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Co-innovating tomorrow™

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Chemical (Fine & Specialty Chemical, Biofuel) & Pharmaceutical

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Success Story Collection

Chemical (Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

This is a showcase of success stories from our customers worldwide.
Many leading companies are using
Yokogawa products to manage their plants and processes.

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Plant Information

- Location: Tongluo, Miaoli County, Taiwan
- Order date: 2013
- Completion: November 2014

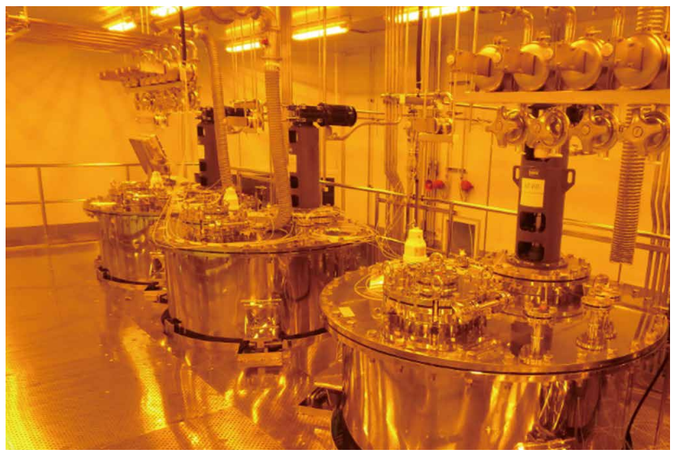
TOK Taiwan Tongluo Plant

MES with High Traceability Enables Production of High Quality Photoresist for Semiconductor Applications

Executive Summary

The semiconductor industry is characterized by extremely rapid change, as the components in integrated circuits grow ever smaller on the nanometer scale and microprocessors steadily become more powerful. Photoresists are light-sensitive chemical materials that play a key role in the semiconductor fabrication process, and they must evolve in functionality and quality to meet the changing needs of state-of-the-art microprocess technology. Manufacturers are posing ever tougher requirements on their photoresist suppliers, demanding not only increased product quality and functionality but also a level of traceability that is comparable with that in pharmaceutical manufacturing processes.

Established in 1940, TOKYO OHKA KOGYO CO., LTD. (TOK) is a global supplier of value-added photoresists and other fine chemicals as well as equipment used in the production of semiconductors and liquid crystal displays. In 1998 the company entered the Taiwan market, where its subsidiary TOK TAIWAN CO., LTD. has sold thinners and a variety of semiconductor-related ancillary chemicals to semiconductor manufacturers and supply chain partners. In November 2014, the company launched production of photoresists at its new Tongluo plant, which is equipped with leading-edge production equipment and is controlled using Yokogawa's CENTUM VP integrated production control system. The plant also utilizes a Yokogawa manufacturing execution system (MES) that has helped to standardize plant operations and thereby maintain the stable production of high-quality photoresists.



Production equipment in the Tongluo plant's clean room

Customer Challenges and Solutions

Building close relationships with customers

The extremely competitive semiconductor industry and the short lifecycle of microprocess technology means that not only chemical agent suppliers such as TOK but also the semiconductor manufacturers themselves are under severe pressure to keep innovating to survive.

In order to ensure sustained growth, TOK decided to start the local production of photoresist materials for its semiconductor manufacturing customers in Taiwan. By locating its production facility near its customers, TOK is able to work with them more closely and gain insights into their changing requirements. This allows TOK to produce new products that match up closely with their needs.

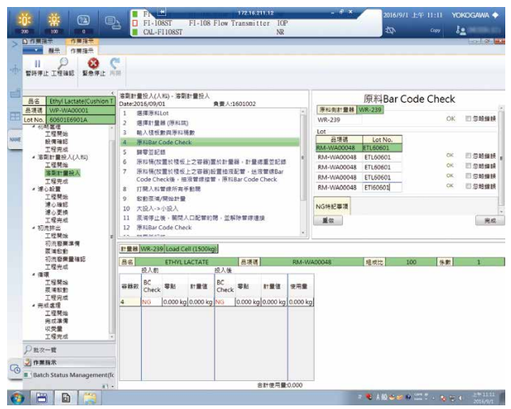
Consistent production activities using MES

TOK's other plants have relied on MES packages that were developed in house, but these have been difficult to maintain, and they have also lacked the traceability functions required by the company's semiconductor manufacturing customers. For the new Tongluo facility, TOK turned to Yokogawa, its trusted process control system vendor, for a better solution.

From the input of raw materials to completion of the final product, it requires approximately two weeks to produce photoresists. There are many steps in this production process and they must be completed without error to ensure consistent photoresist quality.

Yokogawa worked with TOK to identify these steps one by one. This involved a vast amount of production know-how, and it was necessary for Yokogawa to understand and structure all key steps of the production process in its MES. Development of the system specifications required extensive discussions about the production process with TOK's personnel.

Based on these specifications, Yokogawa built an MES that fully supported the operator workflow. The MES converts customer orders into instructions for the production process. In coordination with the plant's CENTUM VP production control system, the MES displays a detailed workflow on the operator PCs. Operators follow these instructions step by step while taking interlock with the system. Information such as raw material lot number and amount and equipment and process parameters are all tracked for reporting functions that allow them to be reviewed at any point. Operators thus have all the information they need at each step to ensure consistent outcomes in the production process.



The MES interface
(Detailed instructions are displayed together with set points, etc. in accordance with the operating sequence)

MES display of detailed process steps
(Steps jointly identified by TOK and Yokogawa)

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

▸ Full traceability - every bottle traceable to production information

In addition to supporting production operations, there is also the need to record and store production-related information on raw material usage, production processes, inspection results, and so on. In the off chance of a product anomaly, the ability to trace the raw material lot and processing records can help to identify other products that use the same raw materials or processes. Even in the absence of an anomaly, traceability makes it possible to locate changes that can impact the quality of the final product. Production process traceability is extremely important for quality control.

Even when such information is available, the analysis of root causes can take a vast amount of time. To get around this problem, TOK was looking for a means to store and quickly and efficiently search vast amounts of data. As a solution, Yokogawa added the tracking and reporting functions to the MES. The tracking functions allow both product-originated trace-back analyses and raw material-originated trace-forward views, enabling detailed multi-directional tracking of the relations between final products, intermediary products, and raw materials. The reporting functions allow output of a detailed 4M (Man, Machine, Material, Method) production record, enabling an at-a-glance check of the entire process, from upstream to downstream. The amount of time required to generate a report was dramatically reduced, freeing up time for other quality improvement activities.

These functions have made it possible to quickly and efficiently track down the production information for every bottle coming off the Tongluo production line. This adds great value and is one of the factors that is helping TOK to win the trust of its customers.

Customer Satisfaction

The Tongluo plant was soon operating at full capacity despite the fact that it was a grassroots facility manned almost entirely by local staff. The MES contribution was significant in that it allowed the production technology developed in Japan to be presented in a standardized form and utilized to prevent human errors in multiproduct processes. For the future expansion of product lines, the master version of the MES can be easily updated to accommodate new production recipes, making the system highly scalable. The integration of production planning and execution and the incorporation of traceability have helped this facility consistently produce high quality photoresist, making it the product of choice for the clean, high-precision fabrication of semiconductors.

Takashi Kawashita, vice president and manager of the Tongluo plant:
"We built the Tongluo plant with the aim of attaining the highest level of product quality. Introduction of the MES helped make this possible. We have benefited by being able to provide detailed traceability information for each product. Our customers highly value this capability.

However, the pace of change is very fast in the semiconductor industry, and our customers are always looking for what is coming next. It's a challenge to keep up. The desired characteristics for photoresist differ from customer to customer, so it is good that we are able to discuss this in depth with them and use that information to customize our products to suit each requirement. Our products are reputed to be the best, and we must maintain that reputation by delivering new products that meet ever tougher customer requirements and by expanding our production capabilities in a quick and responsive manner. We expect that Yokogawa will understand these needs and continue to provide us strong local support.

We plan to begin producing photoresist-related chemicals at a new plant that is currently under construction at the Tongluo site. Our aim here is to have the best facilities and to achieve traceability for its products as well. By producing products that our competitors cannot match, we will gain a competitive advantage. This is the plan for the new plant.

Our dream is to grow with our customers and to contribute to the further development of the Taiwanese semiconductor industry."

Plant Information

- Location: Castellón, Spain
- Order date: October 2016 (Start PoC)
- Completion: June 2019

Ube Corporation Europe

Co-innovated Field Assistant Transforms the Field Maintenance Operations

Executive Summary

Ube Industries, Ltd. was established in 1897 to develop the Ube coalfield in Japan's Yamaguchi Prefecture. Later, the company grew through the mining of coal, limestone, and cement in the surrounding area, and the manufacturing of fertilizer raw materials derived from coal. Today, the company engages in the construction materials and industrial machinery businesses as well as the production of high-performance chemicals and pharmaceutical ingredients.

The Spain plant of Ube Corporation Europe (UCE), located in Castellón, produces nylon 6 for food packaging films etc., chemical fertilizers for the markets of Europe, North and South America, and Africa.

Ube Industries is committed to making the most of its facilities through the use of asset management solutions and total productive maintenance (TPM). To improve efficiency and enhance productivity at the Castellón plant, the staff at this facility worked closely with Yokogawa to build and introduce a Field Assistant mobile solution that makes use of IIoT technology. Through the use of this innovative solution, field operators at this plant are able to work more efficiently and UCE Spain has improved the performance of its plant assets.

The Challenges and the Solutions

The challenge

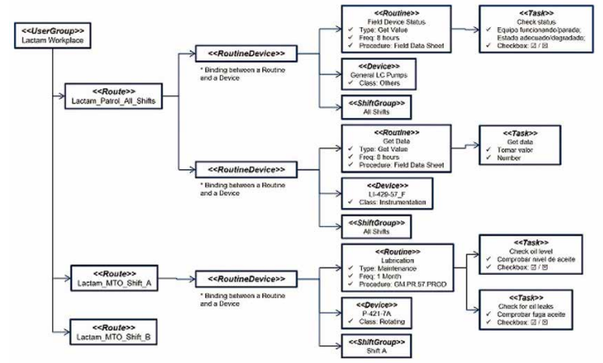
Francisco Falomir Arias, a manager in the Process Control Systems Department at UCE Spain, wanted to improve maintenance and other operations at the Castellón plant. In their routine inspections at this facility, field operators had to perform the following:

- Check all inspection points
- Carry out maintenance tasks
- Deal with any abnormalities and notify the central control room thereof
- Make a paper-based report and submit this to a supervisor

However, problems such as inspection omission and over-maintenance sometimes occurred. Moreover, an excessive amount of paper-based inspection and patrol reports (as many as 400 each day) made it very difficult for supervisors to keep track of inspection progress and identify problems to be addressed.

Mr. Falomir was aware, however, that these paper-based reports contained valuable information that could be used to improve on-site operational efficiency and equipment availability at this plant, and wanted to improve access to this information by digitizing it.

To assist him in this endeavor, Yokogawa Spain made a presentation to Mr. Falomir on a mobile solution for the digitalization of field maintenance, and he decided to work with Yokogawa to build, test, and implement this solution at his plant.



Object structure of plant information

Co-creation of Field Assistant mobile solution

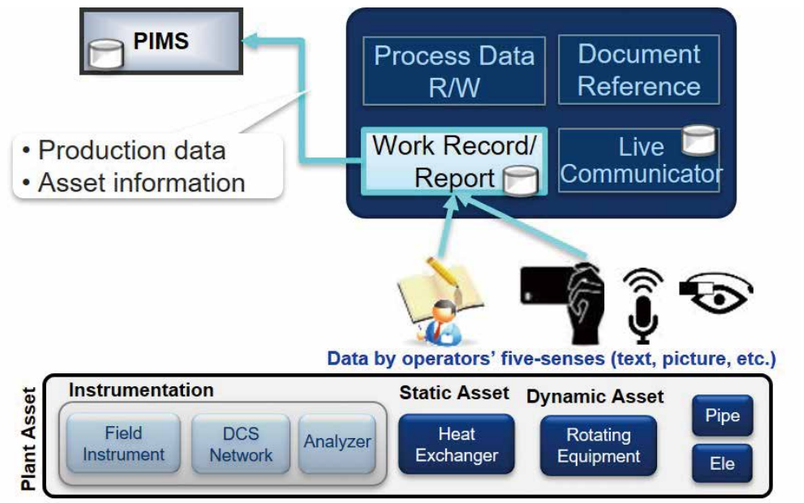
Yokogawa had already been working on the development of Field Assistant, a tablet-based solution for field maintenance. One aim of this solution was to improve maintenance efficiency and field operations by enabling personnel in the field to access digitized information such as task lists and related documents. It was also believed that analysis of the data input using these tablets as well as data collected by other means would facilitate maintenance planning and scheduling.

As Yokogawa Germany had already been promoting mobile solutions in Europe, it was decided that they would commence a proof-of-concept (PoC) of the Field Assistant with UCE Spain, in cooperation with the R&D Department at Yokogawa headquarters.

Following the successful completion of this PoC, information was gathered to facilitate discussions on what would be required for a practical implementation of this solution. UCE Spain provided maintenance knowledge and data that had been gathered over a long period of time and Yokogawa provided know-how on process control and industrial software applications. Yokogawa also interviewed field operators, supervisors, and the plant manager at UCE Spain, based on which it placed all maintenance tasks into a detailed work flow and created an object structure to organize the maintenance information that would need to be gathered and reported for all of the equipment on each inspection route. Based on this data, Yokogawa's Exaquantum plant information management system was configured to store daily maintenance work histories and device information.

Sophisticated UX design

The user interface for Field Assistant included a tablet screen used by field operators and a custom-made dashboard for supervisors to check maintenance progress. The development of this interface was coordinated by the user experience (UX) design team at Yokogawa headquarters, and the UX team met frequently with Mr. Falomir and other plant staff to create a better design.



Overview of Field Assistant

During the development phase, UCE Spain provided much feedback on functionality and usability as well as ideas for brushing up the solution, and these ideas were incorporated by Yokogawa. As a result of this collaboration between UCE Spain and Yokogawa, the development of Field Assistant was successfully completed and UCE Spain decided to introduce it for use throughout its plant.

