“Especially in a digitalized world collaboration is key to achieving better results.”
The world of industrial production is changing – and that includes the process industry. Markets are becoming more volatile, investments more complex, and new technologies are transforming production methods and plant concepts. The chemicals industry must become increasingly flexible and efficient while at the same time ensuring the safety of its plants, from both technical and financial perspectives.

As a result of ever shorter innovation cycles, companies are facing many questions. How can investments be maintained and maximized over long periods of time? As plants become increasingly interconnected how can data and assets be better protected from unauthorized access? You can read about the strategies Evonik is pursuing in this regard on page 10. On a personal level I am particularly interested by the statement that working together on better answers, solutions and products can bring huge benefits in the digitalized world. This aligns with experiences from our daily business, where we frequently engage in dialogue with our chemical customers to find the right solutions for their specific situations and requirements.

By bringing together the right skills and expertise, we create solutions that are innovative, efficient, practicable, and reliable. You’ll find a number of examples in this issue. We have created a strategic partnership with Evonik to implement the company’s digitalization strategy. We support Braskem on a multinational project, and we are working with Solvay to modernize process control technology using state-of-the-art simulation tools. These examples demonstrate the diversity of solutions to different requirements as well as the importance of networked thinking and close collaboration – especially in the digitalized world.

Miguel Fernandez
Vice President Market Development
Chemical Industries
Custom alarm management optimizes plant and process performance

An innovative concept for safe hydrogen storage

Simulation software aids smooth modernization of the process control system

Robust network components in the desert
Contents

01.2017 | siemens.com/magazine/industry

3 Editorial | 27 Imprint

Cover Story

09 Small space, great performance
Fiber-optic temperature measurement enables multiple measuring points in a confined space at a polymer plant

10 Networks for greater success
Interview with Dr. Henrik Hahn and Dr. Wilhelm Otten, Evonik, on digitalization strategies

13 Right message, right time
Alarm management solution optimizes plant and process performance for Evonik production in Singapore

15 Complete power
Integrated energy management solution for a chemical plant gives Evonik a competitive edge

Trends

06 Promoting innovation
Interview with Dr. Jürgen Brandes, CEO of the Process Industries and Drives Division, Siemens AG

46 "Industrie 4.0" in plant design
Digitalization solutions with new opportunities for OEMs in the process industry

48 Two pioneers join forces
Siemens and Hydrogenious Technologies develop a new hydrogen storage technology

Chemical industry

16 Complex processes reliably controlled
Reliable phenol production at INEOS Phenol with MPC module in Simatic PCS 7

19 It takes a world
Multinational cooperation on largest ever petrochemical project in Latin America: Braskem Idesa

22 Simulation instead of risk
Simit simulation software aids smooth update of Simatics PCS 7 for production plants

30 Safety and sustainability
Functional safety system supports company-wide excellence at Huntsman

32 Turning CO2 into bricks and cement products
Scalable process control system supports Australian technology development for carbon management

Technology

24 Data exchange for more efficient engineering
Comos supports integrated data handling for future-proof plant management

28 Flexibel for the long term
Simatic PCS 7 V 8.2 with open system architecture and standardized interfaces

Engineering

26 More than just an interface
Linking Comos and Bentley OpenPlant to keep all plant and engineering data under control

Water

34 Clean water for all
Reliable control of water treatment plants ensures drinking water supplies in Ho Chi Minh City

36 Long pipeline under close watch
Siwa Leak smart water solution reliably localizes leaks in the salt water pipeline of a potassium mine

Integrated Drive Systems

39 Perfectly coordinated complete solution
Innovative drive concept for maximum availability and reliability of pumps at BASF Antwerp

40 Cutting downtime
Increasing production flexibility at Märkische Faser GmbH with modern drive concept on fiber lines

Chemical industry

34 Complex processes reliably controlled
Reliable phenol production at INEOS Phenol with MPC module in Simatic PCS 7

19 It takes a world
Multinational cooperation on largest ever petrochemical project in Latin America: Braskem Idesa

22 Simulation instead of risk
Simit simulation software aids smooth update of Simatics PCS 7 for production plants

30 Safety and sustainability
Functional safety system supports company-wide excellence at Huntsman

32 Turning CO2 into bricks and cement products
Scalable process control system supports Australian technology development for carbon management

Industrial communication

42 Direct data exchange
OPC Unified Architecture for secure data exchange in industrial automation

44 Rugged performance
Robust network components from the Ruggedcorn product line can even withstand desert conditions

Process analytics

50 The ideal result
Gas chromatographs supply current natural gas parameters for testing and controlling gas turbines
Jürgen Brandes

Jürgen Brandes has been CEO of the Siemens AG Process Industries and Drives Division since October 2015.

Following his role as Vice President for the Strategic Planning and Program Office, he headed the Large Drives Business Unit and the Rail Automation and Mobility Management Business Units.

The electrical engineer acquired his doctorate in drive engineering at the University of Hanover. He has been with Siemens for over 25 years.
Promoting innovation

Volatile markets, globalization, digitalization – the process industry is facing some major challenges. What expertise is now needed to not only safeguard but also enhance a company’s competitiveness? We discussed the subject with Dr. Jürgen Brandes, CEO of the Process Industries and Drives Division.

Mr. Brandes, we’re currently experiencing a period of great market change in many sectors of the process industry. How are companies responding to that change?

Jürgen Brandes: The current climate in the process industry – tough in some areas – is motivating many of our customers and partners to rethink their strategies and business models. They’re asking themselves: What do we need to do to be more successful in future? And what partners will be able to provide substantive assistance? I believe that the answers to those questions present a wealth of opportunities.

What answers can Siemens provide?

Jürgen Brandes: We have broad-ranging expertise in many areas that make companies more competitive, efficient, and flexible, and we bring the right expertise to the table. Working alongside our customers and experts in the fields of plant manufacturing, process development, and IT enables us to generate excellent and innovative ideas. As partners, it’s important that we listen carefully and respond to the questions and challenges that are emerging. This will allow us to work together to find the best solutions – or develop new ones.

Can you give an example?

Jürgen Brandes: One issue that’s currently troubling many companies is plant documentation and approval. Regulatory requirements are becoming ever more stringent, which entails greater cost and effort to compile and maintain the relevant documents. Our design tools help customers compile plant data and documents faster and manage them more efficiently. Another example is preventive plant maintenance: The information provided by our tools often delivers significant added value.

A while back we worked with a leading chemical company to develop an application based on our XHQ software, which analyzes plant states across multiple sites. That allowed us to detect a fault in a key component in time to prevent downtime – so the joint project paid off for the customer. Now we’re talking about how the solution can be expanded. Our MindSphere platform, for example, provides us with entirely new possibilities for connecting numerous data sources to the Cloud and to customized apps. That will lead to new ideas for enhancements. Our collaboration with the customer is changing as a result, too. Thanks to projects like this, we’re increasingly being seen as a business consultant rather than just a product or system supplier.

This kind of close collaboration establishes trust, but it also creates interdependencies. How do your customers deal with that?
Jürgen Brandes: There have always been interdependences. When a company opts for a particular control system, it’s a commitment for years if not decades. What’s new is that interdependences extend beyond engineering into areas like data and knowledge. Today, when we talk about new business models from joint development projects to operator models – it’s especially important for all the stakeholders to think about how knowledge can be protected while at the same time utilizing third-party expertise. This issue will occupy us even more in the future – especially in the field of digitalization.

The process industry is considered to be quite conservative. Don’t many companies have major concerns about these changes?

Jürgen Brandes: I don’t think it’s possible to avoid these issues. Digitalization has already delivered a major efficiency boost in many sectors. Today companies are able to easily utilize large-scale computing capacities and services in the Cloud – as with our MindSphere. This means, for example, that administration and logistics processes can become faster and more agile. It seems only logical to me that manufacturing should also be able to benefit from those technologies. A key factor is that the various new approaches take into account the specific demands and concerns of the process industry, especially with regard to plant safety and protecting investments. We’ve already implemented groundbreaking solutions in other industries, and I’m certain that we’ll be able to gradually exploit the potential for digitalization in the process industry, too. But doubtless, there won’t be a single big solution; rather, we’ll achieve minor improvements in many areas, which will then deliver an overall competitive edge. This is how we’ll establish trust in the technologies and in Siemens as a partner. Achieving better answers and solutions in a digitalized world requires mutual cooperation, as numerous projects with well-known chemical companies such as Evonik increasingly indicate (see interview on page 10).

Is Siemens going to have to change to achieve this?

Jürgen Brandes: We’re already very well prepared in many areas. We have account managers who are doing an outstanding job providing our customers with the full range of our expertise. Always open to new ideas, they are delivering multiple benefits both to our customers and to Siemens. For example, we recently equipped an entire ethylene plant for Braskem that incorporated numerous systems on a greenfield site in Mexico. The project involved coordinating between different departments, EPCs, and OEMs. Working alongside Braskem, the complex project was a complete success.

And we have terrific teams in our departments and regions, implementing new ideas and translating these visions into real success stories. But yes, the changes are also challenging us to rethink our own processes. That will allow us to exploit the opportunities presented with new business models. And as CEO of the Process Industries and Drives Division, it’s part of my job to promote innovation and motivate our employees to pursue new ideas for achieving success with and for our customers.

Mr. Brandes, thank you for talking with us.

Performance brings rewards: performance-based contracting

One example of a new business model is the collaboration between a manufacturer of specialty chemicals and Siemens to develop and implement a digitalized filling line. Both companies are currently working on the pilot project, developing the technology for a smart line control system at an intelligent line control. The goal is to improve the future productivity, flexibility, and efficiency of the company’s filling operations. What’s special about this project is that both parties are sharing the development costs of the pilot. Siemens will subsequently roll out the concept acting as a contractor at other sites, and will be involved in productivity enhancements. This performance-based contracting represents a new kind of collaboration for both sides. The innovative production line is scheduled to go live at the beginning of 2017.

»I’m certain that we’ll be able to gradually exploit the potential for digitalization in the process industry, too.«

Jürgen Brandes,
CEO of the Process Industries and Drives Division of Siemens AG

siemens.com/digitalplant
cornelia.duerrfeld@siemens.com
Small space, great performance

In-line measurements of temperature profiles in spatially confined applications place special demands on the measurement technology. Fiber-optic temperature measurement allows a greater number of measuring points while reducing space requirements.

Matthias Hüning of Evonik Industries in Marl, Germany, specialist in electrical measurement and control technology in the High Performance Polymers business sector, describes the problem in his plant as follows. “We use tube bundle reactors in our production plant for Laurolactam. The challenge is to install a sufficient number of temperature measurement points in a small space within a single tube reactor. We need this to quickly detect high temperatures that may lead to the destruction or accelerated aging of the catalyst.”

Due to the small diameter of the reactor tubes, the necessary number of measurement points, and the demands on the speed of data acquisition, it was not possible to use a conventional measuring system. Together with Siemens, Evonik therefore employed Sitrans TO500 fiber-optic temperature measuring lances based on Fiber Bragg Grating (FBG) technology. The system consists of a transmitter with up to four fiber-optic measuring lances and up to 48 FBG sensors per lance. This makes it possible to synchronously measure the temperature at up to 192 locations per measuring system with a measuring error of less than 0.5 seconds and a fast response time of less than 4 seconds.

In Marl, FBGs were implemented every 20 cm. “Our plant personnel can now reliably detect the development of hotspots or the effectiveness of the catalyst. Plus, we get a detailed recording and visualization of the complete temperature profile in the reactor,” Matthias Hüning continues. “We use this information to initiate measures to reduce the temperature, for example, in the first scenario. In the second scenario, we can perform maintenance procedures, such as replacing the catalyst when necessary due to its age.” Both applications extend the life of the catalyst in the reactor, which means cost-effective, preventative maintenance procedures are performed based on need.
Digital developments and the intelligent utilization of data are producing a significant change in market and competitive dynamics. Evonik also sees its transformation into a digital company as a great opportunity to stand out from the competition and position itself at the forefront of cutting-edge developments.

