

# TECHNOLOGY HORIZONS

A publication by Zeton, the pilot plant specialists

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Horizons is also available on our website at [zeton.com](http://zeton.com)



## BIOENERGY PROJECTS TAKE CENTRE STAGE

With the current interest in biomass-to-liquid fuels – or *biofuels* – resulting from a focus on sustainability and on utilizing renewable fuel sources, bioenergy projects have come full circle. Such activity was last seen in the mid-70s to mid-80s following the 1973 oil crisis which sparked a decade of active research and development in renewable fuels and alternative energy. Subsequently, funding for such projects reduced significantly as oil prices fell to \$20/bbl by 1986.

The US Department of Energy's Integrated Biorefinery (IBR) initiative can take much of

the credit for rekindling interest in biofuels and bioenergy projects in the United States. Announced in 2009, the program has committed US\$480 million to eighteen new Integrated Pilot and Demonstration Biorefinery projects. Zeton was selected to design and build pilot plants for three of these projects.

In addition, companies like KiOR and Coskata have funded bioenergy technology development using private funding, and DuPont and BP have undertaken new projects by combining their individual strengths in a joint venture company. The articles on Pages 4-5 and 7

discuss how Zeton has assisted each of these companies with their pilot and demonstration scale plant requirements.

Incredibly, within the past six years, Zeton has delivered, or will soon be delivering, fifteen bioenergy projects for customers across Europe, Asia and North and South America.

This follows two biomass pyrolysis projects completed for Red Arrow and Ensyn in the late 80s and early 90s. That bioenergy projects should take centre stage after a 20-year hiatus, who *wood* (sic) have believed it? ■





“THE WORK THAT ZETON DID WAS EXCELLENT.” DR. KARSTEN KELLER, ASSOCIATE DIRECTOR OF R&D ENGINEERING, SOLAE, LLC

## ZETON DELIVERS FULLY-AUTOMATED FOOD INDUSTRY PILOT PLANT TO SOLAE, LLC



Solae, LLC, a world leader in researching and developing soy based ingredients for the food industry, approached Zeton in the 4<sup>th</sup> quarter of 2010 to design and fabricate an integrated pilot plant for protein-based research.

The fully-automated pilot plant uses membrane filtration to increase the concentration of the product feed while reducing energy consumption compared to conventional separation processes. The plant also employed online analysis of retentate and permeate streams from the filtration unit, which in turn allowed for production and clean-in-place procedures to be fully automated with minimal operator action required.

A key step in the engineering phase was programming the logic controller to handle multiple operating modes with process sequencing, operator messaging and safety interlocks. To meet Solae's operational and research needs, a sophisticated graphical interface was created to allow a high level of flexibility and automatic prompts for operating and design parameters. The programming sequences for multiple



Having only recently emerged from a global recession, we now find that governments and financial systems around the world are again under pressure. Such uncertainty will, without doubt, affect the industries our customers and Zeton are active in. While this, of course, is not good news, from an optimistic standpoint it forces us to find smarter solutions to our daily problems, and to drive innovation across our whole industry.

The need to innovate starts with education. In The Netherlands (and, in general, across Europe) there has been a downward trend for a number of years in the number of students selecting technical studies in further education. This has been recognised by governments, and several initiatives have been developed to reverse this trend. As well, we have seen a focus on creating stronger interactions between

technical universities around Europe and abroad, realising that, with the declining number of students, they have to join forces. Such specialised universities will ensure companies have access to the brightest new graduate scientists and technologists.

Another important factor in innovation is the capabilities and contribution of SME's. Many SME's are spin-offs from universities, focusing their efforts on a specific innovative product or technology. For such innovation to reach the market, it is essential that there are places where innovative solutions and industry challenges can meet and join forces. Last year, one such initiative began in The Netherlands, the Institute of Sustainable Process Technology (ISPT). The Institute aims to bring together top scientists and technologists from around the world, to jointly develop pre-competitive solutions for innovations that matter to the process industry. The first projects have already begun, and the aim is clear – top class solutions for tomorrow's challenges. Zeton is proud to have been involved in some of the ISPT first projects as a solutions provider. ([www.ispt.nl](http://www.ispt.nl))  
**Johan ter Harmse, Managing Director, Zeton B.V.**

modes and sub-modes were developed by project manager, Sulogna Roy, with high level inputs from the Solae design team consisting of Sebastian Stahl and Brian Pierce. PLC programming at Zeton was led by Gloria Gao and Sean Murray.

Appropriate component selection and careful piping design were critical to meeting food industry requirements. Key components were fabricated from stainless steel including the equipment, structure, electrical cabinets and process piping. The operator control station was customized to be part of the modular skid structure and was suitable for the wash down environment. Zeton carefully designed and fabricated the process piping to ensure lines were self draining to inhibit dead spots that could lead to bacterial growth.

