IN BRIEF

HIGHLIGHTING RECENT AND COMPLETED PROJECTS AND ENGINEERING STUDIES

A BioCat demonstration plant

A plastics conversion production plant

A polyethylene pilot plant

- A biomass pretreatment pilot plant
- A biobutanol plant upgrade
- A biomass to chemicals demonstration plant (ref. p. 10)
- A Fischer-Tropsch lab scale test unit
- Several ACE Technology® Model R+, M100 and HT100-2 units
- A basic engineering study for an LX demonstration plant
- A basic engineering study for a mineral precipitation pilot plant
- A basic engineering study for a continuous chemicals production plant
- A basic engineering study for an advanced bioreforming demonstration plant

A synthetic natural gas pilot plant

SPECIAL ANNOUNCEMENT

Announcing our special 30th anniversary year symposium titled The hidden potential of CO_2 - to Reduce or Reuse?

During this complimentary, one-day symposium on **Thursday October 6, 2016** invited industry leaders will present their latest research on new processes and products for utilizing CO_2 in the chemical industry.

Please contact Esther Schröder (marketing@zeton.nl) for the symposium program and for registration. We look forward to welcoming you to Zeton B.V.'s facility in Enschede.

CONTACT US

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

ZETON INC.

740 Oval Court
Burlington, Ontario
Canada L7L 6A9

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

David Edwards
Adam Whalley
Sulogna Roy

ZETON B.V.

Marssteden 206
7547 TD Enschede
The Netherlands

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

Herman Bottenberg
Thomas Ladrak
Robert-Jan Zwiers

Visit us online at www.zeton.com

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TECHNOLOGY HORIZONS

A publication by Zeton, the pilot plant specialists

SPRING 2016

IN THIS ISSUE

Key milestones remembered by Archie Bennett

Interview with Zeton Inc. customer Rick Caron

Archive photos across four decades

David Beckman and Johan ter Harmsel share insights into Zeton's success

Interview with Zeton B.V. customer Thomas Krug

AND MORE!

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

Zeton's original seven employees with specially commissioned ice sculpture - Paletta Mansion, Burlington, ON, February 12, 2016

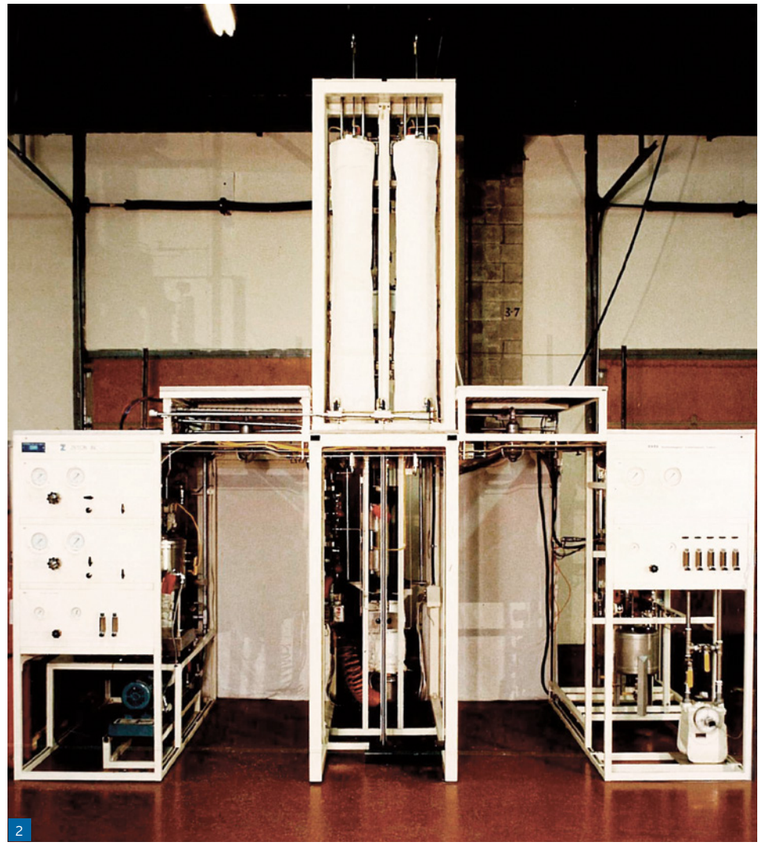
CELEBRATING ZETON'S 30TH ANNIVERSARY

Welcome to a special 30th anniversary edition of Technology Horizons, where we look back at Zeton's history through interviews and archive photographs. Former president and chairman Archie Bennett guided Zeton through significant growth in the 1990's and 2000's, and he leads off by sharing a few of his memories...