As part of its company strategy, in early 2016 Evonik established a new department tasked with developing a digitalization strategy. What are its core features?

Henrik Hahn: Our strategy rests on five pillars: creating a lasting digital customer experience, speed and agility, good access to external skills, consolidating and developing expertise, and, not least, a digital culture for collaborative work and situational leadership. To this end, following intensive preparations by colleagues in innovation, engineering, and IT, we put together an interdisciplinary digitalization team in early 2016 and translated the five strategy pillars into a digital agenda.

»Trust is the currency of the digital age.«

Dr. Henrik Hahn, head of Digitalization Strategy, Evonik Corporate Strategy
We also regularly liaise with our operational segments and functional areas. At present, we’re focusing on incubating digital business models, for example in B2B e-commerce solutions. Another area we’re looking at is the development of method knowledge. This includes technology and start-up scouting as well as developing and maintaining an external partner system.

What role will Evonik play in the development of Industrie 4.0?

Wilhelm Otten: A key element of Industry 4.0 is the extensive networking of systems in several dimensions. Horizontally throughout the company supply chain, including production, and in the future in particular, the entire intercompany value and logistics chains. And vertically from the field level to the ERP system, and now – this is a new component – to the Internet, too. The third dimension involves networking throughout the lifecycle of an asset. This networking makes our planning and production processes in the chemical industry more effective, efficient and, of great importance in the future, more flexible. Evonik is conducting technology projects in all of these areas to allow us to exploit the benefits of these new technologies. We follow the relevant NAMUR recommendations and support the introduction of standards like FDI (field device integration). In addition, we’ve initiated the development of a “module-type package” for the specification and integration of complete units and modules in automation systems. And we’re also working to apply the principles of integrated engineering to our planning processes. Another aim is to increase production flexibility, and so we have gotten involved in the “F3 Factory” project. We achieve flexibility by configuring our systems using modules that are easy to replace. We intend to go a step further than the F3 initiative with our strategic project titled “Next level of modular readiness.” This is the starting point for our third strategic project. Based on the SIDAP project funded by the Federal Ministry for Economic Affairs and Energy and NAMUR recommendation 161, “Remote Operation Basics,” we intend to develop pilot applications to show the safety and efficiency benefits that can be generated for our production processes using remote operation.

How are you approaching these new issues?

Wilhelm Otten: What’s important is finding the right partners. Siemens, for instance, is a strategic partner for automation engineering, and we work with them on many common issues: for example, on the DEXPI initiative, on modular systems, and on automation solutions for our major plants. In all the three dimensions noted above – the asset lifecycle, the supply chain, and vertical integration – Siemens offers a wealth of expertise and solutions. Especially when it comes to innovative topics, trust is also a major factor, so it’s a great advantage that we’ve already been working closely with Siemens for a long time.
How digital is your business at present?

Wilhelm Otten: Not all the digital topics are new to us. Take, for example, the Process Technology and Engineering business line that I head. We develop and implement virtual plant simulators in this field and have effected advanced process control in our major processes. For more than 20 years, we’ve also had a group that conducts data analyses in both production and other areas. At Evonik Technology & Infrastructure GmbH, our services practically cover the entire asset lifecycle and supply chain and we have all operational IT and automation applications in our unit. That makes it all a lot easier for us.

How will digitalization affect the company and its employees?

Henrik Hahn: Digitalization will make our employees’ work easier. It functions as a tool to increase work efficiency and productivity, and it opens up opportunities for employees to act constructively both within and beyond their own areas of work. As a result, the importance of digital skills will continue to grow. As a company, we see primarily six digital trends that are of key significance to the various issues we face: data analytics, mobility, the Internet of Things, the Cloud, security, and collaboration. Beyond this, we are also seeing a marked trend toward personalization in the B2B environment. We’re at the forefront of a genuinely cutting-edge field and are thus creating new growth opportunities in a stable company that is ideally positioned to address the future.

Are there also risks associated with this trend?

Henrik Hahn: Digitalization affects the entire value chain – from the producer to the supplier and ultimately the consumer. That naturally brings up the critical issue of what data can I share with whom, and why? When we utilize and make data available across companies, the issues of knowledge and data protection are of course central. For me, that’s why data are not the key issue here – trust is the real currency of the digital age.

Thank you for the interview.
A tailored alarm management solution can effectively support control room operators in monitoring and controlling processes to help prevent errors, and also contributes to optimum plant and process performance, as a project at an Evonik production site in Singapore demonstrates.
a suitable alarm concept, data collection and system benchmarking, “bad actor” alarm resolution, alarm documentation and rationalization, real-time alarm management, and last, implementation in the DCS. Working closely with personnel from the plant, the Siemens team tailored the alarm management system by integrating the existing user requirements and best practices from the Evonik site in Darmstadt, Germany. Implementation of the new alarm management in the Simatic PCS 7 system and corresponding application software was performed by the local Singapore Siemens team. One crucial success factor of this project was the involvement of the Evonik plant operators in the concept and design phase, which allowed their years of operational experience to be applied in the design and creation of the solution. The Singapore Siemens team organized several workshops throughout the project to support the alarm evaluation and prioritization process, and to identify the causes of “bad actor” alarms.

One key feature of the alarm management system is the Advanced Alarm Suppression concept, which filters and aggregates alarms. Tailored alarm prioritization according to urgency and consequence ensures that operators are always presented with the most important alarms.

As part of the new concept, the alarm cockpit in the plant was also redesigned. Alarms are now aggregated into several logging lists, with one for all incoming process alarms and another for PLC process control messages. This concept ensures that process-related alarms are directed straight to the operator, while other alerts are sent to the plant maintenance personnel. As a result, tasks can be dealt with in a timely manner, because they are quickly assigned to the right person.

Positive feedback from operation

The new alarm management solution has exceeded Evonik’s expectations. In terms of the alarm optimization system, Evonik was able to effectively address the issue of operator stress in its Singapore plant. Following smooth implementation without any system downtime, the number of process alarms displayed in the control room has been reduced by more than half. In addition to the alarm management solution, Siemens also supported Evonik in implementing several system improvements. The plant personnel have easily adapted to the new solution and are already experiencing the benefits in their daily work.

Each process produces a significant number of alarms. Proper alarm management helps to reduce the likelihood of mistakes and impacts process performance and safety – thus reaching operational excellence.
Complete power

The current methionine plant in Singapore is Evonik’s largest chemical investment in the company’s history. With a fully integrated energy management solution for power supply, monitoring, control, and automation, Siemens is helping to hone Evonik’s competitive edge.

Methionine is an indispensable amino acid for healthy and sustainable animal nutrition – and Evonik is the market leader for this product. The company strengthened this position with the largest investment in its history. The Evonik Me5 plant boasts an annual capacity of 150,000 metric tons and produces not only the amino acid methionine but also all important raw materials required for the production process.

Fully integrated energy management

The most essential “raw material” is, of course, a reliable power supply that not only keeps the production up and running but precisely meets the demands of complex chemical production processes. With a holistic approach for developing a fully integrated energy management solution for power supply, monitoring, control, and automation, Siemens was able to meet the customer’s requirements: a stable and reliable power supply and control system, highest product quality, and prompt and accurate support. Siemens acted as a one-stop shop for Evonik in Singapore, from engineering, fabrication, and delivery to work at the construction site, system integration, and testing and commissioning of the entire electrical network system. The solution comprises 66 kV gas-insulated switchgear, 400 V dry-type distribution transformers, and network remote control through the substation automation system Sicam PAS.

Better performance thanks to reliable power

The system was made to order with components from Siemens factories in Germany, then tested and shipped to Singapore, where it was installed and commissioned. Now Evonik can count on a holistically developed power supply system that allows the company to strengthen its leading position in a growing market based on a reliable, safe, and low-maintenance power supply.

The cooperation will continue. Evonik also commissioned Siemens as one of the partners for the energy management solution for the new Me6 plant.

Scope of products and services

- 66 kV GIS – 8DN8 (7 bays)
- 10 kV GIS – 8DB10 (55 units)
- GEAFOL cast-resin distribution transformer (13 units)
- Substation automation system
- Sicam PAS (1 lot)
- 12 kV busduct (1 lot)
- Neutral ground resistor (4 units)
- Siprotec (4 protection relays)
The INEOS group, headquartered in Rolle, Switzerland, is an international manufacturer of petrochemicals and specialty chemical products, with 67 sites in 16 countries. One of its divisions is INEOS Phenol, which operates five production facilities in Belgium, Germany, and the United States. INEOS Phenol is the world’s largest producer of phenol, acetone, and cumene.

The facility in Gladbeck was established back in 1952 as Phenolchemie and was acquired by INEOS in 2001. Producing over 650,000 metric tons of phenol a year, the Gladbeck facility is today the second largest phenol plant in the world after its sister plant in Antwerp. Phenol is a key industrial chemical that is used as an intermediate product in the manufacture of plastics like polycarbonate, epoxy resin, and nylon (polyamide).

Acting and reacting
Phenol is produced by a continuous process culminating in several distillation towers. Each of the towers removes residues from the phenol and also filters out unwanted substances like alpha-methylstyrene. This requires a sophisticated control system, because the individual processes react with great sensitivity, and any changes in one tower will automatically impact the downstream processes in the other towers.

These are generally rather slow processes, entailing lengthy reaction times. It can take several hours, for
example, before a stable state is reestablished in a distillation tower in the event of a change in one or more parameters. INEOS controls the processes in the individual towers based primarily on the following three parameters: evaporator capacity, return flow rate, and water feed. These are used to determine the temperature in the tower sump, which in turn influences the phenol concentration at the tower head.

**Predictive process control**
INEOS runs its process automation using model predictive control (MPC). MPC is a state-of-the-art method for the predictive control of complex processes dictated by multiple process variables. INEOS has been using the technique for over eight years now, and its key benefits have been stable processes and consistent product quality.

MPC creates a time-dependent dynamic model that is the basis for calculating the future behavior of the process, depending on multiple influencing factors. The model is referred to a specific time horizon, and normally uses only the current prevailing influencing factors to calculate the next time increment. As opposed to conventional optimal control, MPC is a continuous control loop that is continuously self-regulating in order to adapt to changes and disturbances as and when they occur. For the production of phenol, MPC provides an intelligent control system that creates the optimal preconditions for realizing precisely the goals that are of vital importance in chemical production: increased throughput, improved process reliability, and optimized energy and raw material use. In other words: It’s all about efficiency, reliability, and quality.

**Successful pilot**
INEOS in Gladbeck had previously been using an MPC control software solution that covered multiple process parameters which, though delivering flawless results, also resulted in a number of disadvantages. Because the algorithm for such a controller demands extremely high computing power, the application ran on a separate PC, which was in turn connected to the process control system via an OPC interface.

Migrating the process control system to a new version would also have required extensive modifications to the independently running MPC software. That effort and expense was avoided, however, because Simatic PCS 7 Version 8.1 and above comes preinstalled with the MPC 10x10 function block by default.

INEOS therefore decided to give the Siemens integrated solution an opportunity to prove itself. In a three-month pilot, a PCS 7 box with the new MPC 10x10 function block was installed and connected to the control system via an AS-AS interface. The tried and proven process model was derived from the multiparameter controller already in use. This required artificial learning data to be generated by simulating the future behavior of the process.

Dr. Michael Lausmann, Production Manager at INEOS Phenol
the existing model and imported into the PCS 7’s MPC configurator in place of real measurement data. The result was highly promising, revealing a conformity of up to 98% between the two models.

