

# TECHNOLOGY HORIZONS

A publication by Zetron, the pilot plant specialists

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AND MORE!



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Omani employees of Grace's Ecat lab at Sohar University, where the DCR™ Pilot Plant will be housed, along with other Grace representatives celebrating the inauguration.

## REVOLUTIONIZING FCC RESEARCH: THE GRACE DCR™ PILOT UNIT AND THE SUCCESSFUL PARTNERSHIP BETWEEN W.R. GRACE & CO. AND ZETON

On March 16, 2023, Sohar University and W. R. Grace & Co. held an inauguration ceremony for their jointly-operated DCR™ Pilot Unit that shipped from Zetron's Oakville, ON facility in 2022. This important event marks the beginning of a 15-year partnership between Sohar University, Grace and OQ that will enable the transition of Grace's laboratory from a purely analytical focus to a world-class research facility.

For context, the Grace DCR™ Pilot Unit is a proprietary circulating riser Fluid Catalytic Cracking (FCC) pilot plant which has become the industry standard for pilot-scale FCC plants. With its superior performance, the DCR™ pilot unit has become the leading choice among major energy and petrochemical companies as well as research institutions, with 34 plants already licensed worldwide and counting.

The DCR™ Pilot Unit emulates all the operations that occur during commercial FCC

operation and has the ability to function under conditions that are different from the standard FCC operating mode, allowing for the analysis of different feedstocks. For this reason, the Grace DCR™ Pilot Unit has proved to be an exceptional tool for industry, providing high-quality data for research and development purposes, and paving the way for innovation in the energy and petrochemicals sectors.

Grace and Zetron have had a close and successful partnership, starting when Zetron built its first DCR™ unit in 1989 for British Petroleum. Through this collaboration, Grace and Zetron have been able to leverage each other's strengths and build a strong foundation for long-term growth and success. As a result, multiple DCR™ units have been shipped worldwide and important design improvements have been made to the DCR™ units both by Grace and Zetron that ensure the design is up to date in safety and performance standards, as well as control system and data handling systems.

Zetron is excited to continue our long-standing partnership with W.R. Grace and congratulates Sohar University and Grace on this major achievement!

"In 1989, the first Grace-licensed DCR™ Pilot Plant was built and delivered by Zetron and I have been excited to see the improvements and innovations that have been made since," said Scott Purnell, VP R&D, Refining Technologies, W. R. Grace & Co. "Our long relationship with Zetron and the smooth communication that fosters recently led to the successful installation of a new DCR™ Pilot Plant at Sohar University in Oman. The new plant, one of 24 provided by Zetron, will expand our research capabilities to support the energy transition, help us serve key regional customers and provide in-country value to the Sultanate of Oman."

Zetron Director, David Beckman: "Grace's endorsement of Zetron as a fledgling company in the late 1980's was paramount to our future growth and success. Myself and all our staff will always be grateful for this, and the important role Grace played in Zetron's history." ■



# ZETON DELIVERS BIGGEST PROJECT IN ITS 37 YEAR HISTORY TO LANZAJET IN SOPERTON, GA

The LanzaJet Freedom Pines Fuels SAF commercial-scale plant is an innovative and exciting development in the world of sustainable aviation fuel. The project began when LanzaJet's investor, LanzaTech, approached Zeton in 2018, seeking to conduct studies for different scales of the project. After conducting feasibility studies on various scales, the project eventually progressed to the construction of a 10 million gallon per year plant located at LanzaJet's Freedom Pines Fuels site in Soperton, Georgia.

One of the main challenges of the project was finding the right balance between commercial and research objectives. The 10 million gallon per year scale was ultimately selected because it met both needs; it allowed the technology to be scaled from pilot scale, while also producing sufficient sustainable aviation fuel for commercial scale.

The engineering phase of the project took two years to complete, longer than Zeton's usual timeline, due to the plant's size, complexity, and the involvement of two external technology providers. This is a first-of-its kind technology that has been a collaborative effort across several partners. Despite supply chain disruptions from 2020 through 2023, the project remained continuously active from late 2018 until early 2023 when it finally shipped from Zeton's Oakville, ON facility to site.

The SAF plant has two primary sections. The first section is Technip Energies' Hummingbird® technology, which converts sustainable ethanol to ethylene via ethanol

dehydration. While ethanol conversion to ethylene is not a novel process, Technip Energies' Hummingbird® technology provides an efficient, low-cost process for dehydrating bioethanol to ethylene at a polymer grade specification. This technology allows for higher yields of ethanol to ethylene thus optimizing the economics of the biggest cost in running the plant: the cost of the bioethanol feed.

The second section leverages the LanzaJet Alcohol-to-Jet Process™ developed over a decade ago by LanzaTech and Pacific Northwest National Laboratory, where ethylene from the first section is converted to jet fuel via an oligomerization process. In the oligomerization stage, ethylene is transformed into longer chain olefins with the ability to generate high yields of either jet fuel or diesel. Then a hydrogenation stage converts any remaining olefins to paraffins or iso-paraffins. Later in a fractionation stage, the product is separated to produce Synthetic Paraffinic Kerosene (SPK) jet blend-stock, which is a stable, paraffinic kerosene with superior features such as enhanced energy density, thermal stability, and freeze point compared to petroleum-derived jet fuel. The remaining fraction is Synthetic Paraffinic Diesel (SPD), which is also a high-quality renewable diesel with better properties than traditional diesel fuel.