It seems so long ago, now. In 1989 I accepted an offer from Zeton's Board to leave behind a career with several large engineering firms to join what was still a start-up company. Three years after its birth in 1986, Zeton was still finding its feet, working hard with clients to gain acceptance. Fortunately, the engineers and technicians were skilled, innovative and dedicated to making Zeton a success, allowing me to focus on building the business. Through hard work, some luck at times, a competitive dollar and overconfidence by our main competitors, we showed that quality and the goal of unquestioned client satisfaction with our plants made us different, and we gradually drew level with - then outgrew - the competition.

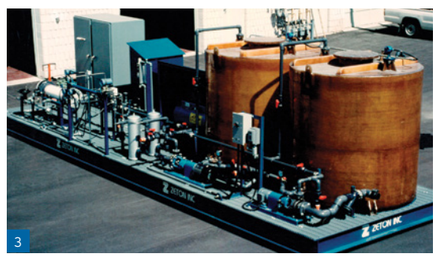
In 1992, with support from BMO and the federal government, a major order of about $2M gave us the cash flow to lease a larger building and grow staff. In 1996, after 9 months of intense negotiation, the purchase of our Dutch operations provided a strong presence in Europe. By 2002, we had built new facilities in both Enschede and Burlington as business volumes and plant sizes increased.

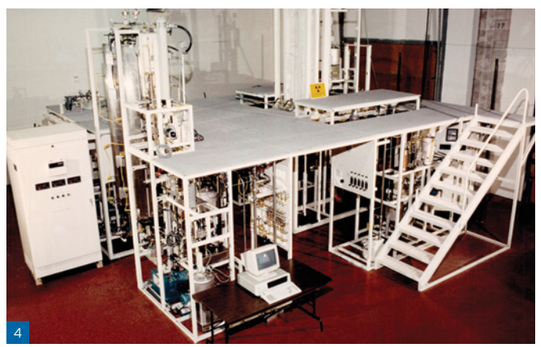
In 2003, Zeton's board approved a business plan to increase employee share ownership to a majority position. I am proud of the world leader we created, of the friendships with respected colleagues in Burlington and Enschede, and of the success we achieved together and the ways we found for our staff to share in that success. ■



1980's

(1986-89) Among the first projects were coal liquefaction/heavy oil upgrading co-processing and delayed coking plants for Canada, FCC pilot plants for the UK and Spain and a large PVC plant for Mexico...





1 *Alkoxylation pilot plant*

2 *Delayed coking pilot plant*

3 *Membrane waste water treatment system*

4 *Coal liquefaction/heavy oil upgrading co-processing plant*

5 *Grace DCR FCC (Mark III) pilot unit*

6 *Absorption desorption pilot plant*

RICK CARON RECALLS A SUCCESSFUL EARLY PROJECT WITH ZETON INC. IN CONVERSATION WITH DAVID EDWARDS

Rick Caron, President, Canadian Energy Inc.

David: "Rick, tell us about your company in 1986?"

Rick: "The Canadian Energy Group of Companies was looking to build a heavy oil coal upgrader in Alberta around 1986. We had some early processing data from the Alberta Research Council, and we knew we had to build a pilot plant to prove out the technical parts, and to obtain better process data in order to scale up the technology."

David: "Okay, so what originally drew you to Zeton?"

Rick: "We had obtained some estimates for the pilot plant, based on the old way of building large plants - design the plant, purchase the materials, build it on site and hope it would work. These large plant estimates were too expensive for smaller pilot plants. Then we heard about Zeton in Ontario; they had a new way of designing and building pilot plants based on modular fabrication in a dedicated shop, followed by shipping, reassembly and commissioning at the owner's site.

After a few visits we determined that we had to work with this company. We saw some very smart and dedicated professionals like Dave, Chris, Paul and Sean, and together we figured out how we were going to build this very complicated plant."

David: "Did the pilot plant deliver the results you were expecting?"

