ZETON®

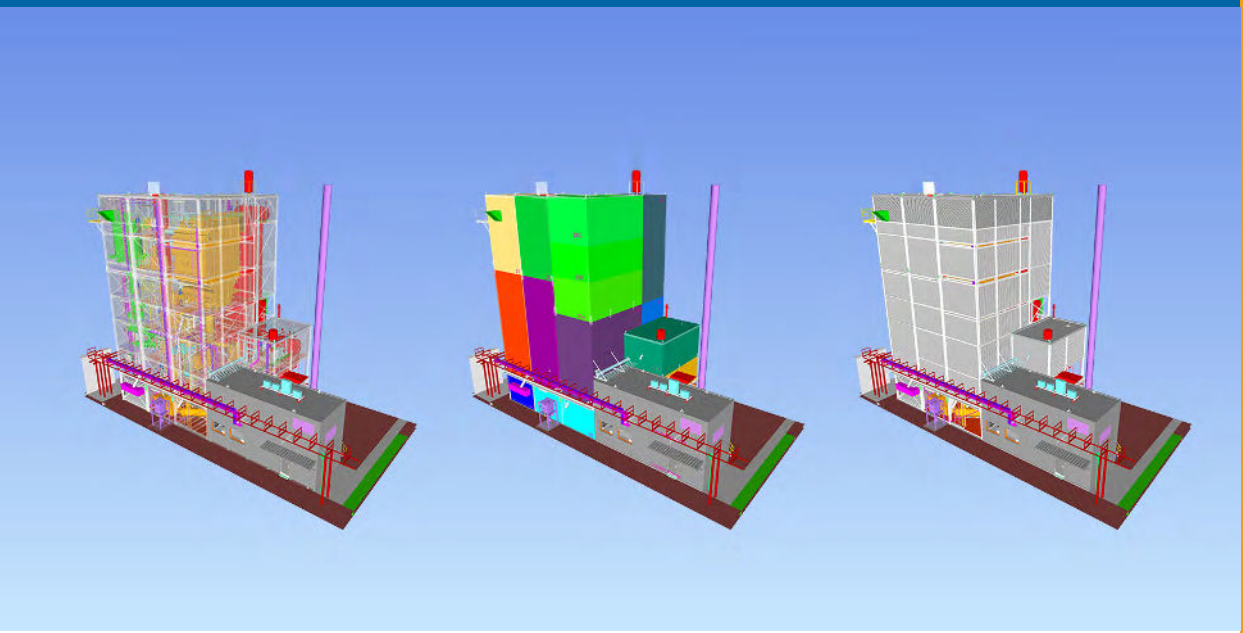
REALIZE THE FUTURE

TECHNOLOGY HORIZONS

A publication by Zeton, the pilot plant specialists

FALL 2025

IN THIS ISSUE



Horizons is also available on our website at **zeton.com**

EARLY INSIGHTS, LASTING IMPACT: THE CASE FOR MODULARIZATION STUDIES

A modularization study is a powerful tool for shaping a project early in its lifecycle. With just a few inputs—like a heat and material balance, process flow diagram, and layout constraints—engineers can begin sizing equipment and exploring how the plant might be divided into modules. These early insights help clarify layout challenges, operational needs, and the impact on cost and schedule.

The true value of modularization studies lies in their ability to guide strategic decisions before detailed design begins. By evaluating equipment size, maintenance access, interconnections, and fabrication versus installation locations, teams can determine which areas suit modular construction and which are better stick-built. Logistics are also key; transportation, site access, and installation windows often shape the modular strategy as much as the process design.

Beyond feasibility, these studies can validate plant scale and sometimes reveal opportunities to downsize without sacrificing performance, or scale up within the same budget. They also help define scope boundaries for technology providers, EPC partners, and suppliers, reducing overlap and improving collaboration.

One recent example: Zeton completed a modularization study in just two weeks using minimal data. The results showed the original design was oversized, leading the client to scale down by a factor of ten while maintaining functionality. This early insight streamlined execution and boosted confidence.

Modularization studies are more than technical evaluations, they're strategic tools that lay the foundation for efficient, scalable, and cost-effective plant designs. ■

FROM LABORATORY TO PILOT SCALE: ADVANCING CO_2 FERMENTATION FOR SUSTAINABLE PROTEINS

Zeton is pleased to contribute to the development of a novel fermentation pilot plant for the Department of Biological and Chemical Engineering (BCE) at Aarhus University. As part of the joint research program 'CO_2-to-Protein', initiated by BCE and the Novo Nordisk Foundation CO_2 Research Center (CORC), this project represents a meaningful step toward circular and sustainable food production.

Based on a recent scientific breakthrough by Professor Lars Angenent - professor of environmental biotechnology at the University of Tübingen and part-time professor at Aarhus University - the pilot plant enables the biological conversion of surplus CO_2 into protein-rich biomass. This technology opens new possibilities for producing food-grade proteins using renewable inputs.

From Concept to Pilot: CO_2 Fermentation in Practice

The pilot plant uses waste CO_2 as a feedstock for microbial fermentation. Microorganisms convert a mixture of CO_2, hydrogen (H_2), and oxygen (O_2) into high-quality proteins suitable for human consumption. The H_2 and O_2 are generated on-site via electrolysis, making the system fully self-sufficient and aligned with the principles of green chemistry and the circular economy.

This setup allows researchers to study and optimize the fermentation process, with the goal of improving efficiency and preparing the technology for future scale-up.