All the control parameters were subjected unambiguously to primary and secondary goals. The primary concern for INEOS’s process engineers was to attain a consistent phenol concentration single space and therefore a consistent product quality. The second goal was to optimize the input of the necessary heating energy. Applying the default values suggested by the MPC 10x10 configuration tool, a highly robust overall process control system was realized.

Benefits from the integration
Switching from an external MPC software solution to one directly integrated into the process control system proved exactly the right choice for INEOS. The prime benefit is that no cost will be incurred in the future for additional software, and the engineering costs will also be much lower. For example, the entire circuit configuration is executed very simply by CFCs, as in the case of a conventional cascade control. The effort and expense of documenting two separate systems and having to match them together again in the event of a system change is also avoided.

But lower lifecycle costs were ultimately not the decisive reason for INEOS to give up what had actually been a tried and proven solution: The key factor was the result of the pilot. After just a short time, it delivered a control quality that was every bit as good as the existing solution. The MPC 10x10 function block was even able to handle a load switch of the process plant in automatic mode. So the decision was clear, and INEOS Phenol’s Gladbeck plant is now running reliable processes based on the MPC control system directly integrated into Simatic PCS 7.

Another factor also came into play, and it was only fully revealed in the course of the project: Having integrated the MPC control into the familiar operating concept of the process control system, INEOS’s staff will in the future be able to optimize the process control themselves. And not just for the existing production plant, but for future plants too.

SP = set point, PV = measured process variable
It takes a world

Braskem Idesa is a 75-25 joint venture between Brazil’s Braskem, the largest producer of thermoplastic resins in the Americas, and Grupo Idesa, a traditional petrochemical company in Mexico. As one of the project’s top suppliers of skills, technology and equipment, Siemens itself marshaled resources and employees from 11 different countries to collaborate on a truly multinational and multicultural level with Braskem Idesa and its global partners.

The project is the largest greenfield investment ever undertaken by a Brazilian company abroad, with an annual production capacity of 1.05 million tons of polyethylene. By the time Braskem Idesa began producing ethylene in April 2016 at the new $5.2 billion petrochemical complex in the state of Veracruz, Mexico, the project had, at its peak, employed 17,000 people. Of that number, a vast majority were Mexicans, while others on-site came from more than 23 countries throughout Europe, Asia, and the Americas.

Paths to growth merge
Driving the project from the beginning has been a convergence of the growth strategies of a country and a company – Mexico and Braskem. Despite its wealth of petrochemical resources, Mexico remains a major importer of polyethylene, which in various forms is used to manufacture everything from plastic bags and milk jugs to piping. To meet its growing needs – and to stimulate economic development – the country set a goal to establish Mexico’s first polyethylene production plant in the private sector. As an incentive to attract a company experienced at commissioning and operating such facilities, an auction was set for a 20-year supply of the raw material ethane from state-owned Petroleos Mexicanos (PEMEX).

The incentive aligned perfectly with Braskem’s strategy of internationalization and global growth. Anticipating an eventual slowdown in Brazil’s rapidly growing economy, Braskem had earlier launched a series of strategic international investments.

By 2010 and 2011, Braskem concluded acquisitions of seven polypropylene production facilities in the United States and Germany from Sunoco Chemicals and The Dow Chemical Company. “Braskem had also been looking to make an investment in Mexico for a long time,” said Braskem Idesa Project Director Stefan Lepecki. “The auction presented a perfect opportunity.”

01.2017 | siemens.com/magazineindustry
Braskem Idesa

**Greenfield growth in Veracruz**
Located in the municipality of Nanchital, Veracruz, some 325 miles southeast of Mexico City, the Braskem Idesa greenfield site neighbors PEMEX’s own petrochemical complex. The site also lies only five miles from the port city of Coatzacoalcos, with existing freight, rail, and highway access to meet the project’s significant logistical needs.

Still, Braskem Idesa would face challenges. “No one had ever undertaken a petrochemical project of this scale in Latin America,” said Lepecki. “When you build something like this in the United States, Europe, or Asia, you have resources already in place – EPC (engineering, procurement and construction) companies, service providers and infrastructure. In Latin America, we often have to start from scratch, build our own infrastructure, and call in international companies to provide many of the services we need. But this is what we have to do to bring Latin American industries to the next level. And that’s one of the important steps we’re accomplishing with Braskem Idesa.”

**International scope and strength**
Global powerhouses in EPC, technology and systems for the petrochemical industry competed intensely for Etileno XXI’s business. At the core of the complex would be an ethane cracker with an annual capacity to produce 1.05 million tons of polyethylene, two high-density polyethylene plants (400,000 and 350,000 tons), and a low-density polyethylene plant (300,000 tons).

Siemens needed a new approach to differentiate itself. By the end of 2011, Siemens designated Braskem Idesa as a priority corporate customer and appointed Ricardo Vilaca Reis as corporate account manager to represent the entire Siemens portfolio for Braskem. Ricardo Reis’ strategy was to coordinate all relevant units within Siemens, draw on the company’s international strength and present a unified proposal and collaborative approach to Braskem Idesa.

“We had to recognize Etileno XXI as a project that Siemens units could not pursue individually,” said Ricardo Reis. “A capture team had to focus efforts on every aspect of the customer’s demands, using every resource available throughout Siemens’ global organization. The capture team needed to make contact and collaborate at many levels throughout Braskem Idesa as well as at the EPCs.”

He also stressed that in a project of such scale, adjustments would become necessary as changes inevitably occurred during the project’s development. “That is when project management becomes critical, adaptability is essential, and having connections at many levels in the organization expedites positive change.” Braskem Idesa’s Stefan Lepecki added, “It is important to have an international supplier with the power and depth of Siemens to understand the complexity of this type of project and help connect all the points of engineering, procurement and construction.”

For its part, Siemens had previous experience with members of the winning EPC joint venture for Etileno XXI – Odebrecht Industrial Engineering, Technip and ICA Fluor – and relationships that spanned continents.

**Water/wastewater win opened the floodgates**
In 2012, Siemens won its first award for Etileno XXI: water/wastewater treatment systems. The capture team used a collaborative approach between Siemens units from Brazil, Mexico, and the United States and executed with the Etileno XXI Joint Venture. This critical water technology was required at an early stage before further project development could proceed.

“We collect our own water from a river and have to pretreat it before we can use it. And after we use the water, we must treat it again for reuse and return to the river in better condition than the water we first took out,” said Lepecki.

“We had to meet a lot of new environmental regulations, and this was a very important issue.
for Mexico, as well as for Siemens and us and the banks we received financing from. Siemens provided a lot of very good equipment and technology to our project – in fact, they were our second largest provider of equipment – but their water/wastewater systems were the most valuable technology they provided to our operation.”

Siemens Brazil provided the raw water treatment plant, while Siemens USA provided the oily wastewater treatment plant and a wet air oxidation unit. Siemens Mexico performed precommissioning and commissioning services. “The system is in the final commissioning phase and we count on Siemens support to conclude successfully all the performance tests,” said Lepecki.

**Main high-voltage substation**
Collaborative efforts between businesses in Brazil, Germany, Italy, Mexico and the United States provided the strong technical and commercial positioning to capture Siemens’ second award: the main high-voltage substation. Close collaboration with EPC joint venture partners, as well, ensured the expertise required for successful execution. Seven units in total, the order included substation transformers for internal distribution, generator step-up (GSU) transformers, and a power transformers bank for an external distribution line and/or the main substation.

**Secondary medium-voltage substations**
The technical complexity of the Braskem Idesa project required exceptional coordination and more than a yearlong intense effort to capture and fulfill the third order won by Siemens: all secondary medium-voltage substations. Collaboration between Siemens teams from Brazil, Canada, France, Germany, Italy, Mexico, and the United States supplied a complete solution of innovative technology, including a high-voltage, gas-insulated substation and related transformers, and medium-voltage systems that included gas-insulated and air-insulated switchgear, a motor control center, and a generator circuit breaker system.

**Medium-voltage transformers**
The substation order was followed closely by an order for a range of medium-voltage transformers and related equipment. The transformers were manufactured in Colombia, but their contracting, delivery, and installation required close coordination between Siemens teams in Brazil, Colombia, Italy, and Mexico and Braskem Idesa’s on-site contractors.

**Motors and drives**
Siemens’ fifth order covered a range of motors and drives as well as transformers and switchgear related to a low- and medium-voltage portion of the project. Led by Siemens Japan, the team provided a single point of contact for the customer and coordinated work from factories in Austria, Czech Republic, Germany, Japan, Turkey and the United States, as well as with EPC Technip through an extruder OEM. Critical factors: meeting customer specifications with fewer deviations and providing quality engineering support from acquisition to execution.

**Gas analyzers, shelters**
Siemens’ sixth and final order was for gas analyzers, shelters, and a complete analytical solution. The team closely coordinated work at headquarters in Germany, the customer relationship through Siemens Italy, manufacturing at Siemens Singapore and the Philippines, and installation through Siemens Mexico. Global relationship management and commitment to an important delivery date proved key to the win.

“We took a complex multicultural and multiregional approach,” said Siemens’ Ricardo Reis. “But in the end, it worked for both Braskem Idesa and for us.” Clearly, Braskem Idesa agrees: “We hope to work again with Siemens on another project in the future,” said Braskem Idesa’s Stefan Lepecki.

»No one had ever undertaken a petrochemical project of this scale in Latin America.«
Stefan Lepecki
Project Director, Braskem Idesa Etileno XXI

**Focus on the future**
Braskem Idesa is now turning its focus to operations, process optimization, and commercialization. The company is developing a new corps of technically skilled employees and has sent many to Brazil and Europe for training on the operation and maintenance of Etileno XXI’s sophisticated equipment.

Perhaps the most important lesson Braskem Idesa takes away from Etileno XXI is a lesson for the entire region. “This was a mega project of huge complexity, and Mexico and Brazil have proved to the rest of Latin America and the world that we and others can accomplish something on this scale within Latin America again,” said Lepecki.

siemens.com/chemicals
ricardo.vilaca@siemens.com
Simulation instead of risk

When time is short, a new process control system must start working properly right away. At a huge chemical plant in the Alsace region of France, the simulation software ensured smooth and efficient modernization of the complete process control system.
Butachimie is a joint venture between US nylon specialist Invista and Solvay, a Belgian producer of specialty chemicals that is the world’s largest producer of polyamide 6.6. The company’s headquarters are in the small town of Chalampé in the Haut-Rhin department in France. Located on the Upper Rhine, at the Alsace border, Butachimie operates a plant that primarily makes nylon salts and adipodinitrile (ADN). The imposing plant covers an area of 125 ha and employs some 1,000 people. It is the largest production plant of its kind in Europe.

ADN is an intermediate used to make various polyamide 6.6 products. Typical end products are technical fibers and fabrics known by brand names such as Perlon, Cordura, and Kevlar, as well as Nylon. Polyamide 6.6 is also processed into pellets and is used to make thermoplastic injection moldings. In these applications, polyamide 6.6 is valued as a strong, durable material with high resistance to organic solvents.

Fit to meet the demands of the future
The history of the Butachimie plant in Chalampé extends back to 1955. It has been undergoing extensive modernization work since 2010, when the management decided to make a significant investment in safeguarding the future of the site and upgrade it to the latest state of the art. The comprehensive upgrade also includes modernization of the complete process and production control system, for which Butachimie has set in motion a long-term project that is not scheduled for completion until 2023. In France, the plant is regarded as a model for industrial change and a milestone in realizing the factory of the future.

One measure undertaken as part of the upgrade was the replacement of the long-standing analog process control system with Simatic PCS 7. The first step in creating an entirely new automation platform was completed in October 2014, when Siemens presented a full virtual model of the future system.

Migration in small steps
The production process in Chalampé is not only characterized by high complexity; it is also a continuous process that is interrupted just once every three years for maintenance. The plant is composed of several interlinked production units.