Rick: "Yes, absolutely. We were dealing with something quite new at the time, with high pressures and temperatures and challenges related to metals. Notwithstanding, the plant was built, commissioned, and up and running in record time. We were particularly impressed with the automation - I think our computer had maybe 286 kilobytes of memory at the time! After 3 or 4 years, we ended up with a major processing patent for the co-processing and upgrading of heavy oil and coal. But I guess most importantly, from a customer point of view, we got a pilot plant delivered on time, which ran successfully and provided us the results we needed. We were very happy."

David: "Where was the innovation on the project?"

Rick: "Well, figuring out how to modularize the process was not an easy task. The team had to invent a lot of things, like pressure couplings in slurry service, and custom electrical and structural connections. But at the end of the day, they were able to ship these modules, reassemble them on site, and make it all work. That was no easy task. Like us, so many companies must have appreciated the fact that their plants do work at the end of the day."

David: "Do you have any anecdotes from this time?"

Rick: "Chris Brown was the project leader, and came to Alberta prepared for whatever it took to get the pilot plant up and running. He basically said "Rick, I brought a suitcase full of clothes, but if I have to I'll go shopping and buy new shirts and pants. I'm here for as long as it takes". And he was. That's why it got commissioned so quickly, with the help of Chris and the rest of the guys at Zeton. And there were many nights we would leave and, if you know engineers, you know that at night time you gotta have a hot dog and a beer, and the shop talk never stops. I think we solved as many problems over beer in the evening as we did during the day. It's that kind of commitment you see at Zeton."

David: "So despite the pressure to start up, you guys had a lot of fun?"

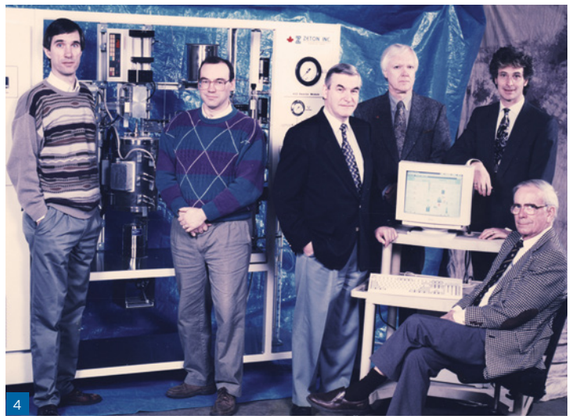
Rick: "As you know, stress can be fun. Yes, you want to meet timetables, and you want to meet your goals. Zeton has a culture – it comes from being employee owned - where you can think independently but if you've got a problem you can solve it with the group. The team is there to help everybody to grow and become problem solvers. And it's the problem solving that's fun."

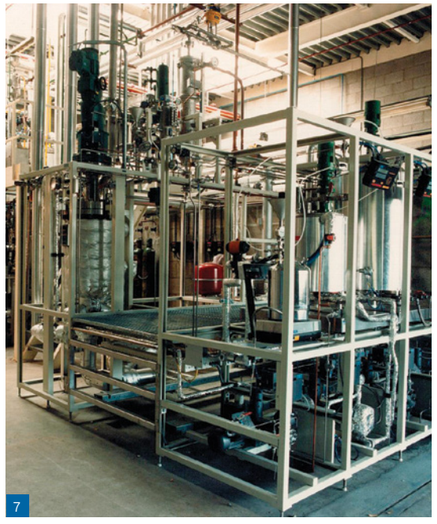
David: "Finally, how would you say Zeton has changed over the past 30 years?"

Rick: "If you take away the fact that Zeton has grown into a worldwide company, and the leader in its industry - which is a tremendous statement in itself - not much has changed. Zeton still has a very dedicated professional staff, and their ability to solve problems at this (pilot) scale is second-to-none. For pilot plant projects, it's one thing designing something on paper, but actually making it work is the real challenge. And Zeton still has the ability to do that. The focus on meeting performance targets and deadlines has always been there." ■

1990's

Many projects in this period had a polymers focus, included polyethylene, polypropylene and high pressure emulsion polymerization pilot plants...