Field Assistant changes field operation

Today, field operators at UCE Spain perform inspections as follows:

- Download task list and documents to a tablet for access during a field inspection.
- As directed by a task list on the tablet, inspect equipment on a specified route, perform maintenance as necessary, and fill out digital forms using the tablet. The task list prevents omissions in the inspection of equipment and the preparation of reports. The information in the reports can also be used at shift handover.
- While performing maintenance, refer to past maintenance logs and setting values. The ability to access logs and setting values helps to ensure that maintenance tasks such as lubrication are performed at the right time (and not when they are not necessary).
- Using the tablet, take photos and record audio and video of any abnormalities. After each inspection round, field operators can upload the recorded content to the server. The photos, audio, and video of abnormalities can also be useful in training younger operators.

Innovative management with Field Assistant

Before the introduction of Field Assistant, supervisors at UCE Spain had to go through a large number of maintenance and patrol reports each day to monitor the progress of field maintenance work and find out if there were any equipment problems that needed to be addressed.

Inspection patrol with Field Assistant

Now, by viewing a dashboard that displays Field Assistant data, supervisors can easily identify whether field operators have missed any checks on their maintenance rounds and get information on any equipment issues. While supervisors will have access to a huge amount of data from throughout the plant, they also can use a filtering function to zero in on the most essential information.

Thanks to Field Assistant and features such as the dashboard, the workload for supervisors has been significantly reduced and the overall efficiency of field maintenance operations and quality of on-site operations have been improved.

Custom-made dashboard screen for Field Assistant

O&M data utilization

The visualization of information leads to innovation. At UCE Spain, history data on field operations and devices, including sensor data from rotating equipment, are digitized and can be downloaded for access from a tablet running the Field Assistant software. By analyzing collected operation and maintenance (O&M) data, it is possible to spot devices that are in need of maintenance and take preemptive action. Condition-based preventive maintenance helps to prevent unplanned plant shutdowns by decreasing the likelihood of device failures and giving more lead time for the ordering of replacement parts (which can take anywhere from two weeks to six months to arrive).
The integrated handling of information on field operations also aids in the identification of wasteful maintenance practices and improves the overall efficiency of maintenance operations throughout a plant.

Benefits

UCE Spain expects the following benefits from the introduction of Field Assistant.

Reduction of maintenance costs

A 10 ~ 15% reduction in maintenance costs is anticipated thanks to changes such as the lengthening of the device lubrication interval.

Improved uptime and quality, and reduced costs

The early detection of abnormalities through the shift to condition-based maintenance (CBM) will improve plant uptime, ensure consistent production quality, and eliminate the need for costly and wasteful corrective maintenance procedures.

Improvement of on-site operation quality

Field Assistant provides operators the information they need to reliably perform field operations not only when things are running normally, but also during operations such as start-ups and emergency shutdowns. And by enabling field operators to analyze the history of actual operations, it is expected that UCE Spain will be able to eliminate wasteful maintenance practices and reduce costs around 10%.

Decision support to maximize manufacturing performance

The use of Field Assistant to analyze collected O&M data and visualize conditions gives process engineers and supervisors insights into plant operations that are needed to make the right maintenance decisions. This also will enable the elimination of wasteful maintenance practices.

Customer Satisfaction

Developed in collaboration with UCE Spain, Yokogawa's Field Assistant has been formally commercialized as a digital transformation solution that will dramatically increase the efficiency of field operations.

Mr. Falomir:
"Field Assistant was completed as a result of deep collaboration with Yokogawa. Since we worked on PoC and UX design together with Yokogawa, the Field Assistant software is really user-friendly and easy to use. Field operators and supervisors find it very convenient to use. Field Assistant is a nice plant information management system that connects field operations with actual plant information. We can understand what is happening in our plant and identify where the problems are. It makes it possible to properly plan and improve plant operation schedules and maintenance plans."

Plant Information

- Location: Kurashiki City, Okayama, Japan
- Order date: July 2015
- Completion: December 2015

Mitsubishi Gas Chemical Company

Stabilization of Process and Improvement of Operation through Process Data Analysis

Executive Summary

Mitsubishi Gas Chemical Company (MGC) produces a variety of specialty chemicals from natural gas and petrochemical feedstocks. The company is the first company in Japan to produce methanol and ammonia from natural gas. The company owns and operates oil and natural gas fields in Japan. Based on MGC's group vision of "Creating the value to share with society," MGC provides unique products and services based on its proprietary technologies to industrial customers in Asia, North America, Europe, and other markets.

MGC's Mizushima Plant produces highly original aromatic derivatives from mixed-xylene that have been obtained through the petroleum refining process. These are used widely in products such as plastic containers and perfumes.

Improvement activity of safety or operation has proceeded at its Mizushima Plant. At one of them, MGC selects Yokogawa process data analysis solution that has helped to reduce operator workload and stabilize processes.

The Challenges

In a continuous process that is monitored and controlled by a Yokogawa CENTUM VP distributed control system (DCS), aromatic derivatives are produced at the Mizushima Plant. With the aim of maintaining high product quality and production efficiency, operators carefully monitor this process at pre-specified points. Whenever there are fluctuations in this process, operators of the CENTUM VP DCS intervene to make adjustments. For certain reasons that were not fully understood at first, these fluctuations tend to occur more frequently at night against at daytime. To identify the reasons for these fluctuations, MGC turned to Yokogawa for a process data analysis solution.

Process Data Analytics screen

Collaborative Analysis with Customer

In July 2015, MGC started working with Yokogawa in a collaborative analysis project using Yokogawa's Process Data Analytics software at the Mizushima plant. Tsukasa Taketa, a section staff leader, had the following to say about this:
"Our plant has been using Yokogawa solutions to improve operations by, for example, automating non-steady operations. Of the various products and solutions that Yokogawa has introduced to us, their process data analysis solution caught my attention. It looked very interesting and I thought it might prove more useful in improving the productivity. I decided to give it a try."

Analysis to find process fluctuation factors

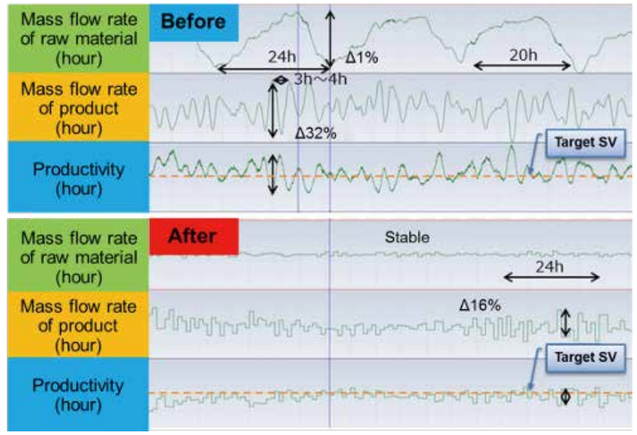
Yokogawa analyst Takeo Ueda began analyzing the entire production process to identify when these fluctuations were occurring and find a way to prevent them. To analyze the process data for thousands of tags that have been stored in the Exaquantum plant information management system, one must first have a good understanding of every aspect of the production process, including the raw materials, the control method, and the final products. Moreover, it is necessary to understand how operators act not only when a process is in a steady state, but also when the process enters a non-steady state. While learning about the production facilities, the configuration of the control system, and the P&ID control method from Mr. Taketa, Mr. Ueda stepped forward his analysis of the plant data.

During the analysis phase, Messrs. Taketa and Ueda paid particular attention to the control of the raw material flow rate. They were vaguely aware that a 1% difference in the flowrate was caused by day and nighttime variations in ambient temperature and atmospheric pressure, and that this was causing major fluctuations in the production process. Wondering how this could be, Mr. Ueda tried to avoid any preconceptions that might lead him to ignore or discount certain factors, and analyzed the data using different techniques.

Looking back on this analysis, Mr. Ueda commented:
"This analysis at the Mizushima Plant was the toughest that I'd ever done, with me having to try and imagine what conditions caused the variations in the data for thousands of tags. By carefully looking at and sharing this data with Mr. Taketa and the members of his production section, I was able to make progress in this analysis. Any time I had a question for Mr. Taketa he was ready with the correct answer, and I was really impressed with his knowledge of the plant and the production process."

He went on to say:
"Yokogawa's Process Data Analytics software makes use of the Mahalanobis Taguchi System (MTS), but that's not all: by examining data from the perspective of the 4M (Material, Machine, huMan, Method) perspective, we were able to select the most appropriate method for analyzing the customer's plant data, and preprocess and convert the data so as not to miss smaller features. Furthermore, we gave careful consideration to how best to explain the results of our analysis to the customer. We have found that, if the customer is not satisfied with the results of process data analysis, it is difficult to move on to the next stage for problem solving."

They achieved progress with their collaborative analysis, while closely sharing information on progress and tactics. In August, next month, the team was able to identify multiple factors that caused the process fluctuations. These were due to variations in the flow of raw material, as the team expected. The data proved that a 1% fluctuation in the flow rate significantly impacted the process.



Result of the collaborative analysis (material, quality, cost)

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Consideration and execution of countermeasures

Process data analysis is meaningless if you stop at just identifying the root causes of a problem. To suppress the fluctuations that were occurring at the plant, the staff of the Mizushima Plant, who are professionals in manufacturing, and Yokogawa, who is also professional in instrumentation and control, began considering practical countermeasures.

As a result of these efforts, a control scheme for stabilizing the process was devised, and the control loops of CENTUM VP were modified and improved.

Results

Thanks to the stabilization of the process with the new control scheme, the number of alarms and manual interventions were dramatically reduced. The number of alarm occurrences was reduced by about 20% and manual operations involving both the manipulated variable (MV) and the set variable (SV) were reduced by about 30%. With the process stabilized, the productivity improved as well. According to the operators, “CENTUM became quiet.”

At the Mizushima Plant, as one tool for making improvements, Yokogawa’s Process Data Analytics software is being utilized on a daily basis to achieve super-stable plant operation. And operator abilities continue to be strengthened.

Customer Satisfaction

Masanori Ishikura, general manager of Manufacturing Department 1 and Power Department:

"Safety is the top priority at our plant. We are also concerned about productivity. Improving operator awareness and ability has a big impact on safety and productivity. Process data analysis is also useful in terms of education and human resource development.
However, analysis is not an end in itself. Rather than focusing on analyzing problems after they occur, why not try to have operators who can spot abnormal conditions before a problem occurs? Furthermore, I want our young operators to understand what is happening with physical phenomena and chemical reactions. Our veteran employees have gained this knowledge on the job, but I would like our younger operators to also learn by engaging in analysis. Analysis is good for both improving processes and education."

Susumu Inagaki, section manager of Manufacturing Section 2 Manufacturing Department 1:

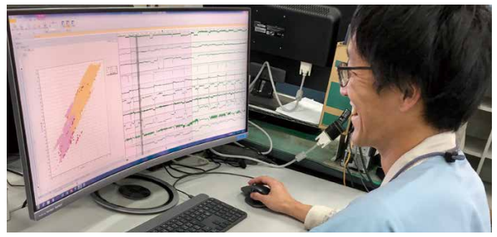
"Analysis has begun to help us stabilize operations. Our operators have been actively using analyzing tools like this Process Data Analytics software, and this is particularly the case with our younger operators who will bear the next generation in the future. They seem to understand the processes on a middle expert level and are able to spot potential issues and take preemptive actions before something goes wrong. They keep trying to make things better and, as a result, have gained new skills and improved the stability of our processes.
Staff in other departments at the Mizushima Plant have also been making various improvements. Yokogawa's Exapilot is widely used to automate tasks that are not performed frequently, and our section takes pride in having been the frontrunner with utilizing Exapilot. I am thankful for all the attractive solutions that Yokogawa provides to us."

Toshio Izutsu, deputy section manager of Manufacturing Section 2 Manufacturing Department 1:

"Thanks to making improvements to our operations with analyzing tool, our staffs here are more curious now about what is going on in our plant and have a greater interest in spotting potential problems, and I think this is a good thing.
Analysis is useful in understanding the sequence of steps in a process and what happens over time with that process. Operators are often mechanically aware of process conditions from their experience. But they can come upon new discoveries if they adopt a more analytical approach. Concerning the matter of the productivity, as such analysis can help personnel to rethink assumptions and take a wider perspective, we will continue to perform this analysis.”

Motoki Tsuji, Manufacturing Section 2 Manufacturing Department 1:

“I am currently in charge of the analysis team. When I first joined MGC and was assigned to this section, my more experienced colleagues were working to automate infrequent operations by Exapilot. I had an interest in taking part in their “kaizen” activities and quickly volunteered when Mr. Taketa told me about this project.
Recently, operators have been using data from the Process Data Analytics software to prepare operation reports and other documents, and this practice has been spreading to members other than analysis team. It is very rewarding to know that we have been able to improve the process through our own efforts.”



Department name and job title are as of interview.

Recent photograph of the project team
Back row (from left) : Mr. Murakami *(Process Technology Section Research & Development Department)*, **Mr. Horiuchi** *(Deputy section manager of Manufacturing Section 2 Manufacturing Department 1)*, **Mr. Norikane** *(Plant Maintenance Section Maintenance Department)*
Front row (from left) : Mr. Narimatsu *(Yokogawa)*, **Mr. Tsuji and Mr. Taketa** *(Manufacturing Section 2 Manufacturing Department 1)*, **Mr. Fujii** *(Yashima Export & Import Co., Ltd.)*

Takeshi Norikane, Plant Maintenance Section Maintenance Department:

"Before moving to the maintenance section, I and Mr. Taketa were among the first members of the analysis team. Our original purpose for doing process data analysis was to make it easier at the start of each workday to check what the situation was with operations on the previous day. At that time I was the only person using the Process Data Analytics software, but now it is entering wider use.
My work with this software has given me a broader perspective. It’s good that I can use it to perform difficult calculations, and this has allowed me to handle a wider variety of tasks.”

Tsukasa Taketa, Manufacturing Section 2 Manufacturing Department 1:

“The project was a great success. The process was stabilized and the operators found it easier to smile. One excellent outcome is that this project gave people who had never worked together an opportunity to get to know each other. Spreading out like the roots of a large tree, I believe these relationships will make innovation continuously in various ways. It’s my duty to create a lively work environment, and I take pleasure when our people go home to their families and come back the next day invigorated and ready to work.
I want Yokogawa to communicate more closely with us and incorporate our operators’ ideas in their solutions. Forward-looking improvement activities are ongoing at our plant, and I am looking forward to Yokogawa providing solutions that meet our needs. Please surprise me with solutions (said with a smile)!”