The migration of each of these units had to be completed in a maximum of three weeks. Then the process had to be fully functional when it restarted, so as not to bring the entire production sequence to a standstill. Units that could not be fully upgraded within the tight time window were provided with a backup combined process control setup in which the old system was temporarily run in parallel with the new one. The physical migration of the first unit began in 2011. Twelve units have thus far been successfully upgraded to Simatic PCS 7, of which four are running in combined system mode.

Simulation, testing, implementation
A system change is always a risk, especially since many problems are often only revealed during implementation and commissioning. Simit simulation software ends this uncertainty because it enables the creation of a complete virtual model of the process plant on which all the functions can be fully run and tested before even a single installation engineer has started work on-site.

The digitalization process is based on seamless interaction between the Simatic PCS 7 process control system and the simulation software Simit, so upgrading to a fully digital system was critical to the project’s success. The new system needs far fewer interfaces between different components, thus dramatically reducing the number of error sources. At Butachimie, there are thoughts about using Comos engineering tool, which is specially designed to support the complete engineering and integrated lifecycle management of a process plant, making it much more efficient.

Simit was the key to the success of Butachimie’s modernization project. Once the smooth running of a production unit had been verified on the computer, the physical installation could be rapidly executed. The commissioning procedures were then completed efficiently, and production could be resumed right away. Butachimie process automation manager Claude Schlagenwarth sums up the benefits: “With the aid of software tools, we already know the outcome of a project before a single plant component has been built.” He adds: “Digitalization is becoming a key factor for industry in meeting challenges such as increasing competitive pressures and continually changing legislative frameworks, markets, and technologies.”

siemens.com/simit
benjamin.cognet@siemens.com
Data exchange for more efficient engineering

Standardized data handling is essential to efficient, future-proof plant management in the process industry, as in other sectors. The Comos CAE software solution provides companies with seamless flows of relevant data.

Transferring data from one system to another is always a challenge in large-scale projects. Although the data are digitalized, conflicts occur between individual functional areas and the software tools they use: for example, when a data transfer between process engineering and instrumentation and control functions is required. Standardized data handling means higher engineering quality, less labor commitment, and shorter project run times. It does, however, also demand standardized interfaces.

The Comos CAE software solution from Siemens provides the basis for cross-company concepts and unified plant management throughout the lifecycle of process plant. The unified data platform provided by the software enables plant designers and operators to implement seamless flows of project-related data across all corporate levels and throughout all project phases. Consistent lifecycle engineering optimally interlinks planning and operational functions, resulting in efficient workflows and high productivity and product quality.

The data exchange standard

Version 10.2 of the CAE software solution was launched in spring of 2016, and it has been upgraded particularly in terms of improved interoperability and user-friendliness. New and improved interfaces permit faster data exchange with external applications. Using the eCl@ss Advanced 9.x standard to compare the product data from different providers and importing it into Comos complete with documentation. Document metadata can be synchronized between Comos and the Siemens Product Lifecycle Management Teamcenter software.

Another new data exchange feature stems from a collaborative project with Bentley Systems. Comos users can now exchange 2D/3D data with no losses via the new interface. So-called i-models (data container) can be generated from 2D piping and instrumentation diagrams (P&IDs). The graph and process data in the P&IDs can be utilized seamlessly for 3D design in the Bentley OpenPlant. Inconsistencies are avoided, and project work is much faster. Another new feature is an interface to the Simit simulation software. A standard interface has been developed to import P&ID data from Comos directly into a simulation model. The benefits are faster and more efficient engineering and shorter commissioning phases.

The consistent application of the interoperability strategy is also demonstrated in an update of the interface to the Proteus 3.6.0 standard, the former XMpLant Schema.

New solutions for plant operations

In the Comos Operations area, resource planning and process visualization for plant maintenance procedures have been enriched with PERT diagrams. With the Comos Walkinside 3D Virtual Reality Viewer, the new program version also enables project and status checking directly in the 3D model based on color-coding and object isolation. This means that all the project stakeholders have a continuously updated overview of the status of a plant or ongoing project. And last but not least, connectivity to Oculus Rift Virtual Reality 3D glasses enables
«Comos Process 2D makes P&IDs more user-friendly, enables custom views to be created, and means project progress can be recorded more quickly and easily.»

Marcus Elo, Product Manager for Comos Process 2D

Innovation in detail
A range of features and wizards in the new program version assist users in their day-to-day operation of the software. New symbols in object libraries and object color-coding in P&IDs provide an improved overview. As Comos Process 2D Product Manager Marcus Elo summarizes: “The new features make P&IDs more user-friendly, enable custom views to be created – for example for revisions or printouts – and allow project progress to be recorded more quickly and easily.” The Brownfield Loop Wizard also provides great assistance in the electrical engineering of existing installations. Planning data and supplier information can be integrated into Comos via dialog boxes and made available for further editing. This permits the efficient handling of inventory data when planning upgrades and plant revisions.

The software solution Comos provides the customary powerful performance of a global collaboration platform for consistent data management throughout the lifecycle of plants in the process industry, featuring even greater levels of interoperability and user-friendliness.

siemens.com/comos
manuel.keldenich@siemens.com
The interface between the Comos and Bentley OpenPlant engineering solutions enables the integrated planning and maintenance of plant and engineering data throughout the entire lifecycle. This facilitates budget planning and helps prevent conflicts at an early stage. Thereby, Bentley and Siemens have laid the groundwork for creating a “digital twin” of process plants.

Integrating and linking 2D and 3D information with Comos and the Bentley tools gives companies full control of their plant and engineering data.

**Improved collaboration during the planning process**

The interface largely uses established standards like XML and is based on the principles of ISO 15926 for data exchange between computer systems. It allows information from Comos to be transferred and stored in “i-models” (data container) where they are available for further use in OpenPlant. Vice versa, it is also possible to transfer data from OpenPlant to Comos. An integrated user interface for consistency checking presents both data pools in comparison and enables the user to verify changes. The upshot: The project team is always fully informed about the project status and can both identify and resolve conflicts – for example, if a different pump type is planned in the 3D planning with OpenPlant, or if a valve is sized differently in...
Engineering

The bidirectional interface enables data exchange between the 3D planning in Bentley OpenPlant and the 2D plant design in Comos.

Comos. This improves collaboration among the various disciplines involved in plant engineering.

Linking 2D and 3D planning with Comos FEED and Bentley PlantWise also ensures that cost calculation information is available to the project team in greater detail and at an earlier stage than was previously the case. This primarily affects the layout engineering for vessels and reactors, where actual space requirements and the necessary structural work can be better planned thanks to the integrated system.

Additionally, when it comes to detail planning, extra information such as cable details available in Comos can be linked to Bentley BRCM, so that the plant engineer knows exactly what cable runs and lengths need to be installed – a key cost factor in large, complex plants.

Innovative approach for modernization and retrofits

The integration of 2D and 3D data, however, is not restricted to new plants but is also effective in modernization projects, which very often show that there are considerable differences between the plant that was originally planned and the actual plant status. Over the years, changes are either not transferred at all or only partially added to the plant documentation, therefore not fully maintaining the associated digital information. In this case, the new interface offers the option to digitalize the actual plant using Bentley ContextCapture and to link it with the digital plant tags from the planning data. The data can then be verified and updated as necessary, and plant operators are given an up-to-date digital reproduction of their plant.

In combination with Comos Walkinside, they can use this information to train employees, test plant scenarios, and schedule maintenance. At the same time, the digital twin is a sound basis for migrations and efficiency-boosting measures, and it facilitates the conversion or expansion of existing systems.

Imprint

Published by:
Siemens AG
Communications and Government Affairs
Wittelsbacherplatz 2
80333 Munich
magazine@siemens.com

Responsible for content:
Winfried Wittmann
(in accordance with the German press law)
Cornelia Dürfeld

Concept, coordination:
Cornelia Dürfeld

Editorial committee:
Dana Friethauer, Ute Forstner, Michael Gilluck,
Jessica Mattmiller, Maria Muellbauer,
Andrea Kerber, Krupa Uthappa, Anja Zimmerer

Publishing house:
Publicis Pixelpark,
Postfach 32 40, 91050 Erlangen

Editorial staff:
Kerstin Panicker, Dorit Gunia,
Dominik Heinz, Sarah Werner

Art direction: Reinhard Sorger
Layout: Bettina Rausenker
Copy editors: Sabine Zingelmann
DTP: TV Satzstudio, Emskirchen
Cover picture: Siemens AG

Print:
Druckerei Peschke, München
Circulation: 25,000

© 2017 by Siemens Aktiengesellschaft
Munich and Berlin.
All rights reserved.

Article number: CGMP-M10028-00-7600

Printed in Germany

If there is no special mention of trademarks, trade names, technical solutions, or similar items, this does not mean that these items are not protected.

The information in this magazine contains only general descriptions and performance features which do not always apply in the described form in the actual application or which may be subject to change in the course of further development of the product. The specific performance features are only binding if they were agreed expressly in the contract.

siemens.com/comos
jan.pawlewitz@siemens.com
Flexible for the long term

A process control system must be flexible and versatile enough to handle plant processes for many years. With Version 8.2 of Simatic PCS 7, Siemens is taking the next logical step into the future of process control.

A process plant is often operated for 20 years or more. It may well undergo many modifications during that time as it’s upgraded, modernized, and adapted to new requirements. Merging several plants into one is also common. A process control system should be capable of handling these changes and adapting flexibly to new situations.

The Siemens process control system has been controlling process plants in a wide variety of different industries for exactly 20 years. The development of Simatic mirrors the general technological progress in the field. The system has regularly proved itself to be a highly reliable solution that combines traditional values with groundbreaking innovation. Today Simatic PCS 7 is controlling the automatic processes of over 22,000 plant installations worldwide.

With the launch of Simatic PCS 7 Version 8.2, Siemens has remained true to its philosophy, once again providing the process industry with all the essential attributes: an open system architecture with standardized interfaces that can also be seamlessly integrated into safety-related or redundant structures. Moreover, the scalability of PCS 7 makes it attractive as a solution for plant installations with 100 I/Os as well as for complex manufacturing systems with up to 200,000 I/Os.

Availability in focus

The availability of a process plant is one of the key criteria determining its efficiency and cost-effectiveness. In this respect, too, PCS 7 has been fulfilling all the key requirements for years. For example, all components can be configured redundantly – regardless of whether they communicate with the system via HART, Foundation Fieldbus, Profibus, or Profinet. That is true for SIL3 applications as well as for installations in Ex zones.

Sophisticated asset management additionally permits monitoring of all field devices in order to detect critical operating states before they can cause plant downtimes. That supports proactive preventive maintenance concepts, which have proved an effective
means of safeguarding plant availability at a consistently high level.

**Steps toward Industrie 4.0**
The increasing use of web technologies has permanently changed the way process plants work. With the new Simatic Process Device Manager (PDM) client/server concept, for example, field devices can be managed remotely from the control room. This can be done using mobile devices to run or parameterize any field device on-site via a simple web interface.

Version 8.2 of PCS 7 supports the use of smartphones, tablets, and other mobile devices independently of their operating system or the installed web browser. This allows alarms to be visualized and reset, trends to be displayed, or specified plant data to be accessed with KPIs (key performance indicators), for example. Shift managers, I&C technicians; or loading supervisors can respond rapidly and locally, making well-informed decisions thanks to data that is always up-to-date.

**User interface reconceived**
An enhanced user interface now allows operators to view exactly the measuring points within their area of responsibility. Measuring points can be filtered by status. That improves on-site transparency and provides for continual plant optimization.

Version 8.2 also permits measuring points to be grouped directly from the process screen. This way, operators can group the key measuring points for specific operating scenarios, providing a much clearer overview of the corresponding process data. Additionally, trends can now be compiled in a user-friendly way, presented graphically, and compared directly against each other.