1 *25 kg/hr HDPE pilot plant*

2 *High pressure emulsion polymerization pilot plant*

3 *Dual reactor hydrodesulphurization pilot plant*

4 *MAT 3000 unit (with former chairmen Don Redfern and Archie Bennett)*

5 *BASF pilot plant module lift (ref. p. 5)*

6 *Double loop reactor polypropylene pilot plant*

7 *Emulsion polymerization pilot plant*

BASF'S THOMAS KRUG RECALLS A SUCCESSFUL PROJECT WITH ZETON B.V. IN CONVERSATION WITH HERMAN BOTTENBERG

Herman: "How do you remember your first contact with our company?"
Thomas: "It must have been 20 years ago and in an early phase of my career. Up to that moment I had worked on smaller research projects and I was involved in the lab scale research for a new promising process. Piloting was going to be the next milestone in this development. We went with a small team to your facilities and we had our first project discussions. Good questions, scale specific solutions and the team approach gave us confidence for further development of the cooperation for this project. In particular I remember the people like Elzo de Haan, Johan de Zeeuw and Han van de Riet. Meeting Elzo and Han recently brought back good memories!"

Herman: "Could you briefly describe the project?"
Thomas: "This pilot plant project was an essential step in the scale up of a new process from lab to production. I have been involved in all these development phases, which is quite unique and exceptional. Normally we would have built pilot plants with our internal resources, however my boss at the time, Dr. Bauer, was always willing to try new things. He had the strong belief that working with your company would bring new ideas, strong commitment and the required timeline. This project was under an extreme time pressure and therefore these aspects were crucial to making it work, but also allowed us to go external."

Herman: "How was this deviation from the traditional approach received within BASF?"
Thomas: "For both companies this has been a challenging project. For us going external and for Zeton working at the limits of modular plants at that time. Therefore this project was closely followed by many people. It was the first time that modules of this scale were brought to BASF site. A large crowd was watching these modules being lifted into the buildings. The short and smooth reassembly and successful operation provided all the results we required to scale up to production."

From left to right: Thomas Krug (BASF), Luuk van Oefelen (Zeton) and Dr. Karl Gerhard Baur (BASF)

Herman: "I have been informed that due to this important project you got the opportunity to move to the US?"
Thomas: "Yes, having been involved in the pilot plant project, I had the right knowledge and experience. I was one of the project team members selected to support the scale up to production. We built this first production plant in the US from 1999 through to start up in 2001. It was a great experience for me and my co-workers!"

Herman: "Now looking back at our cooperation at the end of last century, how would you describe Zeton?"
Thomas: "Customer-oriented; experienced; creative (for small-scale solutions); trustworthy; having a strong will to succeed."

Herman: "Being back in touch, how would you compare Zeton now with the company you remember from your earlier project?"
Thomas: "Zeton now has even more professionalism and competence by having grown and extended its capabilities. However, the essentials remain the same. You work with small teams of highly skilled people, all very much loving what they do - designing and building modular pilot plants."

Herman: "Is there anything you have taken from the joint project, that is still of use in your current role?"
Thomas: "From this first project I learned that you need to try new things and before starting a new cooperation give credit and trust to new external companies. Always start with the positive approach!"

Herman: "At the end of the project there was also a celebration. You received a souvenir to keep the memory of the project alive?"
Thomas: "Yes, we all received a facade sign, which typically is on houses and farms in your region. I was told this sign protects the occupant against bad luck. I have taken this sign with me through all the places and offices I worked. It seems this helped through the years working with the pilot plant and thereafter!" ■

2000's

Alternative energy and gas to liquids projects took centre stage between 2000 and 2009, with many projects in Fischer-Tropsch reaction and upgrading, as well as competing process technologies...

1 *Fischer-Tropsch pilot plant*

2 *F-T reaction and upgrading process demonstration unit*

3 *Lab scale ATR unit*

4 *Syngas pilot plant*

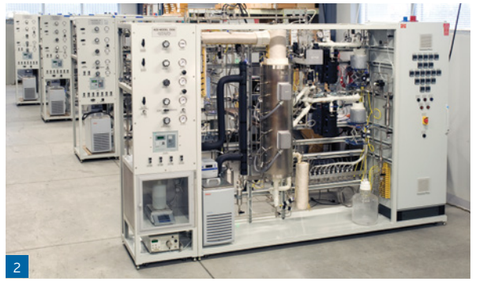
5 *Novel reaction GTL demonstration plant*