Engineering for Flexibility and Food Safety

Zeton designed and built the pilot plant with a strong focus on modularity and hygienic operation. The system consists of a main frame with two stacked subframes, allowing for easy transportation and robust set-up.

To meet the stringent requirements of food-safe and microbiological processes, the plant features SIP and CIP features with minimal dead volumes, optimizing cleanability and preventing contamination.

Collaboration and Impact

By combining Aarhus University's scientific insights with Zeton's expertise in process design and system integration, together we created a pilot plant that is not only functional, but also designed to allow for easy scale-up towards an industrial-scale process. This collaboration bridges the gap between academic innovation and industrial realization, enabling the quick transition from research to scalable, real-world applications.

We are proud to support this pioneering initiative and look forward to contributing to future developments in sustainable food technology.

Professor Lars Angenent:
"The Zeton team is very detail-oriented, and you quickly feel part of the team, they then deliver on what they had promised on time." ■

DELIVERING INNOVATION: ZETON DESIGNS AND BUILDS MODULAR DEMONSTRATION PLANT FOR TRAVERTINE TECHNOLOGIES

Zeton recently completed the design and fabrication of a modular demonstration plant for Travertine Technologies, a U.S.-based company developing a novel electrochemical process for carbon-negative critical chemical and mineral production. The plant, now installed in Rochester, NY, is a key step in scaling Travertine's process. This plant uses Travertine's core process to upcycle waste gypsum and carbon dioxide from the air into sulfuric acid used in mineral extraction and fertilizer production and calcium carbonate which can be blended into cement.

Travertine's process posed unique engineering challenges, requiring a custom modular solution capable of integrating electrochemical reactors, gas handling systems, and solid-liquid separation—all within a compact footprint suitable for rapid deployment and scale-up. Zeton's team worked closely with Travertine to translate data from their continuous lab-scale pilot into a fully functional demonstration unit.

One of the most intricate aspects of the project was managing the piping layout and drainage design around the electrolyzer system. The relatively small plant footprint introduced routing constraints that required creative solutions to maintain accessibility and ensure mechanical integrity. Achieving reliable free-draining from the electrolyzer to the recirculation tanks was particularly complex, requiring close coordination between equipment design and layout to ensure proper elevation, slope, and support. These challenges were met through thoughtful planning and collaboration, resulting in a robust and efficient configuration.

The completed plant enables Travertine to validate its technology under real-world conditions, and gain critical data for their first commercial plant. Zeton's modular approach provided the flexibility and speed needed to meet aggressive timelines and accommodate future process iterations.

Owen Cadwalader, COO:
"Zeton is the expert in pilot and demo plant design and construction. Having all disciplines and trades housed under one roof and a single project manager from design through construction is rare and critical for success in first-of-a-kind projects like ours." ■

SAFE BY DESIGN: CDI'S LATEST OXYGEN PURIFICATION SKID

Chemical Design Inc. (CDI) recently completed the design and fabrication of a specialized oxygen purification skid scheduled for installation in Bécancour, Québec. Executed in close collaboration with a network of trusted partners, the project combines a custom catalyst reactor with Temperature Swing Adsorption (TSA) technology to selectively remove hydrogen and water from an oxygen stream. This integration ensures the delivery of high-purity oxygen to support critical downstream processes.

Designing systems for oxygen service requires exceptional attention to detail. Because oxygen-rich environments heighten flammability risks, every material and component must be carefully selected and prepared to minimize ignition hazards. For this project, CDI incorporated exotic alloys, precision welding, risk-mitigating piping configurations, and intricate automatic valves—all carefully chosen to meet the stringent requirements of oxygen handling.

Equally important, each component was meticulously cleaned to CGA G-4.1 standards, which govern equipment preparation for oxygen service. This step is essential in ensuring both safe operation and long-term reliability.

By combining advanced purification technology with rigorous safety practices, CDI has delivered a robust and reliable solution tailored to one of the process industry's most demanding applications. The project underscores CDI's expertise in creating custom-engineered systems that balance innovation, safety, and performance. ■

IN BRIEF

HIGHLIGHTING RECENT AND COMPLETED PROJECTS AND ENGINEERING STUDIES

- A molten salt carbon capture unit
- A lignin pilot plant loop reactor
- An engineering study for a Lithium Extraction Plant
- A CO_2 Waste Electrolysis Unit
- A Methanation Unit
- An engineering study for a methane pyrolysis unit
- An engineering study for a modular flow plant
- An engineering study for a waste plastics recycling unit

An insulation recycling pilot plant

FAT of Continuous Manufacturing System (ContiUnity®)

A hydrogen cryogenic adsorber system

A CO_2 to aviation fuel pilot plant

CONTACT US

TO DISCUSS YOUR PROJECT REQUIREMENTS, OR ITEMS IN THIS ISSUE OF HORIZONS, PLEASE CONTACT:

ZETON INC.

455 Michigan Drive
Oakville, Ontario
Canada L6L 0G4

Phone: +1 905 632 3123
E-mail: info@zeton.com

John Onesi
Pratik Bhishikar
Grant Girouard
Matt Soucie

ZETON B.V.

Marssteden 206/210
7547 TD Enschede
The Netherlands

Phone: +31 (0)53 428 4100
E-mail: info@zeton.nl

Herman Bottenberg
Robert-Jan Zwiers
Jan-Hein Willemsen
Thomas Ladrak
Wouter Bolt

Visit us online at zeton.com