Takeo Ueda, data analysis engineer of Yokogawa:

“Mitsubishi Gas Chemical was the first company to use our Process Data Analytics software. I taught Mr. Taketa and Mr. Norikane how to use the software, and now many of the other operators at the Mizushima Plant now use it routinely to make the analyses needed to make improvements. I’m very pleased with this.
In some of my previous projects, root causes have been identified without actually being able to solve the problems, but I am happy to report that Mitsubishi Gas Chemical was able this time to implement the necessary countermeasures. I admire the dynamic efforts that they are making to improve the safety and efficiency of their operations. I am grateful to Mr. Taketa and everyone else at Mitsubishi Gas Chemicals for taking the time to engage in frequent discussions with us on how best to achieve shared goals. A big factor behind the success of this project was the cooperation with MGC, our business partner, Yashima Export & Import and Yokogawa. We were able to work together to achieve a goal.
I look forward to having further opportunities to provide solutions that delight our customers all over the world, and to helping them improve their site operations and the competitivity of their products.”

Plant Information

- Location: Tembus District, Jurong Island, Singapore
- Order date: May 2011
- Completion: January 2013

Asahi Kasei Synthetic Rubber Singapore Pte. Ltd.

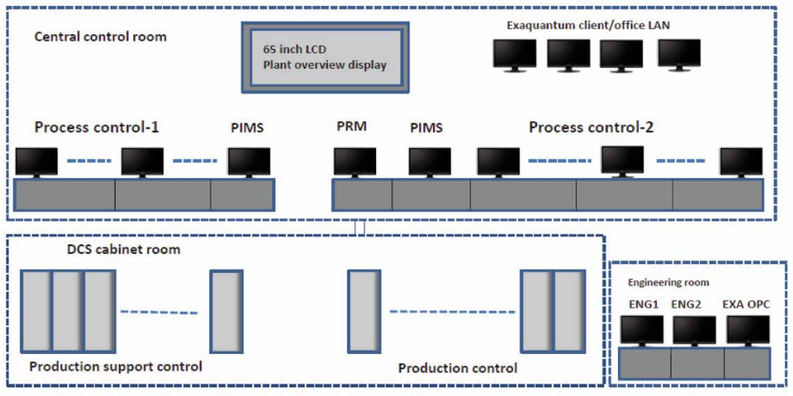
S-SBR Production Automated Using CENTUM VP, ProSafe-RS, PRM, and FOUNDATION™ Fieldbus Solutions

Executive Summary

Asahi Kasei Synthetic Rubber Singapore Pte. Ltd. (AKSS), a subsidiary of Asahi Kasei Chemicals Corporation, has built a plant on Singapore's Jurong Island that produces 50,000 tons per year of solution-polymerized styrene-butadiene rubber (S-SBR), a type of synthetic rubber that is used in green tires to improve fuel efficiency and performance. As the demand for S-SBR is rapidly growing due to increasingly strict environmental regulations and rising awareness of environmental issues, Asahi Kasei Chemicals has made it a priority to accelerate production of this key material.

To automate production at this greenfield plant, AKSS selected Yokogawa's systems solution that was installed by Yokogawa Singapore. The provided solutions included the CENTUM VP production control system (PCS), the ProSafe-RS safety instrumented system (SIS), the Exaquantum plant information management system (PIMS), the Plant Resource Manager (PRM) asset management package, and a variety of FOUNDATION™ Fieldbus-enabled field devices.

The successful installation of these systems for this new plant demonstrates how the Yokogawa Group can work as a best solution partner with its customers around the world to automate their plants.



Production control system overview

The Challenges and the Solutions

Safe nd efficient operations

The main processes at the S-SBR plant are raw material and chemical feeding, polymerization, recovery, and finishing, along with utility processes. Polymerization is a continuous process that requires a reactor to operate continuously. To maximize efficiency at this plant, AKSS required a highly modern integrated production control system. With its sequence and PID control functions, CENTUM VP automates many complicated procedures. From the high-performance, ergonomically designed human machine interface (HMI) terminals, operators can access process, trend, alarm summary, operator guidance message, and other displays that convey large amounts of data in an easy to read format. This gives operators the information they need to identify problems before they reach a critical state and act with agility.

To ensure safe plant operations, ProSafe-RS's emergency shutdown and fire & gas detection functions are fully integrated with CENTUM VP, allowing plant operators and engineers to monitor operations throughout the plant using uniform instrument faceplates. The sequence of events (SOE) function in ProSafe-RS also enhances safety by facilitating the detailed analysis of process upsets and the identification of problem causes. For added efficiency, it is possible from the same engineering platform to make modifications to both the PCS and the SIS that can be downloaded at any time to the individual control stations. This reduces engineering workload.

Proactive maintenance

AKSS is continually striving to introduce the latest technology at this plant to improve its operations improvement and reduce both capital expenditure (CAPEX) and operational expenditure (OPEX). For this greenfield S-SBR plant, AKSS decided to use Yokogawa FOUNDATION™ Fieldbus devices and the PRM asset management package. During plant commissioning, PRM was used to check all control loops and the valves in each loop. With the plant up and running, the operators and engineers can use PRM's device viewer to monitor all field devices from the central control room (CCR). This reduces workload in the field and allows a preventive maintenance approach where maintenance can be scheduled and performed before a field device fails. In addition to enhancing maintenance efficiency, this reduces the likelihood of unscheduled plant shutdowns.

Visualization of operations throughout the plant

Data on the plant's use of raw materials, chemicals, steam and water, and electricity needs to be clearly monitored and reported on a daily, weekly, and monthly basis. Via an ExaOPC interface, the Exaquantum process information management system (PIMS) gathers plant data from the CENTUM VP production control system to generate a variety of reports on the polymerization process. Exaquantum makes it possible to view historical trend data for specific time intervals, so operators and engineers can analyze polymerization processes performed using different recipes. Exaquantum can also perform calculations that show plant performance rate and efficiency, and identify how efficiently utilities like water, steam, and power are being used in the plant. From Exaquantum clients at various locations, analysts and engineers have ready access to data on plant operations. Operators at the HMIs in the CCR can also view production data on a large 65 inch screen, giving them real-time access to all the information they need to promptly take the right action whenever intervention is required.

Customer Satisfaction

Shuji Yahiro, plant general manager of the AKSS, had the following three points to make about the systems installed by Yokogawa.

"First, operators appreciate the HMI's ease of use. Thanks to the ergonomic design of the CENTUM VP HMI, operators enjoy access to large amounts of process data and are able to monitor and run operations throughout the plant with a minimum of stress. Engineers can easily make modifications such as changing set points. With a simulation function, they also can confirm whether a new configuration functions correctly. An on-line maintenance function is user friendly and new configurations can be downloaded to the control station without interfering with plant operations."

"Next, the keys on the operator keyboard can call up trend displays, individual faceplates, a plant overview display, alarm summary, operator's guide message display, and other graphical displays. Certain keys are user definable. Using this keyboard, even newly trained operators can quickly call up the information they need to operate the system. Switching between displays is quick and smooth."

"And finally, as we are always striving to introduce the latest process control technologies, AKSS decided to use FOUNDATION™ Fieldbus technology at his greenfield S-SBR plant. Used in combination with the PRM asset management package, it allows the checking of each loop and control valve signature during the startup period. During normal operations, operators and engineers can see the status of all field devices from the central control room at any time. This new digital technology is changing how field operators work and will make possible a proactive maintenance approach that will allow AKSS to reduce OPEX."

Plant Information

- Location: Huizhou, Guangdong Province, China
- Order date: April 2006
- Completion: March 2008

Bridgestone (Huizhou) Synthetic Rubber Co., Ltd.

CENTUM CS 3000 and Exaquantum PIMS Improve Production Efficiency at Chinese Synthetic Rubber Plant

Executive Summary

In response to growing global demand for synthetic rubber, the Bridgestone Corporation has built a synthetic rubber plant at the Daya Bay Petrochemical Industrial Park in Huizhou, China. The new plant is operated by the Bridgestone (Huizhou) Synthetic Rubber Co., Ltd. (BSRC), and the high-quality synthetic rubber produced there is mainly used in top-of-the-line automobile tires.

At this plant, which has raw material (butadiene and styrene) storage tanks and other facilities, synthetic rubber is produced through continuous and batch processes that include the adjustment of additives, polymerization, styrene recovery, blending, and drying. The batch processes are controlled by a production control system (PCS) that normally receives certain parameters from a production computer system, but is designed with the capability to control all production operations in an emergency.

To control operations at this plant, Yokogawa installed its CENTUM CS 3000 and an emergency shutdown system based on the STARDOM network-based control system. The company also installed an Exaquantum plant information management system (PIMS) for the collection and analysis of process data and a simulator that is used to train plant operators.

The Challenges and the Solutions

Improved information display

At first, operators at this new plant had to scan three different human interface station (HIS) screens, but it was found that they sometimes missed important alarms when multiple alarms were issued. The decision was made to install one large screen in front of the HIS terminals, allowing operators to see at a glance important alarms and trigger an interlock sequence in a timely fashion. On this screen, four windows display process alarms, operator guidance messages, important annunciators, and important interlocks.

Operation data management and analysis

With continuous processes, it is important to have up-to-date information. To improve the collection of process data, Yokogawa installed the Exaquantum PIMS. To improve access to that information so that production decisions can be made more quickly, it also placed client terminals at multiple locations around the plant and connected them via a local area network. This PIMS accomplishes the following:

- Reduces operator workload by automatically generating daily reports
- Facilitates troubleshooting and quality improvement activities by outputting trend data when a malfunction occurs
- Makes possible a more proactive maintenance approach by generating data on operation time and number of batch campaign
- Provides data on long-term trends needed to make improvements to plant processes

During plant commissioning

Today

Training system

A Yokogawa plant simulator was installed to give operators the training needed to ensure a quick and smooth plant startup. The training system features the same functions, database, and graphic displays as a standard CENTUM control system, and is used to bring new operators up to speed on plant operating procedures as well as provide periodic refresher training to veteran operators. This system is also used to carry out simulations to verify software modifications.

Sustainable manufacturing

Many kinds of environment-related data have to be carefully monitored using the CENTUM CS 3000's alarm and trend functions. The data is strictly managed and monthly reports are submitted to the local government. In compliance with government regulations, power consumption data from a motor control center as well as data on steam consumption and industrial water usage are monitored to reduce energy consumption and implement sustainable production processes.

Customer Satisfaction

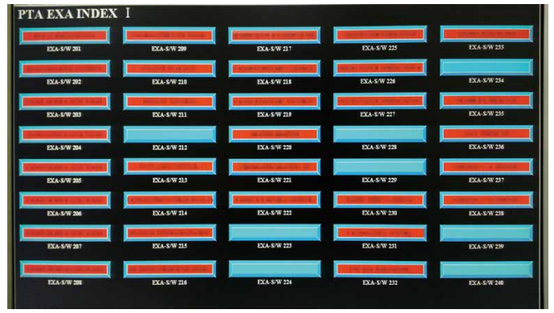
"Thanks to Yokogawa's highly reliable CENTUM CS 3000 production control system, we have complete confidence in our ability to operate this plant."

"By having clear access to all kinds of process data, our plant operators now have an up-to-the-minute understanding of what is going on with a process and can take quick and decisive action."

"We are always looking to make improvements in production processes and product quality, and seek to improve production efficiency using the data from both the system and laboratory data. We plan to repeat the PDCA activity cycle based on Yokogawa's platform."

Plant Information

- Location: Daesan, South Korea
- Order date: January 2012
- Completion: October 2012



Assignment of the Internal switches for Exapilot

Samsung Petrochemical Co. Ltd.

Introduction of Exapilot Reduces Workload, Enhances Safety, and Ensures Consistent Product Quality

Executive Summary

Samsung Petrochemical Co. Ltd. (SPCL), a major Korean petrochemical company, produces 700,000 tons per year of purified terephthalic acid (PTA) at its Daesan plant. PTA, a white powder substance that is produced by oxidizing and refining para-xylene, is a precursor to polyethylene terephthalate (PET), a polyester material that has excellent thermal resistance and wear resistance and is widely used as a substitute for natural cotton fibers and in film packaging, beverage bottles, tire cords, paints, adhesives, and other applications. As of 2010, global annual demand for PTA stood at 39 million tons, and is expected to continue growing by 7% a year until 2016. Growth is especially strong in Asia, particularly China and India. (Source from Petrochemical industries in ASIA 2013 issue)

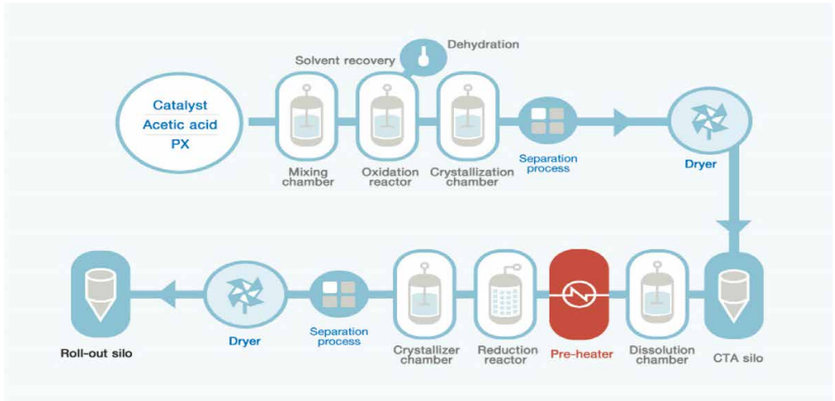
SPCL is striving to improve safety at this plant and wants to reduce operator workload and ensure consistent product quality by automating complex operations. To achieve these aims, Yokogawa Korea installed the Exapilot operation efficiency improvement package and integrated it with the plant's existing CENTUM CS 3000 production control system. With these new systems in place, the SPCL plant is operating flawlessly.

The Challenges and the Solutions

Up until 2000, SPCL was using the CENTUM CS DCS and an advanced process control (APC) package. Around this time, Exapilot was installed and used on a trial basis, as part of an effort to improve quality control in each department and ensure more efficient production. Within the company's quality control (QC) activity, four different production groups received prizes for their efforts in using this package to automate manual procedures.