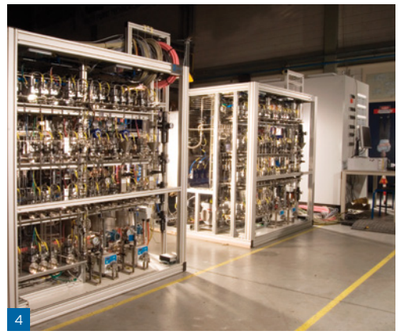
6 *F-T product upgrader demonstration plant*

7 *Strategic marketing retreat, Nov 2005*

2000's

...and Zeton took the first steps in delivering modular process systems for the pharmaceutical industry. In addition to a renewed focus on lab scale systems and pilot plants, the company experienced tremendous growth in large, multi-modular process demonstration plants...





1 *Hazardous chemicals demonstration plant*

2 *Advanced Cracking Evaluation (ACE) Technology® units*

3 *Grace DCR FCC (Mark IV) pilot unit*

4 *Multi-reactor lab scale catalyst testing unit*

5 *Kilo lab unit for pharmaceutical product development*

6 *Chemical intermediate pilot plant*

EDITOR'S NOTE: THE FOLLOWING IS AN ABRIDGED VERSION OF AN INTERVIEW WITH DAVID BECKMAN AND JOHAN TER HARMSEL RECORDED ON JANUARY 20, 2016 IN BURLINGTON.

Johan ter Harmsel, Managing Director of Zeton B.V. (l) with David Beckman, President & CEO of Zeton Inc.

Take us back to the early days at Zeton. How did the company start out?
David: "In the early days at Zeton, there were seven of us in Burlington, consisting of five engineers and two technicians in the shop, with at most five thousand square feet. We completed three projects for British Petroleum in the UK, and that repeat business was very important to us. We also won business with Dow Chemical in Sarnia, and with CANMET in Ottawa."

Johan: "In the Netherlands, we started off with four people. It was "working out of the garage." We were really pioneering - finding our own way to do things in the best possible way, and learning how to be innovative."

David: "Some of our first projects were actually quite challenging. We were dealing with very complicated conditions, and this gave us confidence, and a good base of experience."

Johan: "We were one of the first companies to bring automation to pilot-scale equipment."

David: "There was a lot of hard work and a lot of long hours that we had to put in because we were a small company. But at the same time we had a lot of fun, and this became part of our culture. "

Zeton's clients work on the leading edge of process innovation. Where do great ideas come from in your organization?
David: "Innovation in Zeton comes from the whole company. Everybody's encouraged to come up with ideas. Everything from how we execute projects, to what goes into our designs. The mentality of the people putting the plant together is always quality first."

Johan: "Confidentiality goes hand-in-hand with innovation. All of Zeton's projects have a highly confidential nature, and we must be very sure that this confidentiality remains with each individual project."

David: "We've been able to solve many problems and issues that customers have brought to us, with very innovative and creative solutions. This work has been recognized worldwide. Chris Brown won a design award for Petrobras in Brazil, and our design group won an international award from Bentley for the design of a modular Gas-to-Liquids demonstration plant. This recognition emphasizes the quality of our people, and the expertise that our design team has."

How has being located in Burlington and Enschede helped Zeton to grow and be successful as a company?
David: "Burlington's been a good location for us because we're at the center of where all of our key suppliers are located. Also, it's an ideal location because we are close to several universities, and to Toronto and Hamilton for getting people to come and work for us in our design office and shop."

Johan: "Enschede is situated in between the Rotterdam refinery area and the chemistry area of Germany, and many of our staff have completed their education at the University of Twente. In fact, one of the things that we have set up with the University of Twente, which is physically just two or three kilometers away from our office, is a one day course where the students get educated by our staff, which earns them credits towards their degree."

David: "In Burlington we primarily use the co-op program at the University of Waterloo. The students get to know how Zeton works, and we get to know how they work, and if there's a match at the end of their co-op program, we'll make them a job offer."

"THE HARD WORK - THE EXTRA HOURS THAT EVERYBODY'S PUT IN - HAS BEEN VERY IMPORTANT TO OUR SUCCESS, AND IT'S VERY MUCH APPRECIATED"

What do Zeton's clients share in common, and how would you describe a 'customer of the future'?
Johan: "Many of our customers are on the innovative edge of new technologies, and we think that's the area where our future customers will come from."