**Intuitive engineering**
Factors determining the total cost of ownership of a process control system also encompass configuration, engineering, and implementation. This is where the new Simatic Logic Matrix delivers even greater time savings and transparency. It assigns precisely defined responses to specific process events in a matrix table based on the principle of cause and effect. The software then automatically generates the corresponding CFCs (continuous function charts), including the connections to the measuring points involved. It is a method that makes even complex states transparent, and so plays a key role in reducing the number of potential errors.

Another new feature is a central graphical formula editor. It provides arithmetic and Boolean operations as well as functions which can be easily combined to create formulas. That enables a more flexible use of sequential function charts (SFCs) in sequence control.

Bulk data engineering features have also been significantly upgraded in PCS 7 Version 8.2. The creation of function, system and schematic diagrams is now supported, for example, considerably reducing the effort and expense of drafting system documentation. The Simatic Management Console provides a central inventory function for all hardware and software components, including all version data. The results are complete, customized inventory lists, providing a reliable basis for replacements and updates, for example.

**Standardized data model**
Simatic PCS 7 Version 8.2 highlights more than ever the significant benefits of a standardized data model throughout the system. This digital data base enables flexible operator control concepts as well as enhancing plant efficiency throughout the lifecycle. It starts with the engineering and extends through to ongoing plant management. It also means flexible concepts such as for virtualization, remote maintenance, and preventive maintenance can be realized.
Safety and sustainability

At its site in Pamplona, Spain, Huntsman has partnered with Siemens to raise process safety standards in one of the company’s process units through a tailored solution for functional safety. This project will make a small but significant contribution to achieving company-wide environmental, health, and safety excellence.

Huntsman Advanced Materials serves more than 3,000 customers in 80 countries with innovative, tailor-made solutions and more than 1,500 products that address global engineering challenges. In addition to being a research-driven company, Huntsman also sees operating safe, clean, efficient facilities in an environmentally and socially responsible manner as an essential part of its business strategy and has launched a long-term initiative focused on achieving environmental, health, and safety (EHS) goals called 20:20 Vision.

All plants are monitored as part of a corporate safety program and need to comply with stringent safety procedures, says Alejandro Ayala, automation manager at Huntsman’s Pamplona operations: “It is the responsibility of both management and associates to operate safe, clean, efficient, and compliant facilities in a sustainable and environmentally and socially responsible manner. For this purpose, we have evaluated the safety performance of our operations here in Pamplona and identified several areas where we could elevate safety standards through the implementation of new systems and technologies.”

Safe, sustainable solution
The site at Pamplona is producing specialty chemicals for the company’s advanced materials business and is a core asset for the company, as Europe is currently one of the strongest growing markets. “However, we need to make the best use of available resources, and that also involves utilizing expertise of vendors and partners in our projects,” says Ayala. That is why Huntsman contacted Siemens when it decided to upgrade its operational safety through a tailored solution for a safety instrumented system (SIS).

“We needed a partner who could build a system based on our specific safety procedures and guidelines and who had the required know-how to support us in the design, implementation, and commissioning.”

The plant in question was an acid gas handling unit that purifies the process gas before it is transferred to the process for Lewis adducts. The entire process has a high risk of explosion, so process safety is paramount. In order to ensure that the system would meet the requirements of plant operations and process safety, Siemens first performed an extensive hazard and risk assessment. This approach is in line with the requirements of the IEC 61511 standard for functional safety and safety instrumented systems for the process industry sector. Then Huntsman did a hazard and operability study (HAZOP) and layer of protection analysis (LOPA). Siemens allocated the safety functions to the corresponding protection layers and supported Huntsman in specifying the Safety Requirements Specification for the SIS. Further, Siemens helped Huntsman implement a management system for assessing and auditing Functional Safety in the plant.

»We were impressed with both the professional manner in which Siemens executed the project and the performance of the functional safety system they delivered.«

Alejandro Ayala, Automation Manager, Huntsman’s Pamplona operations

Implementing the SIS
Following the analysis phase of the project, Siemens developed and engineered the SIS based on the proven Simatic PCS 7 process control system. On the hardware side, the solution consists of a fault-tolerant Simatic PCS 7 automation system with a 412-5H CPU, Simatic ET 200M distributed systems in redundant configuration, and Simatic S7-300 systems for controlling several subsystems. After installing the systems, Siemens also provided training for staff at the Pamplona site and will continue to provide additional
prevent process-related incidents. Huntsman is currently assessing which other plants can be upgraded in a similar manner. The customer’s positive experience with Siemens expertise and technology places the company in a good position to serve as a reliable partner for these future projects.

This project will serve as a blueprint for additional projects that are currently planned at the Pamplona site with the ultimate goal of implementing a robust process safety management system to proactively

---

siemens.com/processsafety
ian.curtis@siemens.com
julio.garcia_perez@siemens.com
Turning CO₂ into bricks and cement products

A scalable distributed control system (DCS) solution is helping an Australian joint venture develop and commercialize a new carbon management technology aimed at reducing global CO₂ emissions.

Mineral Carbonation International (MCI) is an Australia-based start-up whose mission is to demonstrate the technical and economic viability of mineral carbonation as a sustainable industrial solution for carbon capture, storage, and utilization (CCSU). The joint venture is owned by three shareholders: GreenMag Group, Orica, the world’s largest provider of commercial explosives and innovative blasting systems to the mining and civil engineering markets, and the University of Newcastle, Australia (UON).

MCI is adopting a fully holistic approach to CCSU – the world’s first – via mineral carbonation by examining the complete chain of operations from feedstock to final product. It all started more than seven years ago, when Canberra-based GreenMag Group teamed up with the UON to investigate the feasibility of current and future technologies to sequester CO₂ emissions. Concurrently, Orica researchers had been working in the same field and the three parties merged to form MCI in 2013. The joint venture won a major research grant funded by the Commonwealth and New South Wales (NSW) governments and Orica.

The company’s approach involves creating and licensing intellectual property that enables captured CO₂ to be used as a raw material for the production of green construction products such as cement and plasterboard, rather than treating it as dangerous waste. From the outset, MCI envisaged creating value by turning captured CO₂ into useful products in order to offset the cost of the transformation process. The technology has the potential to play a key role in closing the carbon loop by providing a means for the safe and permanent disposal of carbon emissions from fossil fuel power stations and other industrial facilities such as fertilizer and cement manufacturing plants.

First of its kind
In 2013 MCI set out to establish a world-first CO₂ mineral carbonation research pilot plant at UON. The pilot plant uses captured CO₂ from Orica’s Kooraingang Island ammonium nitrate production facility in Newcastle to produce carbonate solid and amorphous silicon. Ammonium nitrate is a common ingredient in fertilizer products used in agricultural applications and also the major component of commercial explosives used throughout the mining and civil engineering industries.

The need for a scalable DCS
In addition to conducting research to determine if existing mineral carbonation processes could be scaled to an industrial level, the purpose of the pilot plant is to develop new CCSU technologies that can be economically viable on a larger scale.

The plant was developed in two stages, with the first stage consisting of a batch process and the second of a semicontinuous process. The batch plant is used to validate existing mineral carbonation technologies on a larger scale and to provide carbonate products for further analysis within construction products – while the semicontinuous plant provides valuable experimental data to form the design basis of a demonstration plant.

In order to facilitate high levels of automation and process safety, the MCI team identified Siemens’ range of industrial automation Systems as a suitable solution for the required distributed control system (DCS).

Simatic PCS 7 equipment was selected by the project team due to its proven track record and extensive use in the chemical industry both in Australia and overseas, further supported by the experience from Orica, which is already using the same PCS 7 technology in one of its ammonium nitrate plants in Botang, Indonesia. The scalable architecture and powerful engineering tools of the Siemens DCS solution address the wider needs of a full-scale plant with respect to
engineering, operational, and maintenance requirements. However, it also provides MCi with the flexibility to scale the base technology for the process control system in the future.

The sales and engineering team of Siemens Australia assisted with the selection of suitable control hardware and the implementation of the developed control philosophy for both stages of the pilot plant. The DCS hardware comprised two Simatic PCS 7 box systems with PCS 7 V8.1 SP1 OS runtime to allow independent operation and control. Also included were 11 Sinamics G120 VFD controllers to automate various vessel agitators and the operation of a high-intensity grinding mill.

"The Simatic PCS 7 system allows us to closely monitor and control all steps of our reaction and gives us the ability to record all process data required for detailed analysis of the energy requirements and overall process performance," says MCi program manager Jan-Dirk Prigge.

A bright future
The pilot plant is a world first and the knowledge gained will help determine the financial and technological feasibility of industrial-scale implementations of mineral carbonation processes across the globe. The results achieved so far indicate that process conditions can be optimized further to potentially make mineral carbonation an economically viable way to reduce industrial CO2 emissions, slow global warming, and ensure a cleaner energy future. For commercial explosives producers such as Orica, this may also provide a way to reduce CO2 emissions and achieve more sustainable production.
Clean water for all

In Vietnam, Siemens partnered with PE&E and SWIC to implement a reliable control solution for a water treatment facility that provides clean drinking water to 600,000 households in Ho Chi Minh City.

The Thu Duc Water Treatment Plant provides the majority of Ho Chi Minh City’s treated water supply. First commissioned in 1966, the plant has undergone numerous modifications over the years to increase its capacity.

In 2012, Germany-based Passa-vant Energy & Environment GmbH (PE&E) was awarded a US $46 million contract to expand the facility. Under the contract terms, PE&E was responsible for the engineering, procurement, and construction (EPC) of a 300,000-m³/day water treatment plant, which would provide high-purity drinking water to the region’s inhabitants. Construction began in January 2013 and the plant was put into operation in August 2015.

A single-source provider

In addition to expanding the total capacity of the water treatment facility, PE&E was tasked with constructing a river water intake pumping station and pressure pipes to supply feed water to the facility. Using its patented technology, the Turbo-LME process, along with Siemens’ Integrated Drive Systems (IDS), PE&E began work on the project.

As an EPC contractor, PE&E purchases its own equipment. The members of the project team also discuss with their customers which equipment will fit the project requirements. “PE&E submitted the capacity, experience, and technical profiles of the equipment manufacturers to us for approval. We found that the Siemens equipment proposed for this project met the technical requirements that we set for the contractor,” says Ho Thanh Cuong, deputy director of Drive Systems (IDS), PE&E began work on the project.
Saigon Clean Water Business and Investment Joint Stock Company (SWIC), an investor in the project and current operator of the plant. “We also found that Siemens had the necessary experience as an equipment manufacturer, as well as a reputation for quality.”

Siemens received the order in January 2015, and by May commissioning teams were on-site and the contractor had begun installation. Commissioning of all six units was completed by the end of August, after which Siemens provided staff training for operation and monitoring of the system before handing over control to PE&E.

Christian Beckers, vice president and head of Digital Factory and Process Industry and Drives at Siemens, says that by engaging with a single-source provider, customers find it easier to get support when needed, especially when issues arise. “During the design phase, our engineers work closely to ensure that everything is installed,” he says. “Then we can come back every six to 12 months to check. For us, it’s important that everything is running smoothly.”

**Overcoming challenges**
Reduced energy usage, rapid investment amortization, and increased plant availability were three of the primary goals when choosing the equipment for the Thu Duc project. To achieve optimal performance of the water treatment plant, PE&E employed a variety of Siemens solutions, including a Sinamics Perfect Harmony MV converter and a Simotics HV H-compact Plus 1RQ4 motor to pump its patented Turbo-LME process.

In all, the plant was set up with six drive systems including converters and six motors. According to Nguyen Duc Thanh, senior sales manager for large drives at Siemens, the equipment needed to be installed with a cell bypass function, which allowed for automatic isolation of a defective area so that drives could continue running in the event of a power cell failure. “We needed a kind of redundancy function because the pump to supply water from the plant to the city is a very important machine whose operation cannot be disrupted,” he says. “We needed it to run every time, so reliability was critical.”