When SPCL upgraded from CENTUM CS to CENTUM CS 3000, it extended the use of Exapilot to all other operations throughout the plant, including the startup and shutdown of three oxidation reactors. Prior to the introduction of Exapilot, emergency shutdowns of the reactors were particularly labor intensive, requiring operators to carry out many different manual operations such as ramping down the set points for the reactor temperature controller, opening and shutting valves, transferring intermediate chemicals to temporary storage tanks, and carrying out various other recovery processes. Similarly, many different manual operations were necessary to start up the reactors. Exapilot automates the execution of all these procedures and allows operators to monitor and confirm these operations while they are in progress. Safer operation and greater consistency in product quality was available now.

Another very labor intensive operation involved the treatment of the plant's wastewater. The filters used in the separation process need to be cleaned by means of carbon purification, this takes up to eight hours, needs to be done two or three times per day, and requires the manipulation of 15 valves per filter. This process has also been automated using Exapilot. As a result, Exapilot reduces operator work load.



Overview of PTA production process

Customer Satisfaction

Jun Ho Hwang of Associate Daesan Maintenance Team, commented, "First of all, our company pays careful attention to quality control, and every department is striving to make improvements in this area. Our group aims to improve efficiency by automating manual procedures as much as possible. This helps to ensure safe operations 24/7, to reduce operator work load, and to ensure the consistent product quality."

He added, "All of our operations are managed by Exapilot. Only the interlocks have been implemented through the CENTUM CS 3000 system. APC software and the Exaplog package have also been introduced to bring added improvements in efficiency. Maintenance engineers have assigned a total of 160 internal switches for Exapilot configuration, and all the logic is implemented by the skilled operators.
So the know-how from the skilled operators is transferred by Exapilot to younger operators. Our central control room is quiet and our production operations have been going smoothly."

Central control room (CENTUM CS 3000 and Exapilot displays)

Plant Information

- Location: Nantong, Jiangsu, China
- Order date: October 2012
- Completion: August 2013

Sanyo Kasei (Nantong) Co., Ltd.

Exapilot-based e-SOP System Provides 24/7/365 Guidance, Improving Both Product Quality and Productivity

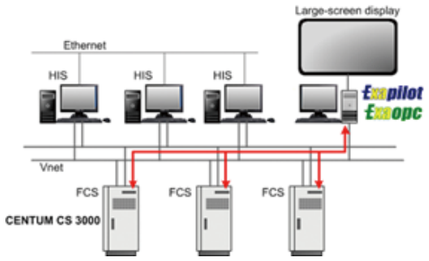
Executive Summary

Founded in Kyoto in 1949, Sanyo Chemical Industries Ltd. is a producer of performance chemicals such as surfactants, high water-absorbent resins, lubricant additives, pigment dispersants, and polymerization toner intermediates. Sanyo Kasei (Nantong) Co., Ltd. (SKN), a subsidiary of Sanyo Chemical Industries, was established in 2003. From its facilities at the Nantong Economic and Technological Development Area, SKN produces performance chemicals such as pigment dispersants, emulsifying surfactants, and glass fiber adhesives for high growth markets in China and elsewhere in Asia. Since 2004, SKN has relied on a Yokogawa CENTUM CS 3000 distributed control system to monitor and control its batch production processes.

To improve the quality of the pigment dispersants produced at the SKN plant, and to raise the productivity of this batch production process, the company introduced Yokogawa's Exapilot operation efficiency improvement package. This is an innovative electronic standard operating procedure (e-SOP) system that draws on the knowledge and experience of skilled SKN operators. Functioning much like a car navigation system, the Exapilot e-SOP system displays the procedures for each operation on a large-screen display in the plant's control room, providing less experienced operators the guidance needed to standardize work processes.

The Challenges and the Solutions

Transferring knowledge to less experienced operators and improving their skills are common challenges worldwide, and is key to keeping plants operating safely and securely. The great variety of products and the many different recipes that are used at the SKN facility present a particular challenge. For example, there are approximately 30 different recipes for the production of the company's flagship product, the Carrybon L-400 pigment dispersant, and this process makes use of multiple reactors and tanks. Before the introduction of Exapilot, less experienced operators often had to consult manuals and ask production line



The system architecture

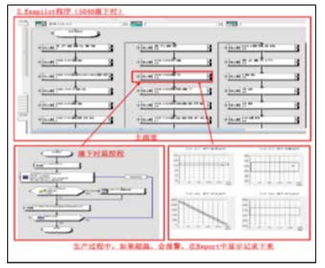
managers for assistance when, for example, the flow rate dropped as the result of a clogged pipe. Situations such as this added to operator workload and led to a drop in product quality.

At the suggestion of Kazutoyo Kato, who was then the production manager at the Nantong factory and who had learned about Exapilot in a visit to the Yokogawa Shanghai office, SKN decided to use Exapilot with its pigment dispersant production process.

24/7/365 guidance for standard operating procedures

With the Exapilot system installed at the SKN plant, the plant's engineers began collecting information about specific processes and other knowledge from their veteran operators. Based on this, they began inputting this information into Exapilot flowcharts. Throughout this process, Yokogawa's Exapilot experts frequently visited the SKN office to provide support.

At many plants, operators have access to both the DCS and Exapilot windows at their terminals, and refer to the information provided in the Exapilot window to guide them through a process. However, because of the complexity of the production processes at the SKN plant, there was a concern that the use of both systems at these terminals would place too much of a burden on the operators. It was therefore decided to implement Exapilot as an e-SOP system that starts up automatically when the CENTUM CS 3000 system launches a



Definition of work processes in an Exapilot flowchart

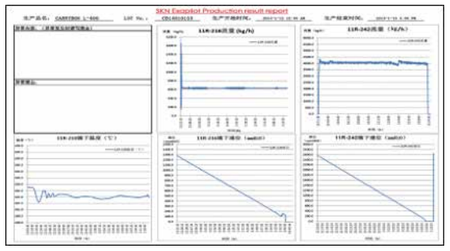
SKN and Yokogawa engineers

The e-SOP system screen: 24/7/365 procedural guidance

batch production process. Monitoring the process via an Exaopc interface, the e-SOP system displays the correct procedure on a large screen in the central control room. Operators thus have all the information needed to issue the right commands to the CENTUM CS 3000 system and correctly carry out the process. By clicking the appropriate item in the Exapilot window, they can also access all necessary documents and image data. And when an alarm occurs, Exapilot navigates the operators to a quick solution.

As a result, procedures have been standardized, product quality has been improved, paper documents have been digitized, and operator workload has been dramatically reduced. Exapilot has helped to improve the overall skill level of operators by giving younger operators access to the know-how and expertise acquired by their more skilled and experienced colleagues.

Moreover, to ensure traceability and enable the detailed analysis of data for each batch production process, Exapilot automatically reports data on flow, level, reactor temperature, problem causes, and operator inputs.

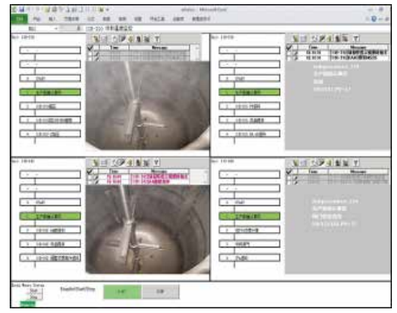


Production records for a batch production process

Customized Exapilot screen for complex batch production operations

One must frequently switch between CENTUM CS 3000 screens when monitoring and controlling complex batch processes that use multiple reactors, and this is a challenge for less experienced operators. To address this issue, Yokogawa engineers were able to create customized screens that use ActiveX controls in Excel to display up to four workflows at one time. Operators are thus better able to stay on top of simultaneous related processes, improving both ease of use and efficiency.

Taisuke Ishida, a Yokogawa Exapilot engineer, had the following to say about this feature: "We were able to get four windows to refresh at the same time by using Microsoft Excel macros and ActiveX controls. In addition to giving us the information we need to safely operate the process, we also can monitor the overall progress of the production process and view other data that is not stored on the DCS, including photos of



Customized screen

materials that are to be charged and real-time video feeds. Exapilot is a useful tool that guides the operators through complex processes."

Customer Satisfaction

Mr. Kazutoyo Kato

Problems with variation in product quality with SKN's pigment dispersant production process were resolved: in the year preceding the introduction of Exapilot, the plant reported 10 product defects; in the following year there were zero defects, a 100% product quality rate. In addition, standard production time was reduced 10%, a significant increase in productivity.

Mr. Kato: "At SKN we called Exapilot the "mother's love" system because, like a mother with a child, it is constantly at the side of our less experienced operators, giving them the help they need. With only basic training, a newcomer can perform standard operations. This also frees up the production team leaders so that they can devote their time to more high-value added tasks."

He went on to say: "We built a good relationship with Yokogawa after the CENTUM CS 3000 system was installed in 2004, and were like brothers: we communicated well with each other and I felt free to speak my mind with them. Yokogawa understood Sanyo Chemical Industries' unique production policies, and helped us construct our system. In addition to helping us improve product quality, Yokogawa helped us localize our operations by providing engineering training to Chinese nationals. The mother's love system, so to say, is a system that our local staff built up on their own, in collaboration with Yokogawa."

Engineers at SKN. From the left, Messrs. F. Yang, Y. Li, L. Zhu, Q. Dong, and F. Liu

Plant Information

- Location: Wakayama, Japan
- Order date: June 2017
- Completion: March 2019

Honshu Chemical Industry Co., Ltd.

Collaborative Effort at Process Data Analysis Stabilizes Production and Leads to Positive Changes in Organizational Culture

Executive Summary

About Honshu Chemical Industry Co., Ltd.

The Wakayama Works of Honshu Chemical Industry Company, Ltd. was established in Wakayama City in 1914. When the supply of dyestuffs from Western countries was disrupted at the start of the First World War, the Honshu Chemical Industry Company constructed the first-ever benzene distillation plant in Japan and successfully launched the production of aniline. The company went on to develop a number of original technologies and produce a wide range of chemical products, and thus contributed to the development of regional industries. Therefore, there are still many chemical companies in Wakayama City.

Today, the Honshu Chemical Industry Company is making use of its expertise in phenol derivative synthesis to produce high-quality fine chemicals for niche applications in such industries as information and communications, automobiles, and pharmaceuticals.

Project Overview

The Manufacturing & Development Section at the Wakayama Works was having difficulty eliminating variations in quality with the production of a certain high-value-added chemical. Since this chemical was made to order, the conditions (seasonal factors, etc.) were not consistent, and the batches were typically smaller than those for products that were in continuous production. Although the staff in charge had tried to analyze the data from this particular process to ascertain the quality of the chemical, these inspections were not always the desired results.

These benzene distillation units were certified as a "Heritage of Industrial Modernization."

Therefore, it was decided that the Wakayama Works would work with Yokogawa to jointly conduct a detailed analysis of the relationship between this production process and product quality. Based on the findings of this analysis, they were able to base their production operations on final product quality estimates and succeeded in achieving these targets.

The Challenges and the Solutions

Challenges

For this high-value-added chemical, the Manufacturing & Development Section aimed to raise the quality acceptance rate to 100% and improve product yield.

The problem-solving process

- Sharing with Yokogawa of information on the production process, control method, and operating methods in steady/non-steady states
- Analysis of process data using a variety of approaches
- Frequent sharing of information on and discussion of analysis results to identify causal factors
- Installation of Yokogawa's Process Data Analytics (PDA) software and instruction on its use
- Examination of hypotheses
- Verification of hypotheses in laboratory and commercial plant
- Planning and implementation of practical countermeasures to solve problems

Step 1: Product quality analysis

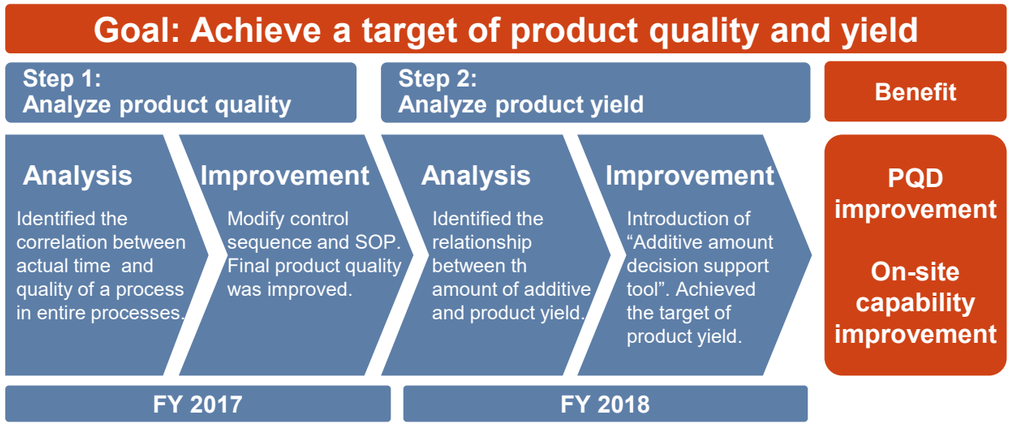
In step 1, Yokogawa sought to identify the relationship between product quality and the amount of time required to complete a certain process. Consequently, modifications were made to production control system sequences and standard operating procedures (SOP) were revised to make clear to operators which operations could cause a drop in quality. As a result, product quality problems caused by the process were eliminated.

Step 2: Product yield analysis

A project team made up of personnel from the Wakayama Works and Yokogawa conducted an analysis focusing on product yield that identified a relationship between the additive injection amount and product yield. Based on this, Yokogawa developed an additive amount decision support tool that calculated and displayed the appropriate additive injection amount based on actual values from previous processes. Thanks to this tool, the plant met its target for product yield while maintaining product quality.

Results

The financial impact of these improvements at this plant is estimated at several million yen. In addition, while using the PDA tool to analyze process data, members of the Manufacturing & Development Section began to actively share information and engage in an exchange of opinions with each other. After coming to appreciate the benefits of this, they made it a regular practice thereafter. This made for a more lively workplace and contributed to ongoing efforts at the Wakayama Works to make improvements through the use of process data analysis.