### Appropriate component selection and careful piping design were critical to meeting food industry requirements

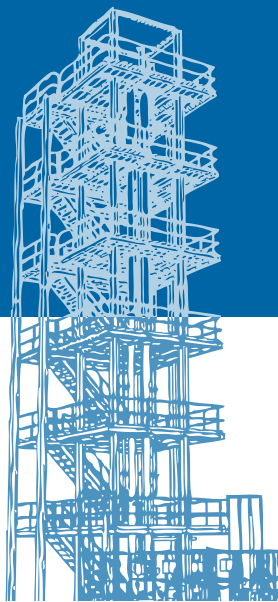
The combination of Solae's process expertise and Zeton's mechanical, electrical and control system design know-how resulted in successful project execution and a smooth start up, with the plant producing consistent, reliable and repeatable results. Zeton

was invited on site to assist with the start-up activities, and was responsible for conducting training sessions for operators and engineers.

Dr. Karsten Keller, the Associate Director of R&D Engineering at Solae, praised Zeton's commitment and dedication during the project, "I want to say the work you all did at Zeton was excellent and I am very happy about where we are today."

And while this project marked the first collaboration between Solae and Zeton, there is a strong possibility of future projects due to the highly successful relationship that was developed between the two companies on the project. ■





# CASE STUDY

A BEHIND THE SCENES LOOK AT A RECENTLY COMPLETED PROJECT

## BIOBUTANOL DEMONSTRATION FACILITY

### PROJECT DESCRIPTION

Following initial discussions in the summer of 2007, Zeton was contracted by Kingston Research Limited (KRL), a joint venture between BP and DuPont, to design and build an Advanced Fuels Facility to demonstrate its proprietary Biobutanol technology on a larger, pre-commercial scale.

Biobutanol is an alcohol that can be produced from many different types of biomass including corn, wheat, sugar cane, sugar beet and, in the future, non-food lignocellulosic materials. It's primary application is as a transportation biofuel in cars and other vehicles, where it is often blended directly with gasoline, or mixed with ethanol to improve ethanol's performance in a gasoline blend.

The demonstration plant integrates the entire process route, from biomass feedstock to Biobutanol product. This includes the handling and dosing of solid feedstocks, the main fermentation process and the product recovery and purification sections.



As the time-to-market in any new innovation is key to its success commercially, the project was executed by a number of parties working in close cooperation, with off-site module fabrication and site development work occurring in parallel. The design and fabrication of the process skids were completed in Zeton B.V.'s state-of-the-art facility in Enschede, The Netherlands, where the height of the building allowed the process modules to be oriented in their true vertical or horizontal orientation during construction.

The project was executed in several phases. Following successful completion of lab testing by KRL, Zeton and KRL started basic design. During this phase, a control strategy for the complex batch process was developed, and requirements for biotechnology standards alongside industrial site standards were established.

Zeton's experience in both industries helped to quickly identify areas that would require special attention in subsequent phases. Also in this phase, a 3D model of the plant was developed, it being a required input for risk assessment and building planning activities.

**“Working with Zeton with their expertise in building modules helped the project team to execute the project in a very efficient manner. Both partners created an open atmosphere, which helped in achieving an excellent result as one team! Early involvement and commitment from Zeton enabled this.”**

G.J. Vaes, Project Manager, KRL



In the detailed design, procurement, fabrication and factory testing phase, Zeton's role was to supply the downstream product separation and purification modules, as well as to integrate all

modules of the entire process into a centrally operated control system. Zeton's control system engineers, headed by Bert Volker, worked closely together with KRL's automation experts, headed by Mike Luyben. Following completion of manufacturing, the process modules were rigorously tested at Zeton's facility.

The demonstration plant was transported ahead of schedule to BP's site in the Hull, UK, where the pre-assembled skids were easily reassembled and prepared for site testing and start-up by the KRL team, with assistance from Zeton B.V.

Project Managers at Zeton (Maurice Bodegom) and KRL (Renk Burgers) are proud to report that there were no lost time incidents recorded on the project. The commitment and dedication to safety by the KRL and Zeton teams was a key factor in the project's success. ■

## TIPS & TOOLS

ADVICE FOR SUCCESSFUL PILOT PLANT PROJECTS

How important is project schedule? Should it be managed as judiciously as project cost, or product quality? Consider schedule, cost and quality as three cornerstones of project management; each must be managed with equal purpose to maintain balance and achieve a successful outcome.

While an event-driven Gantt chart serves as the primary scheduling tool on most pilot plant projects, a handy scheduling device used as well by Zeton's engineers is a *date finder*. This rotating calculator can identify the number of weeks from the current date, often to identify the future delivery date of an equipment item. Or it can backtrack from a future date, to help determine when an order must be placed to receive equipment on a specific date.



Interested readers are invited to contact Zeton to request their own personal date finder. And for additional tips on managing project schedule, please visit the **DOWNLOADS** section of Zeton's website for an article co-authored by Paul Martin, Senior Project Manager at Zeton Inc., titled **Tips and Tricks for Fast-Track Pilot Plant Projects.** ■



# IMPLEMENTING NOVEL HWC® TECHNOLOGY AT THE PILOT SCALE

TNO AND SOLVAY TAKE PROCESS INTENSIFICATION TO THE NEXT LEVEL

In a joint development effort between TNO, Solvay and Zeton, a novel pilot plant design was developed from the results of bench scale testing of TNO's (TNO HWC®) Hydraulic Wash Column Technology.