While conducting a performance test, Uwe Dechert, general manager of the Passavant (PE&E) branch in Vietnam, and his team demonstrated the flexibility of the IDS by putting it to its maximum capacity. “The advantage of this technology is that we can start operating at zero flow – the lowest frequency of the drive.”

Dechert added that during the performance test, the technicians discovered that even when the plant was running at full capacity, it still used less energy than they had initially calculated. “The motor installed at Thu Duc has 96.4% efficiency, while control has 96%, which means we are achieving efficiency that is 2% to 3% higher than other similar products,” he says.

**Long-term benefits**
Leveraging the company’s core expertise in high-rate water purification technology and Siemens’ IDS, PE&E and SWIC have been able to ensure optimal performance of the water treatment facility and reliably provide clean drinking water to 600,000 households in Ho Chi Minh City.

Addressing the long-term benefits of IDS, Nguyen Duc Thanh of Siemens says: “Right now the pump is running at 80%–85% of the rated flow, but power consumption is at only 50%–55% of the rated power. So the flow is reduced by only 15% but the energy use is reduced by 50%, thereby saving the customer a lot of energy and money during operation.”
Long pipeline under close watch

The task at hand was to pump saltwater from a mine spoil heap into a river 63 kilometers away, incorporating high-efficiency leak detection. The Siwa Leak smart water solution reliably localizes unwanted water leakage.

Some 700,000 m³ of saltwater is created every year

Potash salt has been extracted at the Neuhof-Ellers mine for over 100 years
The K+S KALI group is part of the international K+S AG concern (formerly Kali und Salz AG). The company runs a potash salt mine at Neuhof-Ellers in the Fliedetal valley, near Fulda, Germany, that has been in operation for over 100 years. The site employs some 720 people in mining and finishing processes. The products are used primarily for manufacturing fertilizer and also in other industrial manufacturing sectors.

All mines produce spoil waste. In this case, it is composed mainly of rock salt that has built up to create an imposingly tall heap directly adjacent to the mine. Nicknamed “Monte Kali” by the locals, it’s the highest elevation in the flat landscape and visible from far and wide.

The outdoor salt mound is sluiced by rain, creating some 700,000 cubic meters of saltwater per year. For many decades, the water was pumped off and stored in a deep plate-dolomite layer as a means of protecting the environment, particularly the groundwater. As the capacity of the rock was gradually exhausted, new disposal methods had to be found. The existing mining license included permission for the construction of a long-distance pipeline to discharge the saltwater into the Werra River. After reviewing alternative options and obtaining approval for the pipeline’s routing, the project finally began in 2012.

Expertise as key criterion
The TÜV technical inspectorate body stipulated that the line should be built in compliance with the technical standards for long-distance pipelines. “That also included precision leak detection and localization,” says Christoph Hachfeld, the K+S KALI GmbH project engineer. He goes on:

“That requirement was also a key factor in the choice of supplier for the pipeline control system.”

Following an extensive selection procedure, Siemens emerged as the ideal partner for the project. First of all, the company already had comprehensive expertise in pipeline outfitting, and the project team was also greatly impressed by the Siwa Leak leak detection system. In addition, Siemens was not an unknown quantity to K+S KALI. The Siemens Simatic PCS 7 process control system had already been in operation at its plant in Neuhof for some years.

As a result, Siemens was appointed as the general contractor to supply the complete pipeline leak monitoring technology. And for the first time, K+S KALI installed Sitrans measuring devices to record operating parameters like flow rate, pressure, and temperature.

Mastering a complex medium
The TÜV stipulations were demanding: The detected water loss in operation of the pump had to be less than 1% of the maximum flow; while in standby mode, no more than 4 liters of water per hour was allowed to seep through undetected.

The complete pipeline is divided into 14 segments, with a slide valve and air-bleed station between segments. The pressures in the various segments are anything but homogeneous: Altitude differences and temperature fluctuations along the pipeline are among the factors that influence the measurement results. Therefore, an algorithm had to be devised to take into account all those parameters.

“The problem was the fact that saltwater behaves very differently from normal drinking water,”
explains Siemens Project Manager Matthias Rüttiger. This is because of the dissolved salt crystals in the water, which react to fluctuations in temperature completely differently from water, producing unpredictable changes in water pressure. Heavy rainfall also has a major impact on the salt content of the water. The control system had to be capable of allowing for all these factors.

**Fast detection, precise localization**

Working with K+S KALI and TÜV, Siemens devised an entirely new leak detection algorithm. It was tested in a wide variety of different conditions and pipeline operating modes in order to guarantee the reliable detection of leaks while at the same time eliminating false alarms.

The result was more than satisfactory: Siwa Leak not only met the TÜV requirements, it exceeded them. When the pump is running, the system responds at just half the maximum permissible water leakage if the pipeline is leaking at any point. In standby mode, it’s even able to detect leakage at rates of just 1.45 l/h.

But it’s not enough to just reliably detect water loss: It’s also important to determine the exact location of the leak so as to provide a fast, targeted repair. It’s helpful that the pipeline is divided into 14 segments that can be individually blocked off by means of slide valves. This means that very closely targeted measurements can be performed, and leaks can be localized to within a few hundred meters. Then conventional devices such as acoustic leak detectors can be used to scan for the exact location of the leak.

**Complete solution with added benefits**

Of course, a 63-kilometer pipeline with 12 external stations doesn’t just need an efficient leak detection system; it also needs an automation system that provides reliable operation, control, and monitoring from a central control room. The Siwa Leak system is based on Simatic PCS 7, which had already been successfully employed at the Neuhof plant. Additionally, Sitrans measuring devices were installed to record necessary data like flow rate, pressure, and temperature. The new process instrumentation is designed to operate optimally with PCS 7 which comes with pre-installed safety features such as the Safety Matrix, and covers the entire plant’s functionality with no need for additional hardware or software. It even provides extended archiving with a reporting function.

For K+S KALI, PCS 7 was the key to fast engineering and commissioning. Integrating all the functions in just one system also makes system maintenance much easier, which results in substantial cost benefits throughout the plant’s lifecycle.

All in all, the 63-kilometer saltwater pipeline between Neuhof and Hattorf is an example of how even tough challenges can be mastered when all the stakeholders involved work collaboratively. “Of course, a project of this scale doesn’t always run completely smoothly,” project engineer Hachfeld sums up, “but we were all working together to the same end. The cooperation was outstanding.”
Perfectly coordinated complete solution

Global chemicals group BASF has a portfolio comprising five segments: Chemicals, Performance Products, Functional Materials & Solutions, Agricultural Solutions, and Oil & Gas. BASF Antwerp is the BASF group’s second largest plant worldwide and the largest integrated chemical production center in Belgium. One of the products made there is tert-Butylamine, an additive used in the rubber industry. Ammonia and isobutene are required for its production. An integrated production network needs all the processes involved to be fully available, because if any part is obstructed, a chain reaction will affect the entire production process – potentially even bringing it to a standstill. A key element in interconnecting multiple production areas is the conveying of secondary products from one process step to the next. The intermediate products ammonia and isobutene are initially compressed by two volumetric pumps from 20 to 260 bar pressure and then conveyed by a shared pipeline to the next process step.

Reliability in the face of increased demand

Two criteria were key to the search for a replacement for the outdated motors and volumetric pump drives: First, the new systems had to be approved for use in potentially explosive environments and must also be tailored exactly to requirements. At BASF in Antwerp, Belgium, Integrated Drive Systems (IDS), the modern drive concept from Siemens, provides the perfect solution.

Chemical production processes also demand maximum availability and process safety for pumps. The pumps must be suitable for use in potentially explosive environments and must also be tailored exactly to requirements. At BASF in Antwerp, Belgium, Integrated Drive Systems (IDS), the modern drive concept from Siemens, provides the perfect solution.

Globally chemicals group BASF has a portfolio comprising five segments: Chemicals, Performance Products, Functional Materials & Solutions, Agricultural Solutions, and Oil & Gas. BASF Antwerp is the BASF group’s second largest plant worldwide and the largest integrated chemical production center in Belgium. One of the products made there is tert-Butylamine, an additive used in the rubber industry. Ammonia and isobutene are required for its production. An integrated production network needs all the processes involved to be fully available, because if any part is obstructed, a chain reaction will affect the entire production process – potentially even bringing it to a standstill. A key element in interconnecting multiple production areas is the conveying of secondary products from one process step to the next. The intermediate products ammonia and isobutene are initially compressed by two volumetric pumps from 20 to 260 bar pressure and then conveyed by a shared pipeline to the next process step.

Reliability in the face of increased demand

Two criteria were key to the search for a replacement for the outdated motors and volumetric pump drives: First, the new systems had to be approved for use in the potentially explosive areas of a chemical production plant. And second, both pumps would need to work optimally at constant speed, as well as being capable of attaining peak values and being synchronized to each other.

Those requirements led BASF’s process engineers to Siemens. Siemens was not only able to supply the motors and associated drives, but also offered BASF a coordinated complete solution: Integrated Drive Systems (IDS). IDS enhances the efficiency, reliability, and productivity of plants.

For the tert-Butylamine production plant, the Siemens project team first calculated speeds as well as continuous and peak torques. The motor they chose was the robust and durable Loher Chemstar. The drive solution selected was the energy-saving, maintenance-friendly Sinamics G150. Provided that extra encoders are installed on the motors, the drives enable the data required by the controller to be transmitted at a later time in order to optimally synchronize the pumps.

Installation during live operation

To avoid interrupting production, the pump units were shut down in sequence in order for the drives to be replaced. By also signing a Siemens Industry Services maintenance contract, BASF has safeguarded its state-of-the-art system solution for its full lifecycle.

siemens.de/ids
mark.dirckx@siemens.com
Applications for sturdy Grisuten brand polyester fibers include the manufacture of automobile trim panels.

Cutting downtime

Polyester fibers are among the most widely used synthetic fibers. They are very resistant to abrasion, absorb very little moisture, dry quickly, and exhibit virtually the same strength properties when both wet and dry.

Märkische Faser GmbH in Premnitz, near Berlin, has been manufacturing polyester fibers on an industrial scale under the brand name Grisuten since 1961. Today the company is a top chemical fiber manufacturer in Germany and Europe-wide. It produces roughly 55,000 metric tons of fiber per year on a total of seven lines. Polyester fibers from Premnitz are used in a wide variety of applications, including automobile trim panels, hygiene products, functional clothing, and industrial filters.

Modernization for flexible production

In order to enhance its position on the competitive textiles market, the company is investing heavily in the skills of its workforce and in state-of-the-art manufacturing technologies.

The drive technology on two of its seven fiber lines was recently completely modernized. “Our intention with the new drive solution was to improve on-line flexibility,” explains Mathias Pietsch, the modernization project manager at Märkische Faser GmbH. “Our existing drive systems were also quite old, which meant we were struggling to get spare parts. To stay competitive, our lines have to be highly productive, so we couldn’t afford the risk of a breakdown.”

So the company set about finding a drive technology partner that could supply the entire modernization package, including drives, gears, clutches, and switches, as well as provide the necessary support in configuring and commissioning the drive application.

The contract was ultimately awarded to Siemens. Key factor for this decision was the Siemens expertise Märkische Faser GmbH had already experienced during a long-standing and successful previous collaboration in the field of energy and drive technology. In other words, the Siemens project team was already quite familiar with the processes and requirements at the customer’s location. Systems integrator IAT was on hand as an experienced partner to...
assist in integrating the new drive technology in the existing automation system.

**Integrated solution**

Working with the project team at Märkische Faser GmbH, Siemens devised a complete solution based on Integrated Drive Systems (IDS) that improves the performance of the fiber lines and at the same time enhances plant availability and machine speed. The system’s long-term reparability and servicing has also been ensured. In order to implement the new solution with the shortest possible downtime, fiber line 7 was first configured with a new drive package comprising five Simotics M servomotors, each featuring a Sinamics S120 converter, a SmartLine energy recovery module, three heat exchangers with recirculating coolers, and coordinated Flender gears and couplings.