Customer Satisfaction

Interview attendee: Mr. Sekiguchi of Shinkawa Electric and Mr. Shogo Kataoka of Yokogawa

Takeshi Fujioka

Q. How did you use the process data analytics solution?
Fujioka: About two years ago, when we were using another Yokogawa service, Yokogawa's people proposed that we try data analysis. Just two to three hours after giving them process data, they were able to show us the results of an analysis performed using the MT method. I felt it was great because it hit the mark. The decision to introduce this solution was made by our production managers. I was selected to work on this project and was engaged in all its activities.

Q. Did you have any difficulties?
Fujioka: This was my first experience with the PDA tool and it was little bit difficult to use at first. Mr. Kataoka created an MS-Excel macro for importing process trend data into PDA, and this has been very useful. Now we use PDA every day. I use it whenever I sense that something unusual is happening in the process or when there is a need to stabilize product quality.

Q. How did the analysis project go?
Fujioka: I enjoyed working on it. We had tried to do process data analysis before, but the methods for doing this have changed since then. Now we do analysis from a variety of viewpoints. I think that my colleagues in this section now view process data differently, from different perspectives. By sharing information on this each day, I think that we have been able to expand our horizons. The project was a good experience, exposing me to many different things, and I learned a lot.

Q. What results did you get from the analysis?
Fujioka: The data backed my perceptions that something was not right. Most importantly, based on the analysis, we are able to streamline our work processes. When product quality is satisfactory, we are able to avoid unnecessary tasks and devote our time to production activities. We also have more time to improve our own capabilities. There is a market for everything that we produce, so I think that we are contributing to our company's profits. I am very glad to have had the opportunity to participate in this analysis project.

Sekiguchi: When it was decided to introduce the process data analysis solution, a production manager told me that "We are spending money for this, but we don't need immediate results. I would like to give all our staff the opportunity to improve their skills." Did you know that?

Fujioka: No, I never heard that. I am very grateful. We were able to achieve results and contribute to our company, and I feel a sense of accomplishment. I would like to keep working to solve problems at this plant while continually improving my skills.

Susumu Yamasaki

Q. How was your experience with the analysis project?
Yamasaki: The analysis had a wider scope that our previous analysis activities, and it, for example, uncovered in an unexpected location a factor that was related to the problem. I learned that there is almost always something to be gained by looking into things. I learned that it is important to look into things that don't even seem relevant, and to check them off one at a time based on results.

Q. How did things change as the result of the analysis?
Yamasaki: As I was analyzing the data in the project, I realized that I had always only been looking at the data from my own perspective. Working with the other team members, I learned that everyone has their own unique take on the data. It was very interesting to me. So Fujioka-san and I usually fail to see eye to eye (laughs), but we objectively discuss our hypotheses with each other from a variety of angles. By learning how others see things, we are able to benefit from each other's knowledge and know-how. In the past, each of us analyzed things on our own, and a limited number of people received our reports. Now we take it as a given that we should share everything with each other on the team.

Q. What were the benefits of the analysis project?
Yamasaki: It was great to be able to work together as a team toward a common goal. I think Fujioka-san showed good leadership. Today, if someone is using PDA, I go up to that person and say, 'What are you up to? Let me know the results later," and they usually do that. A culture in which we all listen to each other's opinions has taken root. Some people are better than the others at analysis, and some people are good at boring down into the data while others look at it from a broader perspective. I think both approaches are good. By sharing our own views with each other, we can broaden our points of view and everyone can improve their skills. By looking at all parts of a process, even those parts that don't seem relevant, everyone can gain in understanding. Having said that, I don't have much time available for using PDA, and will add that it's a little bit hard to import process data into it.

Kataoka: It can take a long time to import process data from a spreadsheet file. The solution is to use a database, so how about if you install your Exaquantum plant information management system here? (laughter)

Q. Are similar improvement activities being conducted in other departments?
Yamasaki: Honshu Chemical promotes small group activities, calling them step-up activities. At an annual information sharing session, I got the feeling when I was listening to another section's briefing on their process data analysis that we were one step ahead with this. I think without what we learned from Yokogawa, we'd be at about the same level right now.

Kataoka: I think the analysis team in the Manufacturing & Development Section has a fairly high level of analysis. I think it's at about the same level that our analysis team at Yokogawa was at a little while ago. However, we are also working hard every day and will continue to improve our skills so that we aren't overtaken by our customers!

Yamasaki: The production manager who introduced the analysis solution wanted us to take on new challenges, and I am grateful for that. I hope that Fujioka-san, the analysis project leader, will continue to play a central role. I now consider myself a veteran in this, and would like to share what I have learned with my younger colleagues.

Tatsunori Moriyama, Manager, Manufacturing & Development Section, Manufacturing Department

Q. What was your first impression of the analysis?
Moriyama: We chose this product for the analysis because the problem had proven very difficult to solve, and great benefits could be expected if it could be solved. To be honest, we had no great expectations when we started the analysis project, because our past efforts had not gone very well. However, as we got started on this work with Yokogawa, I began to see that success could be possible. I saw that we could learn from Yokogawa's methods for handling and organizing data, discussing matters, working toward solutions, and so on, and became convinced that the project would go well.

Q. Did anything change with the project?
Moriyama: Our section has always been busy because we produce a lot of products and have to switch recipes frequently, so we've never had much time for sharing knowledge with each other. But through their work on this project, people became more willing to share knowledge and express their opinions to each other. In the past, we only reported to the group leader and the person who was responsible for receiving reports, but now people are inclined to share that information with all concerned parties. Today when I ask people about a particular problem, they likely would have already been collecting data on it using MS-Excel, without being asked. It has become an established practice here to think carefully through things and analyze them from different angles, and this has only added to people's individual strengths.

Q. What's your management style?
Moriyama: I aim for a workplace where people have no qualms about expressing their opinions. Given the fact that plant safety is our top priority, some people might say that it is better to be very stern and strict, but I would like everyone to be able to work harmoniously and share knowledge with each other, as we did in this project. And I want to provide our people more opportunities to experience success, as we did in this project. Thanks to the results that have been achieved, we are now in a good situation where we can produce whatever amount our customers require, and sell it as is. From here on we will take on new challenges with our other products.

Q. What's next?
Moriyama: This is a busy department and we often have to attend to problems with equipment, so even if this approach to analysis takes hold we will have to find time for it between everything else. I would like to make use of this experience to improve the abilities of each and all members of this section and develop people who can analyze more efficiently and powerfully.

Kataoka: If you have any problems, please let me know.

Message to Customer

Shogo Kataoka, an analytical engineer of YOKOGAWA:

"With a culture of respecting each other and having fun at work, the Manufacturing & Development Section is a strong team that can take pride in what has been accomplished. What the team cultivated with us was mainly analysis capability, but that is just one way to solve problems in the manufacturing field. I hope that the team will learn from each other and overcome many difficult challenges that will occur in the future. I am looking forward to working with the team again."

Naoyuki Matsushita, an analytical engineer of YOKOGAWA:

"I was very impressed with how the Manufacturing & Development Section worked to make improvements, particularly in how they switched from an individual to a team orientation while working on the project. The reason for this change was that data analysis requires a unique approach. The choice of the analysis method, the question of which analysis results to focus on, and other items all depend on the analyst's experience. Therefore, they may have come to appreciate the effectiveness of multifaceted analysis by a team. I hope that they will continue to work together as a team toward a higher goal."

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Plant Information

- Location: Andrézieux, France
- Completion: 2015

SNF s.a.s.

Polymer Producer Mobilizes Field Device Management to Optimize Productivity and Increase Maintenance Efficiency

Executive Summary

Digital communication standards are playing an increasingly important role in the industrial world. Today's intelligent field devices utilize a variety of digital protocols, hence the need for versatile configuration and management tools that effectively support initial setup, daily maintenance, and troubleshooting for the maximum utilization of smart instrumentation.

The following case study describes how an advanced mobile field device management tool, employing current FDT2® Technology, helps a major global polymer producer streamline device commissioning and maintenance tasks, and at the same time, increase productivity and savings in maintenance and service work. With the implementation of a modernized FDT solution, the company is now able to achieve greater efficiency in overall maintenance activities for production and skid environments.

Expertise in Oil Recovery

Founded in 1978, and headquartered in Andrézieux, France, SNF s.a.s. produces water-soluble polymers for applications in drinking water, wastewater treatment, oil and gas, and agriculture, as well as the mining, paper, textile and cosmetics industries. It is the largest polyacrylamide manufacturer in the world, accounting for 43 percent of the global production, serving customers in 130 different countries.

In recent years, SNF has achieved major sales growth in the area of chemical enhanced oil recovery (CEOR). Chemical injection is used to increase the amount of crude oil extracted from oil fields. Rather than try to force oil out of the ground using primary or secondary oil recovery, CEOR (also known as tertiary oil recovery) can increase a well's extraction recovery potential to 40-60 percent.

Figure 1: SNF has developed turnkey polymer injection skids, which can be set up directly in oil fields

SNF's products are applied in a tertiary recovery method called polymer flooding, which is the most widely used CEOR method. Significant application knowledge is required to make sure the right polymer is injected depending on temperature, water composition, and permeability. Furthermore, in-situ mixing and dosing requires expertise in order to prevent polymer degradation and viscosity loss.

To address the aforementioned production challenges, SNF has developed turnkey skids and trailer-based field installations, which can be set up directly in oil fields. These installations ensure the correct preparation, mixing and dosing of polymers as part of the CEOR process (Fig. 1).

Importance of Intelligent Operations

Preventing unplanned shutdowns, reducing downtime, and lowering maintenance costs have been shown to provide significant financial benefits. One way to achieve these results is to make certain that all installed assets are used to the best of their ability.

In order for plant operations to run smoothly, solutions that streamline processes and workflows must be in place. Additionally, accurate representation of installed equipment assets must be available. Plant owners and operators are seeking tools to support effective and efficient maintenance and operations management.

Like other industrial organizations, SNF recognizes the importance of implementing intelligent field devices, collecting performance-driven data, and optimizing operations throughout the lifecycle of the processes. Intelligent instrumentation makes it possible to securely get the right information into the hands of expert problem-solvers wherever they are located.

As digital and multi-functional field devices are increasingly used in the process industries, organizations have access to large amounts of information available from such devices. The complexity of digital communication protocols and enhanced diagnostics capabilities creates the need for tools providing ease of configuration and analysis of data information.

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Upgrading to Modern Technology

SNF is an expert on polymers and their applications, but for efficient production the company relies on its long-term partner Yokogawa. At the Andrézieux production site, Yokogawa CENTUM CS 3000 and CENTUM VP production control systems are used to control the manufacturing of polymers utilized in tertiary recovery operations.

As part of the facility's mixed network topology, a wide variety of digital process instruments are installed, including pressure, level and temperature transmitters; Coriolis and electromagnetic flowmeters; and pH and conductivity analyzers from various field device vendors.

Some production lines at the Andrézieux site use field instruments with Yokogawa's proprietary Brain communication protocol, as well as a specific type of hand-held terminal for device configuration, commissioning and troubleshooting. Other, more recently implemented installations employ the HART communication protocol with a different type of hand-held terminal. Under this scenario, engineers could not backup, manage or compare data as part of their device management procedures.

When searching for state-of-the-art technology to replace the existing handheld units, SNF turned to Yokogawa to provide its FieldMate solution for deployment on both plant-side processes and remote polymer injection skids. FieldMate was implemented in tablet form to integrate existing and modern digital networks and devices, and to enhance and streamline maintenance workflow procedures for device configuration, commissioning and troubleshooting. The tablet solution is an ideal replacement for costly handheld terminals, providing the same mobility for plant maintenance staff with extended functionality, clear graphical displays, trend panel, parameter database, maintenance information records, and more. Site technicians use multiple tablets, and each tablet has the latest up-to-date database. When work has been executed, the databases are synchronized with the master database on the server.

FieldMate automatically scans the bus and reports the devices found, including the status of the device(s) and basic device parameters, and opens the correct DTM. From there, the user can intuitively navigate to device details such as: diagnostics, configuration parameters, maintenance information, etc. The tool's Parameter Manager capability enables easy configuration of devices, upload of device parameters to the database, and comparison of device parameter sets (actual versus historic) (Fig. 2).

Thanks to powerful field device management capabilities, the SNF engineering and maintenance team can now manage the complete lifecycle of assets and configure devices via a standardized graphical interface, with information accessed from their tablet. It can also perform offline configuration, and when devices are connected during commissioning, parameter sets can be loaded to individual devices – saving an enormous amount of time.

SNF E&I Engineer Pierrick Boissel commented: "The new device tool allows us to access all instrument data for further use, such as off-line checking of instrument parameters and downloading of all data into the instrument after replacement. Through our LAN, we synchronize all tablets so up-to-date data are available to every user. Having this instrumentation database makes our commissioning and maintenance job easier."

Antoine Giri, SNF E&I Technician added, "Before having FieldMate, we were using separate standard HART and Brain hand-held terminals. Now we have a single interface for all intelligent devices, which saves time for troubleshooting purposes. Moreover, standard hand-held terminals only have a simple LCD screen with three parameters displayed, whereas FieldMate offers a more intuitive and simple configuration methodology for reading and recording data."

Figure 2: Field maintenance staff at the Andrézieux site can now manage the complete lifecycle of assets and configure devices via a standardized graphical interface, with information accessed from their tablet

Figure 3: FieldMate is a state-of-the-art, FDT2-enabled device management tool that supports intelligent instrumentation tasks such as performing loop checks

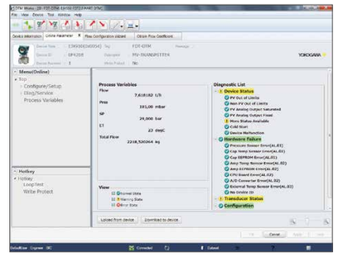


Figure 4: DTMs are used during commissioning and maintenance for visualization of device diagnostics

Value of the FDT/DTM Solution

For industrial organizations, FDT Technology provides a common environment for utilizing intelligent devices' most sophisticated features, as well as a single interface to integrate any device asset and network with access to performance-driven data – sensor to enterprise.

Within the FDT ecosystem, device manufacturers provide Device Type Manager™ (DTM™) software for their products, and Frame Applications (embedded in systems or standalone device management tools), communicate and read those DTMs – regardless of protocol for each device. This enables complete lifecycle access for configuration, operation and maintenance through a standardized user interface, no matter the supplier, device type/function, or communication protocol.