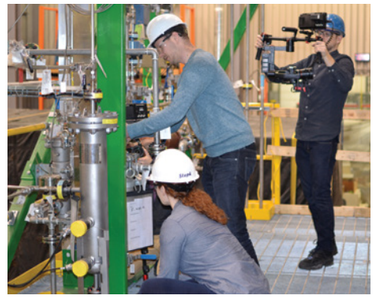
David: The process development industry is worldwide, and more and more the chemical industry is looking at smaller scale production plants. For safety reasons they want to produce certain chemicals at a site where they're using it, as opposed to producing it in a large plant and then transporting it around the world, and this lends itself to small modular production plants. New technologies are emerging in green chemistry and sustainability, which are all part of the opportunities that we see in the future."

Every company has its own unique culture. Can you describe Zeton's culture and core values?
David: "Zeton's culture is very much one of high performance. We give our employees a lot of responsibility for running the projects when they come to the company. And it's also very much a culture of team work and providing the customer with a product that they will be satisfied with. There's a lot of pride in how we build our plants, and that quality really comes from the shop floor."

Johan: "Our staff are very eager to learn, and also eager to deliver, and deliver each time better than the last time."

David: "Being employee owned at Zeton makes us accountable for what we do. We don't have outside bodies that come in and tell us how to run the company. We're making our decisions ourselves. But most importantly, were accountable for those decisions."

Johan: "We have taken craftsmanship to a high level, and take pride in the work we do. In both locations we're very committed to the projects for our customers.



Business has changed enormously over the past 30 years. What are some of the biggest opportunities and challenges facing Zeton today?
Johan: "We see a trend on the manufacturing scale, with the scales going down, and we see more distributed manufacturing facilities surfacing. There is a need either from a logistic or safety point of view that companies want to produce only at those places where the intermediate is being used. The difference between a pilot and demonstration scale unit, which is physically a little bit smaller, and a larger plant used for distributed manufacturing is only on the outside. Complexity inside the box many times is comparable. People must really see it before they believe that you have the capability to build units on this (larger) scale. To get it out from here and reinstall it somewhere now, it's a very swift action."

David: "We've grown as a company to a fairly big size, and we have the challenge now of finding the balance between the project workload and the resources. We have a specialized manufacturing facility space. For the project workload that's coming to us, and that we foresee in the future, we need more space to do that. So we're expanding our manufacturing facilities."

Behind every successful company is a great team. Can you share some of the secrets behind Zeton's success?
Johan: "A unique advantage is by having both design and assembly under one roof. The constant and open feedback from our staff and customers is one of the key enablers to delivering better projects with each new project."

David: "Modularization also helps us to employ standard designs like standard modular designs or standard sections of the plant from project to project. And that improves our efficiency by using standard designs and it allows us to do the projects in as short a time period as possible. Our customers are working in parallel at the site and getting it ready while we're building the plant here."

David: "The hard work - the extra hours that everybody's put in - has been very important to our success, and it's very much appreciated."

Johan: "Without the staff, it's fair to say that the company wouldn't be where it is today."

David: "I think the future at Zeton looks very promising, still maintaining our culture of innovation and team work. We have established a very strong base of capabilities, and we'll be able to handle projects that come to us from many different fields." ■


1


2

2010's

(early 2009-date) After a 20 year hiatus, bioenergy projects were back in vogue, with projects including pyrolysis oil demonstration and production plants, a bioethanol demonstration facility, a cellulosic ethanol demonstration plant and a biomass-to-chemicals demonstration plant...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4


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6

1 *Biomass hydropyrolysis (IH2) pilot plant*

2 *120 te/day pyrolysis oil production facility*

3 *Biomass-to-chemicals demonstration plant*

4 *RTP® demonstration plant*

5 *Cellulosic ethanol demonstration plant*

6 *Biobutanol demonstration facility*


1


2

2010's

...and Zeton has taken process intensification, and continuous processing in pharmaceuticals, to a new level. Furthermore, the company has met the growing demand for small modular production plants from its customers across a number of industries...


3


4


5


6

1 *Small modular hazardous chemical production plant*

2 *Multi-reactor hydrotreater pilot plant*

3 *Natural gas to chemicals demonstration plant*

4 *Six parallel reactor hydrotreater pilot plant*

5 *Slurry processing skid for heterogeneous reactions*

6 *Transformer oil processing (production) plant*