Following the successful implementation of this initial project, work then began to convert the vertical shaft to single drives on fiber line 1. This solution, too, is based on IDS, and comprises nine 1PH8 Simotics M motors with Sinamics S120 frequency converters and Flender gears and couplings. All components were expertly configured at the Siemens Application Center in Chemnitz to withstand harsh production conditions and provide adequate reserves for future upgrades.

**Added benefits in operation**

“The Siemens team really provided us with excellent support. Based on information available on the drawing lines, they devised a concept that enabled us to implement the changeover very efficiently,” Pietsch reports. In addition to the hardware engineering, Siemens also provided the applications engineering services and supplied the turnkey switchboard. The mechanical and electrical modifications were executed independently by the staff at Märkische Faser GmbH. “The new solutions for both fiber lines integrate seamlessly into our production plant network,” Pietsch concludes.

The fiber lines were running much more flexibly just a short time after commissioning, because key parameters like the drawing ratio can now be modified without stopping line operation. Plant availability has improved significantly, and thanks to the harmonized system landscape, the plant is easier to service and maintain. And last but not least, the drives are integrated into the energy data collection system, providing Märkische Faser GmbH with more optimization potential in the future.

» The new solutions for both fiber lines integrate seamlessly into our production plant network. «

Mathias Pietsch, Modernization Project Manager at Märkische Faser GmbH

Positive side effect: The new IDS drive solution has also generally simplified and refined the factory layout.
How should a communication architecture interconnecting tens of thousands of devices in a digital factory be set up? The vertical and horizontal integration of communication levels is a growing trend. A standardized network topology alone is not enough. Integrating data as a source of analytical, data-based services breaks down horizontal levels. That’s because new information resources, like those for predictive maintenance, require high data density – from design and engineering through production quality data to sensors that transmit their data from the plant to the IT system (Cloud).

Attributes like open standards and high levels of service quality and security are also in demand. At the same time, transparency of IT systems across all corporate levels as well as between the office and production networks is also a key requirement. The structures need to be protected from unauthorized access, yet be accessible to authorized users across all levels, devices, and components, with an error-free transfer of all data.

Communication architecture for digital businesses

The answer to all these requirements is the Unified Architecture (UA) from the Open Platform Communications (OPC) Foundation. OPC UA is the recognized standard for secure, reliable data exchange in industrial automation. One specification underlying the OPC standard describes the interfaces between clients and servers. It defines data access, monitoring of alarms and events, and access to wide-ranging applications. The architecture describes engineering tools as well as software stacks for equipment manufacturers and software developers. The information model ensures that the data itself is transferred securely, specific to type, in complex structures with semantic information. Events are supported as ad hoc communications or message brokers for connection to the Cloud.

Standard for PLC programming

To advance OPC UA, industrial bodies are working with the OPC Foundation on the so-called Companion Specifications. One example is the collaboration with PLCopen, an organization in the industrial controls field, to develop standards aimed at enhancing efficiency in application development and models to cut costs in software updating. The activities conform to the EN 61131 international standard for industrial PLC programming languages. For example, Siemens and PLCopen have developed access procedures for data in a PLC. The mechanisms have been implemented in the CP 443-1 OPC UA communication processor, which is used, among other functions, to control communication between OPC servers and the Simatic S7-400 automation system.

Data exchange between applications from different manufacturers

In its early years, the OPC standard was restricted to the Windows operating system. The original name of the standardized software interfaces was OLE for Process Control (OLE = object linking and embedding). The introduction of service-oriented architectures in the manufacturing industry presented new challenges to security and data modeling. In 2011, the declining relevance of the OLE standard led the OPC Foundation to develop a new information architecture, named OPC UA (Open Platform Communications Unified Architecture). Today it forms the basis for an open, scaleable platform architecture for seamless data exchanges between applications from different manufacturers in the automation field.
The controller-based functions devised by PLCopen and the OPC Foundation enable communication sessions to be set up with any OPC UA server, so a device can exchange data structures with other systems independent of the field bus system. Initiatives like Industrie 4.0 and smart factories are all about interconnecting widely varying systems, and making communication between them the key to success. OPC UA-compliant solutions are state-of-the-art, and as a result they are readily accepted for use in industrial automation.

OPC UA – the shared communication architecture for Industrie 4.0
- Direct connection of sensors to the Cloud with no routing by a PLC, SCADA, or other communication layers in the automation pyramid
- Changes to corporate IT have no impact on production areas
- Decoupling of automation and corporate IT apps
- Openness to new big data methods or Cloud apps

siemens.com/industrial-communication
markus.weinlaender@siemens.com
Rugged performance

Temperatures up to 60°C, extreme humidity, and sand everywhere – network components able to withstand such conditions really deserve to be called rugged. Siemens Ruggedcom line demonstrates reliability even under adverse desert conditions.

The Sultanate of Oman is located at the southeastern tip of the Arabian Peninsula. Except for a fertile region along the coastline, the country’s 316,000 km² territory consist mostly of desert. Along the coastline, up to 90% humidity and monsoon-like rains are the norm. In the rest of the country, temperatures can rise as high as 50°C, while blowing sand seems to be everywhere. Oman’s economy is based primarily on oil and gas exports. The exploitation of these natural resources is therefore of vital importance to the country. The largest company in this industry is Petroleum Development Oman (PDO), which accounts for 70% of the sultanate’s oil and gas production and exploration.

Ruggedness at a totally new level
Oman’s oil wells are not only among the deepest in the world. They are also considered to be “sour.” This means the wells need to deal with a high level of hydrogen sulfide (H₂S), a gas that is highly poisonous and explosive under high pressure. For this reason, the number of persons working in the immediate vicinity of the wells needs to be kept to an absolute minimum.

There are two primary issues at the oil wells: ongoing oil production needs to be monitored, and the widespread locations need to be kept free from any intruders. Previously, these tasks were supported by communications equipment that required air-conditioned enclosures, but these systems proved to be too unreliable and costly over the long term. PDO was looking for a solution that was better able to cope with the adverse environmental conditions on-site.

The company was interested in a partner that was well established on the market and able to offer excellent customer service. “At PDO, we tend to go with the preeminent equipment on the market,” says Issam Al Kharusi, the PDO project engineer who is responsible for information management and technology. “If it fulfills our requirements, we standardize on it. That’s when Siemens Ruggedcom entered the picture.” Siemens was able to fulfill PDO’s three key requirements: monitoring of oil and gas production, enhanced SCADA connectivity to integrate legacy and new sensors, and improved on-site monitoring with real-time alarms to enable rapid response in the case of any unauthorized entry into any of the oil fields.

Complex systems and long distances
The requirements for the communications technology become evident if one considers its structure and dimensions. A cluster of oil wells can stretch across an area of 30 km². Each well is equipped with numerous sensors connected to a Ruggedcom RSG900 compact Ethernet switch. Multiple wells are connected to a central gathering manifold station with a Ruggedcom RSG2100 switch via a fiber-optic cable. From there, the collected data are transferred via another fiber-optic...
cable to a central control room with Ruggedcom RSG2100 or RSG2200 switches. In the control room, the production process can be monitored with the help of visualization software. At the same time, collected data are delivered to the PDO headquarters in Muscat, the capital of Oman.

**Reliable under extreme conditions**

The infrastructure components of the Ruggedcom portfolio were designed especially for use under extreme operating conditions, including withstanding changing temperatures between –40°C and +85°C. “Our main concerns are temperature, blowing dust and compact size,” Al Kharusi says. “Since we installed the first Ruggedcom switch seven years ago, we haven’t had a single failure.” Another vital aspect for PDO was the ability to fully manage and monitor the Ruggedcom components from any remote location. This is especially important because sending a service technician to any of the automatic production sites is not only time-consuming but also a costly and dangerous procedure.

**Compatibility to protect investments**

The compatibility of the communications equipment with field instrumentation of different technology generations was important as well. “In some cases, the RS900 switch also allows PDO to combine legacy equipment and newer technologies such as intelligent electronic devices (IEDs), which protects our investment yet enables upgrades,” Al Kharusi states.

Ruggedcom RS400 serial servers located directly at the wells translate the serial communication of remote terminal units (RTUs) into a digital form that can be communicated via the SCADA network. Ruggedcom RMC40 Ethernet switches transform the serial signals of the security cameras into Ethernet signals that are communicated to a Ruggedcom RSG2100 switch in the control room. Special monitoring software automatically detects any unusual movements and immediately triggers an alarm.

PDO is already thinking of additional applications in order to further modernize its oil and gas production facilities throughout Oman. “The quality of the equipment is excellent, and the support we’ve received is excellent, so I’m looking at expanding the Siemens solution to address future requirements,” concludes Al Kharusi.

---

siemens.com/communications-for-oil-gas
mila.mironova@siemens.com
ew business models are what’s needed now. Companies that prudently maintain their traditional strengths while at the same time implementing new technologies with added value will have the greatest chance of maintaining their positions as pioneers in the coming digital age as well. “The list of process industry requirements for plant designers, in other words process OEMs, is long,” says Bernhard Saftig, who is responsible for Siemens’ business with suppliers to the process industry. “And this indicates how strong and solid the foundation needs to be before they can even start thinking about digitalization. As I see it, only the complete package means a competitive advantage.” He is certain that digitalization solutions will need to be included in this complete package in the future as well, so that end customers can achieve shorter project run times, greater flexibility, and increased efficiency. The foundation of an “Industrie 4.0” approach to achieving intelligent planning, production, manufacturing, maintenance, and servicing is digitalized added value. “Not until all machines and subsystems consistently generate data and are networked together and linked to an information system will we have created the foundation for so-called digital twins. However, we need standards and the corresponding systems and software to implement this.”

Digitalization – it all starts with a plan
At the beginning of the value-added chain, plant designers have the option of relying on networked digital planning and simulation, followed by the virtual start-up of entire plants and facilities. This allows operators to put their plants into operation faster, and end customers can put their products on the market sooner. The plants can also achieve more stable production with maximum yield. In the best-case scenario, plant designers will forward their data from the planning and commissioning stage to the end customer or plant operator, who can
The process industry requires that its OEMs manufacture systems with ever-shorter run times, greater flexibility, and increased efficiency.

Trends

01.2017 | siemens.com/magazine/industry

then use these data in the production phase to optimize the plant. Later, if any changes are made to the plant, the digital twin can follow suit.

Perfect synergy
For both the real and the digital plant, it is crucial that all system components are easy to integrate and perfectly compatible with each other. Standardization is another key strength that process OEMs can demonstrate when collaborating with Siemens. Automation standards not only allow increased synergy between all system components; they also significantly reduce engineering work.

Using valuable data during plant operation
Digital networks make it easy to determine the power consumption of both entire plants and individual consumers. For example, based on the captured data, a plant operator can see that fan motors do not all need to be running at full speed all the time when they are not actually required. The simple solution could be a converter. Another example: Thanks to digital networks, operators can estimate more accurately during the production phase when maintenance will need to be performed. Machinery and equipment can be serviced at exactly the right time before a problem causes downtime.

Maintaining traditional strengths
Despite digitalization, process OEMs should stay true to their traditional values. “High product and system quality is one of the core competencies of process OEMs,” says Bernhard Saftig. These suppliers, which are usually market-leading medium-sized businesses, have in-depth process and sector expertise. “Their high-quality plants and subsystems often prove their worth thanks to integrated or connected Siemens technology. This enables process OEMs to give their customers the guarantee of high productivity and availability.” With the wide range of Siemens services – including automation and drive solutions, data-driven services, software and IT solutions – and a holistic approach, process OEMs always have a trump card up their sleeve to win over their customers. And added to that is Siemens’ international network and country-specific expertise, as well as the worldwide stock of spare parts and support during the entire lifecycle of the plant.