FDT creates a common communication method between devices and control or monitoring systems that are used to configure, operate, maintain, and diagnose intelligent assets. The FDT solution is not a communication protocol, but rather a standardized asset integration and data delivery technology. It is recognized as an international (IEC 62453), North America (ISA 103), and China (GB/T 29618) standard.

For applications like those at SNF, DTMs are used during commissioning and for conducting loop checks (Fig. 3). They are also employed for visualization of device diagnostics when troubleshooting is to be performed (Fig. 4). Information is made available in a comprehensive form to maintenance engineers. A standard audit trail feature allows for detailed tracking of any changes to a device, including who did what, when and why. It is a robust solution enabling plant personnel to see smart field devices clearly, know their condition in advance, and act with agility throughout maintenance workflows.

FDT has proven to be effective for the new generation for intelligent operations, enabling improved configuration, calibration and diagnostic capabilities. The technology helps deliver valuable device and process information allowing for many cost-saving and operational improvements. Lower maintenance cost, improved reliability and increased safety are just a few important advantages.

Easier Skid Commissioning

For SNF polymer injection skids delivered to major oil companies around the world, the FieldMate device tool is loaded on a tablet and used to assist with initial configuration and commissioning. All device configuration data is saved for future reference once commissioning is completed, and the device tool's audit trail function is useful in identifying human error in case of future problems.

Because the device management solution leverages the open, protocol-independent FDT standard, it is ideal for skid environments supporting either HART or FOUNDATION Fieldbus – the communication protocols used depending on the complexity of the polymer injection preparation process. Skids designed for simple processes (i.e., preparing the polymer for injection) are delivered with the device management tool to support a dozen or so devices, whereas skids intended for more complex applications are supplied with a processing unit, Centum VP Production Control System and Yokogawa's PRM integrated Plant Asset Management solution instead of the device tool for management of hundreds of devices.

Application Results

In increasingly sophisticated plants and factories, the presence of multiple digital communication protocols, coupled with the need for expanded asset diagnostics capabilities, is driving the adoption of tools providing ease of configuration and analysis of data related to field device management.

As digital devices become more diverse and offer greater functionality, automation suppliers are developing and offering FDT/DTM-based solutions featuring simplified and quantitative features. Manufacturers like SNF will continue to benefit from digital technologies and user-oriented tools for managing their intelligent devices. FDT is ahead of its time in terms of providing secure and reliable interoperability and integration of automation systems, network and devices.

"FieldMate saves us a lot of time," Boissel concluded. "It enables us to achieve real productivity advantages and savings in our maintenance work."

SNF now has a versatile device configuration and commissioning capability, enabling the company to achieve a higher level of efficiency across its maintenance regimen.

Plant Information

- Location: Gulf Road, Singapore
- Order date: July 2005
- Completion: January 2006

Tokuyama Electronic Chemicals Pte. Ltd.

TOKUYAMA Improves Productivity by Migrating from Micro-XL to CENTUM CS 3000

Background of This Project

Tokuyama Electronic Chemicals Pte. Ltd. (TOKUYAMA) is located on the Jurong Industrial Estate in west Singapore. TOKUYAMA manufactures specialty chemicals for the electronics industry. Their Singapore plant had relied on Yokogawa's medium-scale MicroXL process control system for more than 10 years without experiencing a single failure. Due to the discontinuance of MicroXL support and the desire to improve operations with the latest technology, TOKUYAMA decided to undertake a system migration and modify its plant processes. The installation of the CENTUM CS 3000 system was successfully handled by Yokogawa Engineering Asia.

The Challenges and the Solutions

- **The search for Production Excellence**

To improve quality and efficiency, TOKUYAMA was looking to improve the effectiveness of its operation control and monitoring functions. Another consideration was the desire to improve global competitiveness by cutting costs. With its powerful functions, improved operability, and simplified engineering procedures, the CENTUM CS 3000 process control system offered clear advantages to its predecessor.
To ensure high product quality, an existing Yokogawa gaschromatograph was integrated with a CENTUM CS 3000 field control station (FCS). This made it possible for operators of the CENTUM system to monitor data from the gaschromatograph in real time on a graphic display, allowing them to determine whether the product was of sufficient quality to proceed to the next step in the production process.

- **Good customer support**

Engineers from TOKUYAMA and Yokogawa Engineering Asia worked together very closely to complete all the engineering work for this legacy system migration in just six months. The factory acceptance test (FAT) was completed within one week and the plant needed to be shut down for only one day. The plant was started up on schedule in early 2006 and the system has operated trouble-free since then. TOKUYAMA appreciates the high reliability of this Yokogawa system and the fact that Yokogawa Engineering Asia is situated nearby and can offer immediate support should any problem occur.

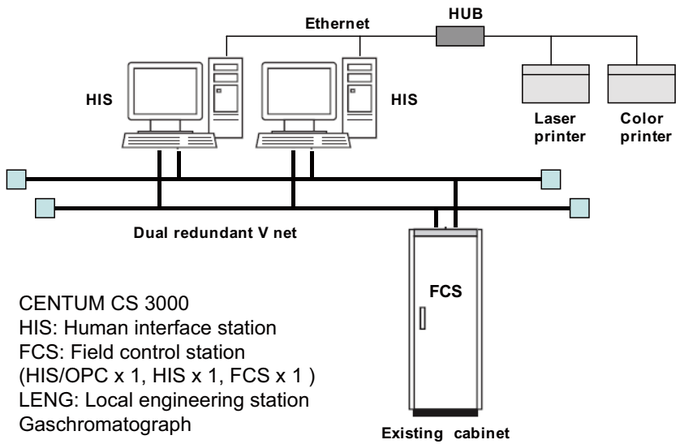
Customer Satisfaction

The following quotes are from the DCS-HCO-Lessons Learned Meeting of September 26, 2008:
Mohamed Kasim Bin Daud, Manufacturing Manager:
"We are always looking for Operational Excellence. After installing the CENTUM CS 3000, we have not had a single failure of the control system. So we are now operating the plant efficiently and the productivity is very high. We appreciate Yokogawa's reliable system."

Shunkitchi Omae, Managing Director:
"We are looking to make further improvements to our operations to achieve sustainable manufacturing. So we need further advice and will work together with Yokogawa Engineering Asia."


Central control room

System Configuration



Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Plant Information

- Location: Ludwigshafen am Rhein, Germany
- Completion: November 2021

BASF SE

Improved Efficiency and More Reliable Operations through the Use of Machine Learning Technology to Conduct Alarm Behavior and Alarm Action Analysis

Executive Summary

BASF SE is a multinational company and one of the largest chemical producers. From its headquarters in Ludwigshafen, Germany, BASF oversees operations at subsidiaries and joint ventures in more than 80 countries and operates 6 integrated production sites and 390 other production sites in Europe, Asia, Australia, the Americas, and Africa. The company supplies products to customers in a wide variety of industries, in more than 190 countries, and its product portfolio is organized into six segments: chemicals, materials, industrial solutions, surface technologies, nutrition & care, and agricultural solutions.

The target facility selected for this project was a water treatment plant at the BASF Verbund site in Ludwigshafen. The solution that Yokogawa provided combines Alarm Behavior Analysis (ABA) and Procedure Analysis for SOP Optimization (e-SOP) technologies that provide insights into alarms and operator actions. They exceed the capabilities of conventional methods like alarm monitoring, and support improvements that are the first step toward the achievement of an autonomous plant.

The Challenges

BASF has been seeking not only to increase efficiency by ensuring the plants are operated in the best operating range, but also to have methodologies for a transfer of know-how to compensate the retirement of skilled plant personnel.

One of the customer's major expectations for this project was a correlation between the occurrence of an alarm and alarms that follow it (consequent alarms). Especially for new less experienced operators the analysis of consequent alarms allows a fast and deep understanding of the alarms and the process and helps the operator to perform the correct operator action.

BASF became interested in this solution by hearing about a case study that used this technology to improve plant efficiency.
To address BASF's challenges at the Ludwigshafen plant, Yokogawa took a different approach in which two solutions, ABA and e-SOP, were combined to improve manual operations in alarm behavior analysis. In the future, these two solutions that use machine learning technology to analyze DCS event logs could help BASF to realize a higher automation level and next step towards autonomous plants.

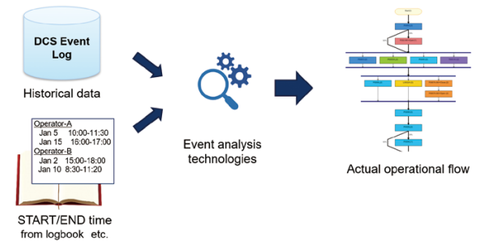
ABA overview

The Solutions

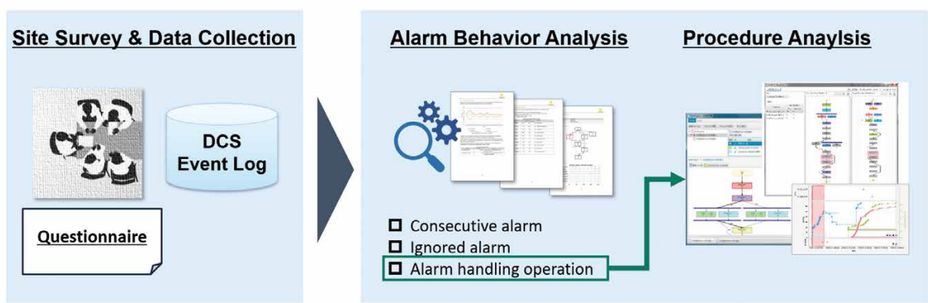
Through the course of this project, Yokogawa collected alarm and event log data from the DCS (Delta V).

As a first step, after retrieving the DCS log data from the customer site, Yokogawa employed ABA to analyze the cause-and-effect relationship between alarms and operations (consecutive alarms, ignored alarms, alarm handling operations).

One of the characteristics of ABA is that it provides not only quantitative but also qualitative results that help to understand alarm behavior. It looks not only at how often two specific alarms occur, but also whether they are interrelated.
After the ABA analysis, Yokogawa made use of the e-SOP technology to analyze in detail all the actions (alarm handling operations) taken by operators after alarms were generated. The e-SOP solution could help to visualize DCS manual operations and identify the difference between SOP and actual operations taken by operators, also the difference in operation between different operators.



e-SOP (Procedure analysis) overview



Project overview

Customer Satisfaction

BASF was very satisfied with the results of the analysis.
The main results were as follows:

- Alarm behaviors and alarm handling operations were clearly visualized.
- The causal relationship between alarms and operations was identified and understood (something that was not possible using existing alarm monitoring tools).

This plant had been in operation for many years with experienced operators and had undergone operational improvements, and still the analysis produced further discoveries regarding options for standard operating procedures. To identify which operation is the best, we need to have another workshop with the customer. However, this finding is necessary to standardize a procedure. This insights for BASF would have been more complicated and time consuming to get with conventional methods.

Based on the findings, the alarm analysis could be improved and accelerated.

With this positive experience in mind, ABA / e-SOP has proven to be an effective tool.

Statements by staff at the BASF water treatment plant:

"An alarm monitoring tool is already available at BASF; however, the use of a cause & effect chart has been especially effective in improving this tool, allowing us to see the relationships between alarms and operator actions, which usually can be identified by an experienced colleague."

"It has benefited me to see how alarms are connected to each other. As I only started working at BASF last year, this information has been an asset in my discussions with my more senior colleagues."

"It has been very interesting to see the differences in the actions that individual operators take. This has been useful in helping us to improve the alarm setting and behavior which leads to a less stressed operator."

"I've been working at this plant for 30 years, but I've learned new things and gained some helpful insights from this analysis."

"One has to keep in mind that the cause-and-effect relation of the alarms are calculated by the timestamp of the occurring alarm. That timestamp depends on the priority-controlled processing of the controller in the DCS."

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Plant Information

- Location: Rayong, Thailand
- Order date: 2007
- Completion: 2009

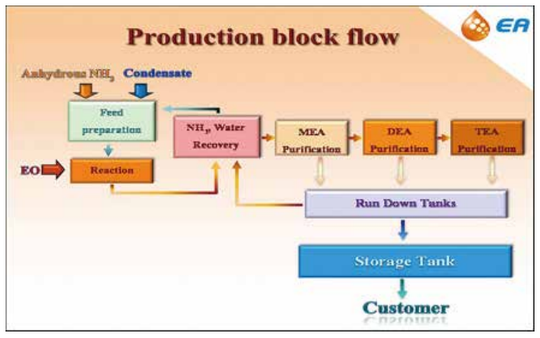
Thai Ethanolamines Co., Ltd.

Integration of CENTUM CS 3000 with ProSafe-RS Improves Plant Safety and Reliability

Executive Summary

Thai Ethanolamines Co., Ltd. (EA), a subsidiary of PTT Chemical Ltd., is the first company in Thailand to produce ethanolamine, an essential ingredient in many personal hygiene products. Made from ethylene oxide (EO) and ammonia, this chemical is also widely used in applications ranging from paint, pharmaceuticals, and cosmetics to cement, detergent, and fabric softener. The company has recently completed construction of a new ethanolamine plant at the Rayong Mapthaput Industrial Complex in Thailand's Rayong Province.

For this new plant, Yokogawa Thailand successfully installed the CENTUM CS 3000 process control system (PCS), the ProSafe-RS safety instrumented system (SIS), and the Plant Resource Manager (PRM) package.



The Challenges and the Solutions

EA wants both high performance and safe operations at its new ethanolamine plant. It gets this with a fully integrated Yokogawa plant control and safety system based on the CENTUM CS 3000 PCS and ProSafe-RS SIS. This is a highly reliable system in which the PCS field control stations achieve seven 9s availability, ensuring stable and reliable control of operations for EA.

To ensure safe operations at this plant, engineers from EA and the owner, licensor, and EPC conducted a careful loop-by-loop hazard and operability (HAZOP) study and defined the SIL level. The EA plant has a number of important safety valves that need to be periodically checked to make sure they will operate correctly in an emergency. Thanks to a unique PRM function that can schedule safety valve partial stroke tests and record their results, EA's operators and engineers no longer have to put on a hard hat and go to the valve location to conduct these tests. They instead can stay in the central control room and keep an eye on the overall status of plant operations. EA is happy to have this capability as it improves both safety and productivity.