This is Zeton's largest plant to date. The project required the expansion of Zeton's Michigan drive facilities as two new indoor high bays were needed to fabricate the modules. And

despite disruptions caused by COVID-19 supply chain issues the project was delivered on time and on budget. To mitigate the supply chain issues, the team tackled the longer lead, and most impacted, items by purchasing structural steel earlier than would normally have been the case, and by switching vendors for certain components. However, the project management approach to finding creative solutions to mitigate delays was really no different than a traditional Zeton project. It still relied heavily on effective teamwork and a positive can-do attitude between the client, consultants, vendors, contractors and Zeton staff.

**“Seeing the project come together and being delivered to the customer's site was a rewarding experience for the whole Zeton team. We would like to thank LanzaTech and LanzaJet for trusting Zeton to design and build their first SAF commercial plant, and for the opportunity to show what we can accomplish.”** - Ian Jessop, Senior Project Manager, Zeton Inc.

**“Building a first-of-its kind facility is no small task and working with collaborative partners like Zeton make it possible. This modular design and construction have come together well onsite in Georgia because of the expertise and coordination of all involved. Our LanzaJet Freedom Pines Fuels plant will significantly increase the production of sustainable aviation fuel produced in the United States and becomes the blueprint for how we can scale this industry through ATJ technology to decarbonize aviation.”** - Louay Masarweh, VP of Operations, LanzaJet. ■



# ZETON DELIVERS PILOT PLANT FOR EFFICIENT CONVERSION OF CO<sub>2</sub> INTO VALUABLE CHEMICALS AND SYNTHETIC FUELS

Zeton was recently involved in the engineering and construction of the pilot plant for the COZMOS project for Turkish Petroleum Refineries Corporation (Tüpräs).

COZMOS is an EU-funded project that aims to provide breakthrough technology for the conversion of CO<sub>2</sub> to C<sub>3</sub> fuels and chemical building blocks. This will be achieved through the cooperative development, demonstration and exploitation of innovative catalyst and process technologies that will overcome the thermodynamic limitations inherent in the use of CO<sub>2</sub> as a sustainable source for these value-added products.

The COZMOS technology will decrease CO<sub>2</sub> emissions by 1.9 tons CO<sub>2</sub> for every ton of C<sub>3</sub> product produced, with expected reductions in CO<sub>2</sub> emissions of 0.4 Mtons CO<sub>2</sub>/yr in 2030 and 2.2 Mtons CO<sub>2</sub>/year from 2034. COZMOS technology will be designed to provide a flexible solution adaptable to local requirements and different industries.

The project is part of a larger EU-funded initiative aimed at promoting sustainable energy and material solutions, reducing

carbon emissions, utilizing CO<sub>2</sub> as feedstock for valuable chemicals and synthetic fuels, using resources in a more sustainable and efficient way, and addressing the European energy challenges of today and the future.

The pilot plant, designed and built by Zeton, has reached Technology Readiness Level (TRL) 5, a critical stage in the development of new technologies to be proven to work in a controlled environment and be ready for demonstration in a real-world setting.

The pilot plant was designed as a complex system with fully integrated GC, a mixed gas compressor and a furnace including air cooling for regeneration and with the processing units integrated into the existing facility.

The COZMOS pilot plant project was a major achievement for Zeton and Tüpräs to set a standard for future projects in the energy and petrochemical industries. The CO<sub>2</sub> to valuable chemicals at TRL5 demonstrates the commitment of the partners of the COZMOS project to sustainable energy and material solutions, reducing carbon emissions and addressing Europe's energy challenges.



"The start-up of the pilot plant is an important milestone within the scope of the EU-funded COZMOS project and completed with expertise and collaboration of Zeton. Development of novel technologies for utilization of carbon dioxide into valuable chemicals and e-fuels is one of the building blocks of sustainable society that is also aligning with the net zero strategy of Tüpräs." Ersen Ertas, R&D Tribe Lead, Tüpräs. ■

## TEAM SPIRIT HIGHLIGHTING THE ACCOMPLISHMENTS OF OUR STAFF IN THE DUTCH AND CANADIAN OPERATIONS

### LET'S CELEBRATE SPECIAL MOMENTS!

Since 1986 Zeton has worked from our facilities in Canada and the Netherlands with valued customers all around the world to deliver units that have enabled them to demonstrate and market revolutionary products and processes.

And now, after 37 years, we have reached a significant milestone in our organization's history - the handover of our 1000th project!

During a special ribbon-cutting celebration event in Enschede on Wednesday May 3, 2023, Johan ter Harmse, Managing Director of Zeton B.V., handed over the 1,000th plant built by the

Zeton group to Arild Selvig, CEO of ZEG Power AS of Norway.

This milestone was celebrated together with the ZEG Power team, long-time suppliers and the entire Zeton Netherlands staff.

As an employee-owned company, our engineers and craft technicians are dedicated to excellence and complete customer satisfaction throughout every project. We are proud of the hard work and dedication of our staff, the support of suppliers and the trust of our customers.

Onward and upward to the next 1000!



# IN BRIEF

## HIGHLIGHTING RECENT AND COMPLETED PROJECTS AND ENGINEERING STUDIES

- A basic design study for laboratory separation system
- A conceptual design for pilot scale modular carbon capture plant
- A basic design for bioplastics monomer separation pilot plant
- A plastics recycling plant
- Design of a 6 ton/day hydrogen pilot plant
- Design of a reverse flow reactor pilot plant
- A heptane recovery system
- A catalyst activation and testing system



An SDRM pilot plant



An MBU for biomass hydrolysis



Twin FCC DCR™ pilot units destined for Asia



A continuous synthesis and distillation plant



## CONTACT US

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

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