Staying ahead
“Those process OEMs that are already exploring the numerous possibilities of digitalization will be the forerunners who, with the support of Siemens, are sure to get ahead of their competitors,” claims Saftig. However, there is no instruction manual for digitalization. “It calls for bold movers and shakers among plant operators and equipment suppliers who can test something on a small scale before tackling gradually more challenging tasks.”

siemens.com/digitalplant
bernhard.saftig@siemens.com

»Those process OEMs that are already exploring the numerous possibilities of digitalization will be the forerunners who, with the support of Siemens, are sure to get ahead of their competitors.«

Bernhard Saftig, responsible for Siemens’ business with suppliers to the process industry
Two pioneers join forces

The question at the core of every discussion on alternative energy in Germany: How can power be transported efficiently from the large wind farms in the north of the country to the south? A new hydrogen storage technology could be the solution – and it would even be affordable.

Hydrogenious Technologies and Siemens both have innovative energy storage technologies and have now joined forces in a pilot project. “With our approach, it is possible to store hydrogen safely, as it is bonded to what is known as a Liquid Organic Hydrogen Carrier (LOHC),” explains Dr. Daniel Teichmann, the CEO of Hydrogenious Technologies in Erlangen, Germany. One cubic meter of LOHC carrying hydrogen replaces approximately 60 gas cylinders. However, the real highlight is that hydrogen no longer needs to be transported in molecular form. Instead, with this chemical storage method, the cargo consists of a low-flammable, non-explosive oil. With its Silyzer electrolysis system, Siemens can transform electrical power into hydrogen without releasing carbon dioxide (CO₂). So combining hydrogen production (Siemens) with hydrogen storage (Hydrogenious) seemed like an obvious candidate for a demonstration project creating an intelligent process chain from the sun to power consumption.

Solar power for the car – even when it’s cloudy

At its Erlangen location, Hydrogenious Technologies impressively shows how this is possible. The power generated by the company’s own solar power plant is transformed into hydrogen with a Silyzer. Then the hydrogen is immediately bonded to the LOHC liquid. The hydrogenated LOHC is transported in a standard liquid tank, which can be either plastic or stainless steel, to Stuttgart, where the hydrogen is released again. There, on the parking level of the Fraunhofer Institute for Industrial Engineering IAO, the substance is transformed into electrical power in a stationary fuel cell.

World market for hydrogen

The worldwide market for industrial hydrogen comprises about 650 billion Nm³ per year. Even though approximately 80% of hydrogen is produced and processed in on-site plants, about 130 billion Nm³ of hydrogen still needs to be transported from point A to point B every year. The total market for hydrogen that has to be transported is worth about €70 billion to €100 billion. For many of the buyers, transporting and storing hydrogen is a major cost factor in their hydrogen supply chain. The market for efficient hydrogen plants is correspondingly large and could continue to grow, especially considering the future of electromobility.
and can then be used to recharge electric cars. The aim of the Fraunhofer project is to demonstrate the intelligent combination of renewable energies, storage options, and electromobility in a micro smart grid.

New horizons for hydrogen technology
Hydrogen as a raw material for industry is also at the center of yet another project by Hydrogenious Technologies that will be launched in mid-2017 in the United States, where a 300-kW plant will be built for a gas producer. It will be about 10 times the size of the project in Erlangen. With this technology, the gas producer intends to expand its range of potential customers. Before, transporting hydrogen was only profitable for distances of up to 200 km. Now, it is possible to cover distances of up to 600 km. "LOHC can help optimize hydrogen logistics," says Teichmann, thinking of the near future. "The possibility of combining these technologies for off-the-grid power supply is particularly interesting, for example, in remote regions in South Africa, where it could be a practical alternative to diesel generators," he speculates.

Hydrogenious Technologies – a start-up with honors
Not so long ago, in 2013, Dr. Daniel Teichmann, together with Prof. Wolfgang Arlt, Prof. Peter Wasserscheid, and Prof. Eberhard Schlücker, founded Hydrogenious Technologies, a start-up with roots in the Friedrich-Alexander University of Erlangen-Nuremberg.

In 2014, Anglo American Platinum came on board as an investor, and in September 2014, the company officially began operations at its current site, with four employees. The company has since grown to 30 employees and has won many start-up prizes with its patented technology. In April 2016, for example, it was awarded first prize in the start-up category of the 35th German Industry Innovation Awards.

»The possibility of combining these technologies for off-the-grid power supply is particularly interesting.«
Dr. Daniel Teichmann, CEO and founder of Hydrogenious Technologies, Erlangen, Germany
The ideal result

Precise knowledge of current natural gas parameters is essential for testing and controlling gas turbines. Engine manufacturer MTU Maintenance relies on Sitrans CV gas chromatographs to produce exact and sustainable measurements.

The ability to analyze natural gas quality and then calculate its characteristic values is essential to controlling turbines and combustors and performing test runs. Frank Materna, specialist sales representative for process analytics at Siemens in Leipzig, is well aware of this: “The natural gas supplied by energy providers is not always the same; there may be differences in composition. It’s therefore possible that the characteristic values in natural gas may fluctuate within a defined range.” In addition to the individual natural gas components, ever more hydrogen generated by electrolysis is being fed into the natural gas network, and its content also needs to be determined. The operators of compressor stations, manufacturers, and maintenance companies therefore need an extremely accurate analysis system that can supply precise results, allowing them to come to informed conclusions. MTU Maintenance Berlin-Brandenburg, a division of engine manufacturer MTU Aero Engines, therefore chose the state-of-the-art analysis system solution from Siemens based on Sitrans VC gas chromatographs.

Integrated in the existing system

A core competence of MTU Maintenance Berlin-Brandenburg – one of two German maintenance sites – is maintaining commercial engines. In the area of industrial gas turbines, the company overhauls and repairs LM series turbines from General Electric. Its customers include all major oil and gas companies as well as leading energy producers, the marine sector, and shipping businesses.

Within the space of one year, Siemens planned and installed their entire natural gas analysis system, including transmitting the measurement and diagnostics values to the control system at the MTU test bench in Ludwigsfelde, near Berlin. One of the challenges involved was that the company specified that its existing control system was not to be modified. “We had to integrate the generated data and signals in the existing system,” says Materna. “It was important that we obtain an extremely precise and reliable measurement of both the natural gas components and the hydrogen content,” says Heiko Krehl, engineering test at MTU. Thanks to its capacity, the natural gas network also serves as a place to store hydrogen, which is generated with the help of excess regenerative electrical energy. This makes it possible to balance out the discrepancies between power requirements and the power currently generated by photovoltaic or wind
power plants. “But this also changes the calorific value,” adds Krehl. “When the hydrogen content is higher, alterations in the combustion properties of the gas may also cause substantial changes in the turbine’s key control parameters.”

In its standard version, the Sitrans CV gas chromatograph can analyze 11 gas components and oxygen. To meet the customer’s requirements, the engineers expanded the system with a second gas chromatograph and special application, allowing the helium and hydrogen content to be determined. “The two analytical devices are connected via a master-slave circuit,” explains Materna. “In the control system, they are displayed together as a single measuring instrument.” The master device calculates the quality parameters, using the “slave’s” measured values in the process.

**Precise measurement of all components**

“This solution, which allows us to determine all 14 natural gas components, including hydrogen, is what makes the project special,” says Materna. “It means that the quality of the natural gas – including its calorific value, density, and Wobbe index – can be calculated with extreme precision.”

MTU Maintenance, which needs the natural gas analysis for scheduled turbine tests, can now explain any nonconformities in the testing process by referring to the current composition of the gas. “It gives us proof of what components are presently in the natural gas,” says Heiko Krehl.

Another challenge for the engineers was the limited space available to install and mount the analysis cabinet. “We built the new cabinet to fit the dimensions set by the predecessor model,” says Materna. To save space, the carrier gas supply lines were simply removed from the analysis cabinet and installed on the wall. “In order to ensure that, for example, a pressure loss in the measuring or carrier gas, or a temperature increase in the analysis cabinet, is immediately relayed to the control system, we installed a range of sensors,” explains Materna. The digital signals and the data provided from the gas chromatographs via Modbus were also integrated in the existing control system. “This means that MTU does not need to make any changes to the control or data evaluation systems.”

**High availability and fit for the future**

“This innovative measurement of natural gas quality using a 14-component gas analysis is both highly available and future-proof,” says Materna. The widespread use of the installed devices also makes it possible to exchange them with other users. Response times are very short, thanks to an extensive and high-quality field service and support network, which significantly reduces plant downtime. “We’ve seen continual improvement in measurement results with the new system,” says Krehl in conclusion.

\[siemens.com/processanalytics\]

\[frank.materna@siemens.com\]
Successful raw material comeback

A plant manufacturer for batching technology and bulk material handling systems is able to achieve very precise weighing with its automatic weigher, thanks to an automation system and weighing electronics from Siemens. These systems are vital to cost-effective plastics production in particular.

We’re all familiar with the routine: Used PET bottles, plastic film, and other recyclable materials like polystyrene and composites are sorted as part of a waste management procedure. This applies not just in the domestic environment but also increasingly in industry. For example, the sheeting used in agriculture and window profiles in the construction sector: Very few people know what becomes of this plastic waste after it’s sorted. Recyclable materials are in fact very valuable. In view of high raw material and disposal costs, and in order to comply with stringent legal requirements, it’s becoming ever more important to recycle and reuse materials.

Bolder automation GmbH, based in Limburg, is well aware of how important it is to achieve...
maximum possible recycling rates. The company delivers customized components as well as turnkey solutions for batching and bulk material handling plants, providing special expertise in the field of gravimetric metering and weighing. For its control systems—which play a key role in precision weighing operations—Bolder automation relies on Simatic solutions from Siemens.

**High-end weighing technology**
Recyclable used raw materials must be reprocessed before being reused. The right mix of new and recycled materials is key to cost-effective plastics production, because, for example, a plastic produced from the wrong mix might not have sufficient load-bearing capacity. The exact mixing ratio must be created by means of an appropriate and precise weighing process.

After being conditioned and crushed, the reprocessed raw material is fed from a hopper onto the Bolder automation CTW automatic weigher, which is integrated directly into the material flow. Automatic means that only the beginning and end of the measurement process are predetermined. Batch weighing starts with an empty weight of zero, after which the material is added on.

Bolder automation’s automatic weigher is controlled by a Simatic S7-1200 automation system. A Siwarex WP231 weighing electronics unit is integrated into the Simatic environment and can be connected directly to the S7-1200 components. All the functions including the weighing process, level monitoring, and valve control run autonomously, and weighing can be started and stopped in a user-friendly way from a touch panel. Because weighing is rarely a standalone operation, the interface to a central PLC also enables programmed jobs to be handled.

Siwarex WP231 can be connected to a PC using an Ethernet port. Data such as weight, status, and tare are transferred via Simatic I/Os. The data set parameters can be programmed in the Siwatool software or entered directly using an operator panel connected to the weighing electronics.

The weighing electronics are integrated into the plant software by a prefabricated function block, enabling extensive diagnostic options, such as monitoring weight trends or monitoring and reporting limit values. The high resolution of up to four million parts also ensures reliable weighing. The display and totaling accuracy of Bolder automation’s weighing machines is so high that no quantity limitations or constraints on resolution need to be anticipated.

The system requires special monitoring of power and pneumatic supply, because any failure would block material flow. The solution is provided by a PLC function that stops weighing, saves the most recent data, and switches the weigher to open feed-through if the supply fails. After responding to the alarm, regular operation can be resumed.

---

© Siemens AG

[siemens.com/weighing](https://siemens.com/weighing)
[georg.angelov@siemens.com](mailto:georg.angelov@siemens.com)
Stay up-to-date!

siemens.com/magazine

Subscribe to our topical newsletters and magazines.