The integration of the PCS and the SIS also means that their loops have the same faceplates and both use the same type of keyboard. This makes it much easier for operators to react quickly and correctly if an emergency occurs.

Central control room

The CENTUM CS 3000 has an OPC interface that supports the provision of all plant process data in real time to the EA facility's plant information management system (PIMS), enabling this data to be shared with all other companies in the PTT Chemical Group. The plant manager, production engineers, process engineers, maintenance engineers, and even the staff in these other companies' sales departments can continuously monitor the current plant situation from the comfort of their own offices. This of course is very convenient, improves productivity, and allows for more efficient analysis of overall plant efficiency and the performance of individual assets.

Customer Satisfaction

Amporn Ketcharung
Division Manager

Amporn Ketcharung, the Division Manager responsible for maintenance operations (asset engineering) at the EA plant, had the following to say about the Yokogawa solution: "Our production is currently 50,000 tons/year. We are very happy using the Yokogawa process control and safety instrumented systems. The systems are very reliable and we have had almost no major problems since 2009. We have also been looking to improve efficiency and productivity, so we started to study how advanced process control (APC) packages like Yokogawa's Exasmoc and Exarqe could help us achieve production excellence."
Commenting further, he said: "We installed Yokogawa's PRM package to manage more than 500 HART pressure transmitters, flow transmitters, temperature transmitters, level transmitters, and control valves. We just started using the package and are looking to take a more proactive approach in our maintenance activities. We may use data from these field devices to improve the performance of individual devices."

Plant Information

- Location: Ulsan, South Korea
- Order date: August 2006
- Completion: June 2008

Korea Kumho Petrochemical Co., Ltd.

Korean Resin and Rubber Producer Relies on Exaquantum to Ensure the Smooth Running of Its Plants

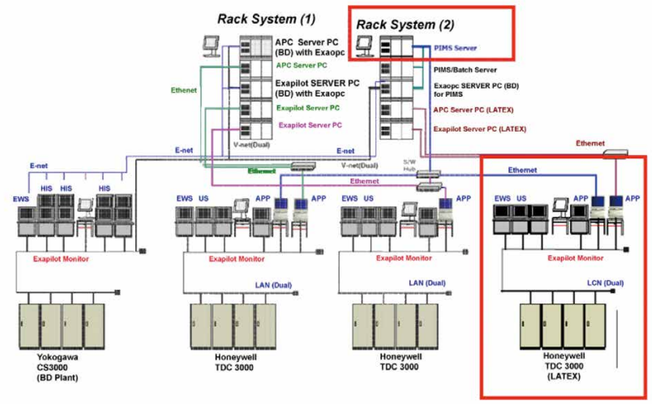
Executive Summary

Korea Kumho Petrochemical Co., Ltd. (KKPC) is a major producer of synthetic rubbers, resins and specialty chemicals, and electronic components for the semiconductor industry, and also constructs heat and power plants that supply steam and electricity. Founded in 1970, KKPC is a subsidiary of the Kumho Asiana Group, a large conglomerate that is engaged in a wide variety of business fields including land and sea transportation, construction, tire manufacturing, and financial services. KKPC has a number of plants in Ulsan and Yeosu, South Korea, and also has operations in China, Germany, Indonesia, and the US. Its products are found in everything from tires and shoes to office supplies and building materials.

In 2005, KKPC decided to implement a major upgrade at its sites to expand its speciality business chemicals (SBC) capability and improve the efficiency of its production operations. The decision to choose Yokogawa's Exaquantum solution over competing products stemmed from both the long and close relationship between KKPC and Yokogawa and the high functionality of Exaquantum.

At the company's Ulsan resin plant, six Exaquantum servers were connected to CENTUM CS 3000 and Honeywell TDC 3000 systems as well as PLCs from other suppliers. Exaquantum servers were also installed at the company's resin and rubber plants in Ulsan and Yeosu. At the company's SBC plant in Ulsan, Exaquantum/Batch along with a four-client system that provides KPI and historian data for up to 50 polymer batch products were introduced. In addition a limited number of Exaquantum clients were installed at the company's head office in Seoul.

Central control room



The Challenges and the Solutions

To capitalize on opportunities and remain competitive in the international marketplace, KKPC needed to expand its SBC capabilities and improve production efficiency at its plants by upgrading their automation systems.

With the Exaquantum solution, KKPC not only gained a fully-featured PIMS, it also benefited from tight integration with Yokogawa's CENTUM DCS, enabling a speedy roll-out and lowering engineering costs. Exaquantum's use of the industry-standard OPC interface also meant that it could be easily integrated with the Honeywell control systems at this company's plants.

Exaquantum helped improve efficiency at KKPC's plants by improving access to process data for all operators, engineers, and executives while maintaining DCS security and integrity.
Exaquantum also enhanced efficiency by making it possible to customize for each type of user the type of data that can be accessed and the way in which it is presented.

Efficiency is further promoted thanks to Exaquantum's role based name space (RBNS) functionality that permits users (with appropriate permissions) at the company's plants and at the head office to view information from multiple Exaquantum servers, at different locations. RBNS can be configured to provide personalized folder hierarchies and naming conventions for the viewing of Exaquantum process data, when the Exaquantum Data Selector is used within Exaquantum/Explorer, Exaquantum/Web, or the Exaquantum Excel add-in across all Exaquantum servers.

The Exaquantum/Batch system at the Ulsan site manages the many different types of polymer batch products that KKPC produces. The ability of KKPC to identify a specific production cycle as a "golden batch" and compare this with other batches of the same formulation enables Exaquantum/Batch users to identify and correct deviations from the expected process parameters during the production cycle, instead of having to wait until the batch is complete to analyze its success.

A further benefit of choosing Exaquantum/Batch is its close integration with CENTUM CS 3000 Batch. By using the OPC interface, Exaquantum/Batch could collect batch information within minutes of being installed.

Another key benefit of the Exaquantum system is its built-in drag and drop trending functionality. Users are thus able to quickly compare key process parameters using easily recognizable equipment names, rather than the obscure tag references that are frequently used.

Mimics are used in conjunction with all the Exaquantum servers. Their drill-down functionality enables users to quickly locate and resolve potential issues at the plant before they develop into more serious problems. The graphic conversion facility enabled existing DCS graphics to be automatically ported over to Exaquantum, for immediate use or for further modification.

Customer Satisfaction

"By using for Yokogawa's Exaquantum, Exapilot, and APC solutions in our plants, we were able to improve product quality and reduce operating costs. Easy access to valuable process data makes us more competitive."

Dong Joo Seo
Plant Manager

KKPC Ulsan rubber plant system configuration System Summary

- CENTUM CS 3000 DCS, CENTUM CS DCS, Honeywell TDC 3000 DCS
- 9 Yokogawa Exaquantum servers
- Exaquantum/Batch server with 50 active recipes / 3,000 tags, connected to 4 clients
- 18 Exaopc servers
- 8 Exapilot professional licenses
- 7 Exasmoc licenses

Plant Information

- Location: Rayong, Thailand
- Order date: 2007
- Completion: 2008

Cytec Industries (Thailand) Ltd.

Migration from Micro-XL and CENTUM CS 1000 to CENTUM CS 3000 Improves Reliability

Executive Summary

Cytec Industries (Thailand) Ltd. is a leading global supplier of advanced liquid and powder coating resins, pressure sensitive adhesives, and mining chemicals. The company's manufacturing facility is located in Rayong, Thailand, the world to ensure a reliable supply of high quality products. New manufacturing capabilities are being added to support growth opportunities, and experienced research and technical service teams are working with customers to develop tailor-made systems and deliver technologies that exceed their expectations. Cytec's product range is comprehensive.
The company offers an eco-friendly product family of waterborne and solvent-borne resins used in high-performance coating applications. This includes new and innovative low-VOC and HAP-free resin technologies as well as already well established binders, additives, cross linkers, catalysts, and solvents.

This portfolio of liquid resins and additives provides Cytec the capability to serve the needs of a wide range of coating markets, including decorative, automotive, packaging, industrial metal, plastic and wood, and mining refining as well as specialty applications such as tires, sanitation, and pools.

Cytec started using Yokogawa's Micro-XL DCS in 1996, and later added a CENTUM CS 1000 system. Both systems were linked by a BCVL0112 bus converter for the monitoring and control of all plant processes.
Although Cytec had been using Micro-XL for more than 10 years without experiencing a single major system failure, it decided to migrate to the CENTUM CS 3000 and the CS Batch package because of the end of support for the Micro-XL system, the difficulty of finding spare parts, and the desire to attain even higher levels of operational excellence.

Main reactor

The Challenges and the Solutions

Operational Excellence

Cytec is looking to increase production efficiency to meet the requirements of its end users on time and reduce production losses. Production involves more than 1,000 raw materials, nearly 200 recipes with many different parameters, and a variety of procedures and sequences for feeding, mixing, cooking, and filtering/discharging final product. Operations at this plant, which runs more than 330 days per year, are all carefully managed by the CENTUM CS 3000 DCS and the CS Batch package. While some products require manual adjustments during batch operations, operators always have all the information they need thanks to graphic and temperature trend displays and operator guidance messages. By allowing them to see clearly, know in advance, and act with agility, Yokogawa is delivering on its VigilantPlant promise of bringing operational excellence to its customers.

The CCR before

The CCR today

Safer Operations

One of the important issues at this ISO14000 compliant plant is the safety of its operations and the resulting impact that this can have on the environment. The CENTUM CS 3000 DCS and the CS Batch package provide accurate information on procedures that eliminate mistakes by allowing operators to confirm the actions that are to be taken during each step of a batch operation. And now that Cytec is following the industry's RC14000 environmental management specification, it is essential to keep data spanning the entire production lifecycle, from the purchase of raw materials onwards. With the CENTUM CS 3000 DCS and the CS Batch package, data on individual batch operations can be stored and retrieved, allowing the detailed time-based tracking of production data that is essential to maintaining safe and environmentally friendly plant operations.

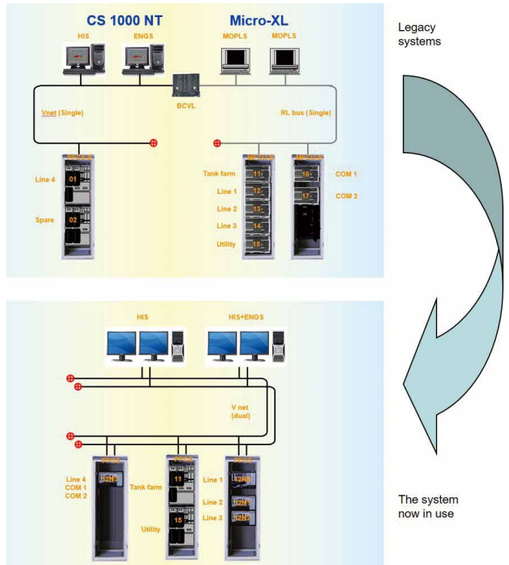
Migration from Legacy Systems to CENTUM CS 3000

The Micro-XL and CENTUM CS 1000 systems were highly reliable even in a single configuration. Now, with dual redundancy in all key system elements such as the communication bus, power supply, and CPU, the CENTUM CS 3000 takes reliability and operational excellence to an entirely different level.

Customer Satisfaction

Boonsong Panjing, Engineering Manager, said, "We are very confident in our ability to manufacture many different kinds of high quality coating materials. Yokogawa's CENTUM CS 3000 DCS and CS Batch package play core roles in our sustainable manufacturing practices. Explaining further, he said, "We always try to satisfy our customers requirements by delivering products on time and on specification. This requires us to keep everything very neatly arranged in our warehouse, as you can see here." (See photo below.)

The customer's requirements, manufacturing schedule, and shipping schedule are all well managed at Cytec. This is consistent with the 5S concept of seiri, seiton, seisou, seiketsu, shitsuke (tidiness, orderliness, cleanliness, standardization, discipline).
"Our plant runs around 330 days a year. Based on production data and many other kinds of data obtained during normal operation, process engineers carefully study and analyze the condition of each process unit to prepare an annual maintenance plan. We have a maintenance contract with Yokogawa Thailand for the control system, and the DCS is always kept in good condition. The DCS is the brain for our entire production facility."



Product storage

Plant Information

- Location: Morris, IL, USA
- Order date: 2003
- Completion: 2004

Reichhold

High Reliability Assured through Upgrade to Yokogawa's CENTUM CS 3000 Production Control System and CS Batch Package

Executive Summary

With 19 manufacturing sites and four technology centers in 13 countries, Reichhold is one of the world's largest suppliers of unsaturated polyester resins for composites and a leading supplier of coating resins for a wide variety of markets and applications. Reichhold is committed to being the preferred and responsible supplier of both conventional and specialty products to an increasingly diverse group of global customers. To serve these customers, Reichhold has expanded into rapidly growing markets such as India and China.

Reichhold is dedicated to providing its customers innovative and high quality value-added products and services. Under such well known brand names as POLYLITE®, HYDREX®, DION®, and NORPOL®, the company offers a complete line of resin products, gelcoats, and bonding pastes for a wide variety of composites end use applications. Four state-of-the-art technology centers support the development of new materials for both advanced and conventional composite applications. The company is committed to developing new resin systems based on renewable, recyclable, and environmentally friendly materials, and it markets these under the ENVIROLITE® brand.

Central control room

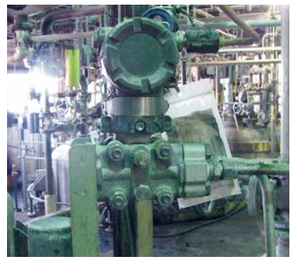
Reichhold began using Yokogawa's Micro-XL distributed control systems at its emulsion and polyester plants in 1993 and experienced no major problems while they were in operation. When the end of support was declared for Micro-XL and its batch recipe package, Reichhold chose to upgrade to Yokogawa's CENTUM CS 3000 production control system and CS Batch package. The installation was a success and both remain in use today.