In this process, phosphoric acid with a relatively high concentration of ionic impurities is cooled down to form pure phosphoric acid hemi-hydrate crystals, with the impurities remaining in the liquid phase. A high-efficiency countercurrent wash of the crystals occurs in the Hydraulic Wash Column, where the crystals almost completely separated from the impure liquid. A final phosphoric acid product with impurity concentrations in the parts-per-billion range is produced.

Proofing new technology at the pilot scale often requires the integration of industrial scale engineering and construction with laboratory scale development work. The pilot plant for TNO and Solvay consists of two main sections; a small scale technology for indoor service (front skid in photograph), and an industrial crystallizer section designed for outdoor operation.

Zeton's responsibility in the project included engineering, fabrication, factory testing and reassembly at site. Following design and fabrication of the pilot plant at Zeton B.V.'s Enschede, The Netherlands' facility, the onsite start up and testing phase of the HWC pilot installation at Solvay's site in Bernburg, Germany was initiated, and completed successfully. During the site acceptance test, 9000 kilograms of high purity phosphoric acid were produced, and operation of the plant proved to be very stable and robust.

The product will be used as high purity etchant in the electronics and semiconductor industries.

An important consideration was the implementation of the pilot plant at an industrial site. Zeton's design team worked closely with TNO and Solvay to find the right balance between the

process and operability requirements of the plant and Solvay's site standards. An excellent team effort from all participants, and the strong involvement and commitment from TNO and Solvay, resulted in the successful implementation of this new, promising process intensification technology. ■

**"The delivered skids were on site on time and had a professional appearance."**

Monique Oldenburg, Project Manager – Sustainable Chemistry, TNO



# DEMONSTRATION STEP KEY IN TECHNOLOGY COMMERCIALIZATION

IN THE PAST YEAR, THREE OF ZETON'S CUSTOMERS ANNOUNCED SUCCESSFUL DEMONSTRATION OF THEIR PROCESS TECHNOLOGIES, AND ARE NOW PLANNING COMMERCIAL SCALE PLANTS. THIS ILLUSTRATES THE IMPORTANCE OF THE DEMONSTRATION STEP IN THE COMMERCIALIZATION OF NEW PROCESS TECHNOLOGY.

The three companies and their process technologies are:

- Coskata, Inc. - Cellulose to Ethanol
- Kingston Research Ltd. - Cellulose to Biobutanol (see article on Pages 4-5)
- KiOR, Inc. - Biomass Catalytic Cracking to Biofuel

Each of these companies chose Zeton to design and build their demonstration plants.

## CHALLENGES

The purpose of a demonstration plant is to prove the technical and commercial feasibility of the process, as well as to

verify process data for the next scale-up step to a commercial plant. The plant scale is set at a capacity where all the process steps will replicate commercial plant operation as closely as possible.

The design and fabrication of demonstration plants present unique challenges for our customer, the technology developer, and for Zeton, the designer and fabricator. Firstly, the company developing the process technology has invested significant time and money in the research and development effort and must quickly show progress towards commercialization in order to maintain interest and funding in their technology.

The demonstration plant must therefore be completed in as short a time as possible, requiring Zeton to commit to a fast-track project schedule.

Secondly, while Zeton is designing and fabricating the demonstration plant, the customer's R&D efforts continue. This often leads to changes in the process design that must be incorporated into the plant. A flexible, disciplined and integrated approach is required between Zeton and our customer to enable the project to continue moving towards completion, while implementing the necessary process changes. ■

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

### EMPLOYEES AND SPOUSES CELEBRATE ZETON'S 25<sup>TH</sup> ANNIVERSARY

Zeton employees and their spouses in Enschede and Burlington recently celebrated the company's 25<sup>th</sup> anniversary with two special events this past summer.

Zeton's staff in Enschede enjoyed a visit to Berlin in July. A weekend full of events included a guided tour of the city, opportunities for cycling and The Beatles Musical.

Zeton's Burlington staff enjoyed an overnight stay at a country club resort in June in the nearby Muskoka region, with golf, hiking and canoeing among the activities on offer. In the evening, a group dinner was arranged with a Hawaiian theme and a DJ.

As can be seen from the photos, a good time was had by all!





# IN BRIEF

HIGHLIGHTING RECENT AND COMPLETED PROJECTS AND ENGINEERING STUDIES.



A four reactor hydroprocessing pilot plant



A biomonomer recovery pilot plant for a green chemistry application

- A large two stage hydroprocessing unit for Haldor Topsøe A/S
- A biomass hydrolysis pilot plant for Gas technology Institute (see photo on Page 1)
- A chemical intermediate demonstration plant
- A resins processing pilot plant
- A hydroconversion pilot plant for petroleum residues
- A study for a pharma kilo scale plant
- A basic design study for a pilot plant with a novel, process-intensified reactor
- A basic engineering study for a modular silane production plant



A novel lab scale reaction analysis system for Cambridge University



A biomass catalytic cracking demonstration plant



## CONTACT US

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