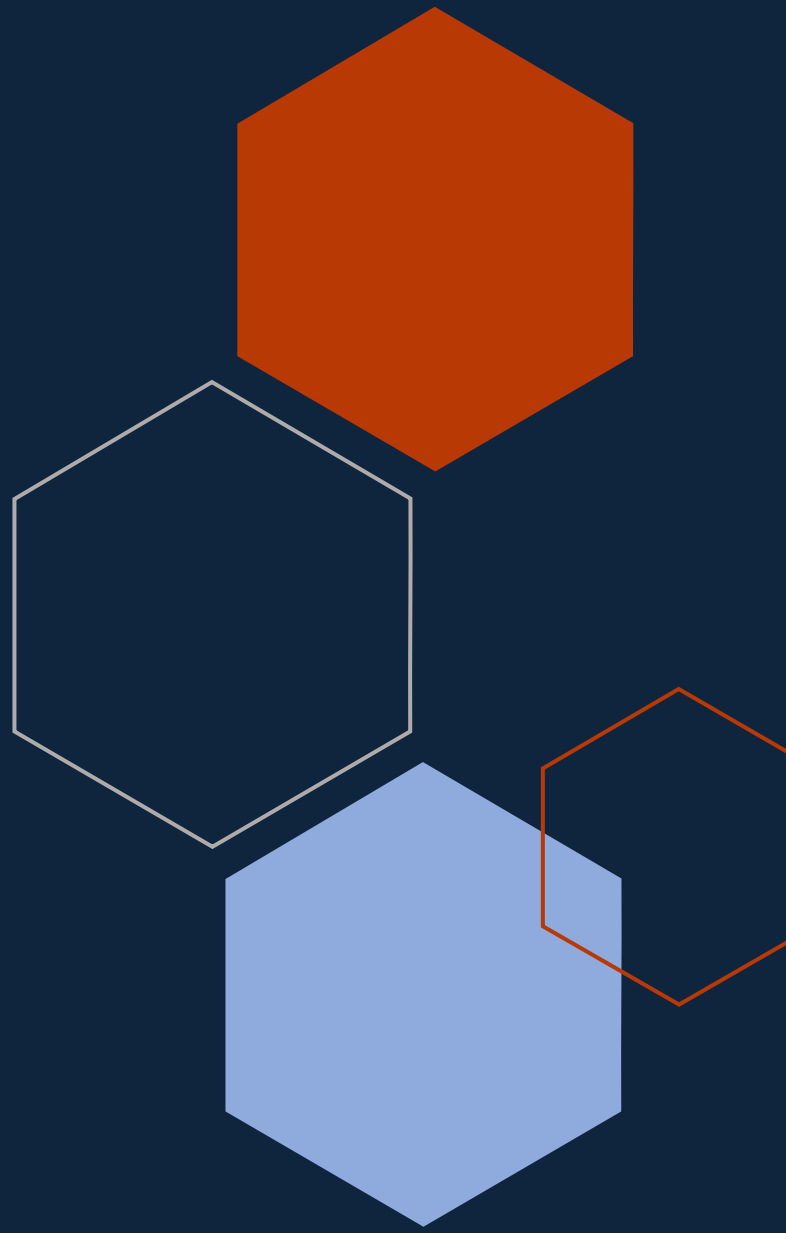
Financial Overview

- Cryogenic mechanical hybrid systems resulted in large-scale production success at lower costs and personnel
- Cryogenic material processing technology allowed for further particle reductions in polymer-based materials and an increase in material production
- New customer orders from AbTech Industries Inc. resulted in company technology investments, rapid market entry, and greater product demand

Quarter	Particle Reduction (µm)	Production Growth (lb./day)	Customer Demand
Q1	~710	~50	1,000 lb. / month
Q2	~490	~410	4,000 lb. / bi-weekly

Future Initiatives

- Increase robustness of cryogenic hybrid systems
- Integrate further safety standards & operations
- Expand growth trends through new materials
- Scale infrastructure & material quality
- Identify new opportunities and industry sectors



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References

- *California Nanotechnologies Advances Commercial Production with Two Purchase Orders and ISO 9001 Certification. (Apr 21, 2025).* https://www.calnanocorp.com/california-nanotechnologies-advances-commercial-production-with-two-purchase-orders-and-iso-9001-certification
- *California Nanotechnologies Presentation. (2023, March).* https://www.calnanocorp.com/Cal-Nano-Presentation-March-2023.pdf