The Challenges and the Solutions

Production excellence with CS Batch

More than 200 main recipes and 50 blending recipes are used in eight reactors and blending tanks at the Morris plant, and reaction times vary from eight to 28 hours. In addition to preventing contamination, it is important to maintain efficient production operations by optimizing the utilization of resource cycle times and minimizing downtime. Yokogawa's CS Batch package supports the complex batch operations at this plant. The CS Batch package includes flexible and scalable batch management software for centralized recipe / process management and distributed unit supervision. CS Batch is used to automate a wide range of Reichhold's batch processes and multi-product / multipath processes, thereby demonstrating ease of use, outstanding reliability, and sophisticated functionality. Using the CS Batch package, Reichhold has reduced lifecycle engineering costs, shortened time to market, improved plant performance, and kept unexpected control failures to a minimum.

A large amount of operational data that is vital for making business decisions on productivity, quality, and safety was transferred from the CENTUM CS 3000 to an existing PI data historian system via an OPC interface. Reichhold analyzes this data to identify improvements that can be made to operations.



Fieldbus pressure transmitter

Fieldbus temperature transmitter

Remote terminal

Asset management: FOUNDATION™ Fieldbus devices, AS-i system, and PRM

Reichhold is always striving to apply new technologies that minimize maintenance costs and make maintenance more proactive. Nearly 300 FOUNDATION™ Fieldbus-enabled devices are utilized in the Morris plant. Data such as temperature, pressure, and flow rate from individual transmitters can be monitored at the same time and easily assigned to different instrument blocks, with minimal engineering. In addition to reducing wiring costs, this makes it possible for process engineers to analyze a process in real time.

An Actuator Sensor Interface (AS-i) system is used in this plant to connect more than 700 valves, achieving a major reduction in wiring costs. AS-i offers many of the benefits of more complex and costly bus systems, but at a substantially lower cost, and with greater simplicity.

All FOUNDATION™ Fieldbus devices can be monitored from the engineering room using the Plant Resource Manager (PRM) asset management software package. Using this package, process engineers can immediately find out the status of every field device without having to do an onsite inspection. An engineer is able to identify what went wrong, pinpoint the failure location, and identify suspect parameters from the comfort of an office desk. A plant maintenance technician can then schedule a check of the problem devices. In this way, PRM introduces an entirely new approach to field device maintenance.

HIS anywhere

CENTUM's virtual terminal server (VTS) is a very useful function provided by Yokogawa. With it, engineers and operators can view the current status of an operation from any location. When a key Morris engineer was in India to support the start-up of a Reichhold plant, he used this function to monitor the operation at the US Morris plant in real time, and was able to troubleshoot problems using a voice link with the operators there.

Integration of CENTUM CS 3000 with all subsystems

Subsystems such as the raw material weighing system, safety shutdown system, and product shipping system at the plant locations including the truck loading station and drumming area are all integrated with the CENTUM CS 3000 production control system, allowing operators to clearly see at a glance on graphical displays what is happening throughout the plant and take immediate corrective action when necessary. All process data and production related data is transferred to the PI system. The information collected by the PI data historian is utilized to improve quality, safety, and production efficiency.

Truck loading area

Customer Satisfaction

Roja Challa, Process Control System Support Adviser, stated, "We are very happy using the Yokogawa system and products. We are manufacturing various kinds of resin products with different formulas and are doing this on time and on specification." He went on to say, "Reichhold has now standardized all of its process control systems in the US with Yokogawa's CENTUM system because of its high reliability. Yokogawa hardware is very reliable. The availability of more than 99.99% is really amazing."

Roja Challa, Process Control System Support Adviser

Plant Information

- Location: Niigata, Japan
- Completion: October 2010

Asahi Carbon Company Ltd.

Installation of Exaquantum PIMS Package Improves Efficiency of Process Data Management

Executive Summary

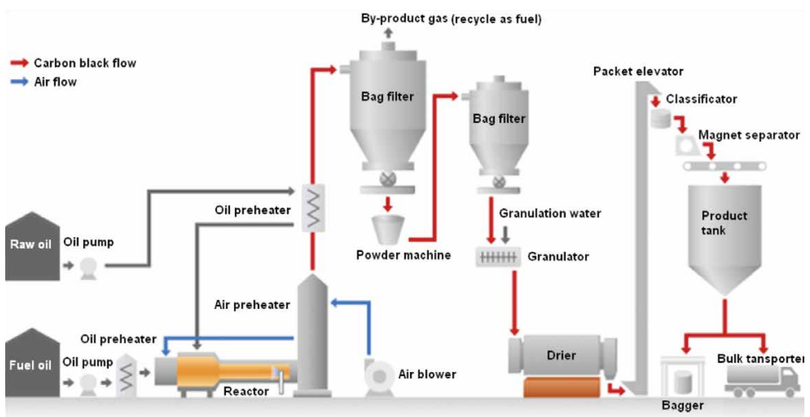
Asahi Carbon Company Ltd. (ACA) is a major carbon black producer. Founded in Niigata, Japan in 1951, ACA is strong in the R&D of unique new technologies as well as in manufacturing, sales, and market promotion. The company has plants in Japan and other countries, and sells its products worldwide.

Carbon black is a carbon substance and is used as a pigment and reinforcing agent in rubber and resin products. This protects these materials from erosion and ultraviolet rays, and gives them strength and elasticity. Carbon black is mainly utilized in rubber products such as tires, for which its specifications vary depending on the application (airplane, passenger car, racing car, etc.). Other applications include rubber hoses and vibration proof materials as well as batteries, inks, and other items that require particular conductivity or coloring characteristics.

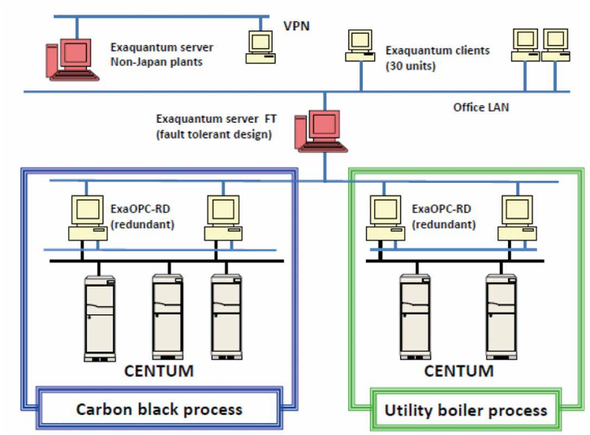
ACA has long been a user of Yokogawa's CENTUM distributed control system (DCS), starting with CENTUM XL and migrating to CENTUM CS 3000. At the request of ACA, Yokogawa successfully installed its Exaquantum plant information management system (PIMS) package on the top of this DCS.

The Challenges and the Solutions

To analyze the performance of its production equipment and identify countermeasures for any problems that occur, ACA wished to install a data historian that was capable of collecting process data over long periods of time. An additional need was the ability for the sales department to monitor production data over the company's computer network. Specifically, these requirements were:



Process overview



System configuration

- Storage of production information (parameters, data) acquired over long periods, and the easy viewing and confirmation of this historical data
- Monitoring of operation status and analysis of production data not only from the DCS, but also from PCs on the company network
- Seamless integration of the DCS with other systems

To meet these requirements, ACA decided to install an Exaquantum PIMS package on the top of the existing DCS. One package was installed for the carbon black process in August 2005 and another was installed at the utility boiler plant in October 2010. Redundant OPC servers and a fault tolerant Exaquantum server were also installed to prevent plant shutdowns.

Improve quality and yield through proactive maintenance of plant assets

By using the Exaquantum historian to review and analyze process data collected over long periods of time, ACA is able to track the heat exchange efficiency between gas and air and predict when an asset might fail. It can carry out proactive maintenance, improving both product quality and yield.

Remote monitoring

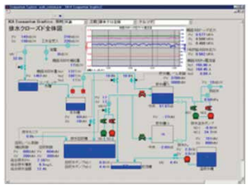
With Exaquantum clients in its sales office, ACA is able to monitor all the data from its production operations around the world. The information displayed on the clients is updated frequently, and can be customized to display various kinds of trend data. This ensures that engineers at the Japan headquarters can stay constantly apprised of the status of production operations and provide online technical support wherever it is required.

Shared information access for quick problem solving

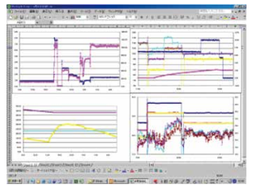
Using Exaquantum, production supervisory personnel and operators can have shared access to the latest production data from the DCS at all times. This ensures that the right person can have all the information necessary to make the right decision. Past and current production data can be easily compared, allowing problems to be solved quickly.

Automated daily reports

Data from Exaquantum and ACA's main computer system can be easily combined for daily reporting purposes. Automation of this function reduces the workload 90%. When Exaquantum is used together with Excel and VBA, the extraction and analysis of process data is greatly facilitated.



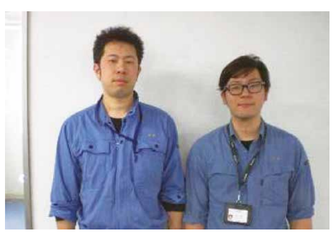
Exaquantum monitoring display



Customized trend display

Customer Satisfaction

"Exaquantum allows us to accumulate production data and use this for reporting and analysis. We have continual access to all necessary data. This allows us here at ACA to analyze what went wrong when a problem occurs. We can also share process and production data with any other department at any time. Exaquantum also saves us a lot of time by generating reports, making our work more efficient. Exaquantum is a very important package at our plant. Everyone at ACA really appreciates the reliability of Yokogawa's systems and packages."



Mr. Matsuda and Mr.Tamaki of the IT Management Section

Plant Information

- Location: Rayong, Thailand
- Order date: 2008
- Completion: 2010

UBE Chemicals (Asia) Public Company Limited

Yokogawa's CENTUM VP and PRM Improve Efficiency at New Nylon Plant in Thailand

Executive Summary

Established on February 1, 2010 through a merger of Thai Caprolactam Public Company Limited (TCL) and Ube Nylon (Thailand) Limited (UNT), UBE Chemicals (Asia) Public Company Limited (UCHA) is the only producer and distributor of caprolactam and ammonium sulfate in Southeast Asia and the first specialist manufacturer in Thailand with the ability to produce nylon-6 resin, from monomer to compound.

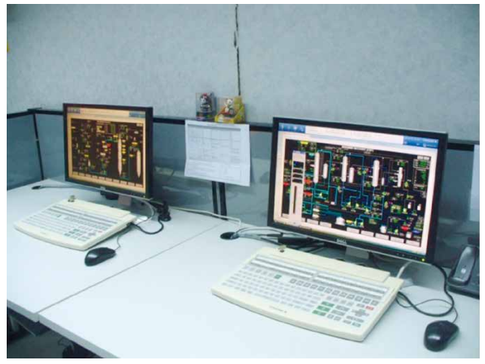
The company's production technology is licensed from UBE Industries Ltd., a world leading producer of caprolactam and nylon-6 that has 50 years' experience in this field. The current annual production figures for UCHA's nylon-2 plant in Rayong, Thailand are as follows:

Caprolactam (a raw material used in nylon-6 production): 110,000 tons
Ammonium sulfate: 440,000 tons
Nylon-6 (monofilament grade, film grade, injection grade): 74,500 tons
Nylon compounds: 6,000 tons

Nylon is a widely used material in the automobile industry because it is heat resistant. In addition to engine parts, it can be found in oil containers, wire harness connectors, fuse boxes, cylinder head covers, crankcases, timing belts, and wheels as well as motorcycle body frames. Nylon is also utilized in tire cords to increase their strength, and there is a growing trend to use nylon compounds in such components as intake manifolds and automotive modules.

UCHA is focused on becoming more competitive while maintaining high quality and safety. The company has ISO 9001, ISO 14001, and OHSAS 18001 certification and strictly follows quality and process improvement practices such as total productive manufacturing (TPM), Kaizen, and 5S.

At the Rayong nylon-2 plant, Yokogawa Thailand successfully installed the CENTUM VP production control system, and the plant is now operating very smoothly.



Central control room

The Challenges and the Solutions

Excellence in production

Always looking for new technology that can improve production efficiency, UCHA opted for CENTUM VP, Yokogawa's latest process control system, at its new nylon-2 plant. All auxiliary control systems running on packaged PLCs were integrated with CENTUM VP through a Modbus interface, allowing the display of all process data at operator terminals. A rich variety of data is displayed on the CENTUM VP human machine interface, but it can be easily accessed by the UCHA operators and engineers thanks to a very ergonomic design. The Exaquantum plant information management package runs under CENTUM VP, allowing the assignment of more than 2,000 types of process data. UCHA now uses Exaquantum for reports, plant performance calculation, and operation data analysis. A fiber optic link to a nearby UBE fine chemical plant allows all important production data to be monitored in a plant information system and to be accessed at UBE's Japan headquarters. Together, Yokogawa's reliable CENTUM VP control system and the Exaquantum data collection and analysis package are contributing to production excellence at UCHA.

Asset management: FOUNDATION™ Fieldbus + PRM

UCHA's operation and maintenance teams conducted a study at the beginning of the engineering phase at the nylon-2 plant to classify and rank each field device according to quality and safety criteria. In so doing, they established a standard maintenance interval for each device. At the plant startup stage, PRM was used together with FieldMate to thoroughly check all loops and confirm the characteristics of each control valve. This was much more efficient than the former labor-intensive manual loop checks. Today the plant is operating normally. Field operators check all the field devices every shift and the maintenance department is using PRM to check the condition of all the field devices on a monthly basis. Based on the classification/ranking and the results of using PRM, UCHA is now considering additional proactive maintenance measures to reduce maintenance costs.

Customer Satisfaction

Mr. Chavanavatch

Vasit Chavanavatch, Control & Application Engineering Manager, said, "The nylon-2 plant just started commercial operation in 2010. At this time, Yokogawa's DCS is operating well. This DCS is quite a new system for the UBE plants in Thailand, but CENTUM VP's human machine interface is very easy to use and the density of valuable data in each display helps us improve our operational efficiency. Our first phase target was to start up this new plant smoothly, and we completed that without any severe problems. We are now looking to make further use of the connection between our FOUNDATION™ Fieldbus devices and the PRM package, using data from the devices not only for proactive maintenance but also process analysis."

Plant Information

- Location: Ulsan, South Korea
- Order date: May 2010
- Completion: February 2011

Hanwha Chemical Corporation

Highly Reliable CENTUM CS 3000 Replaces Legacy System and Automates Batch Plant Operations

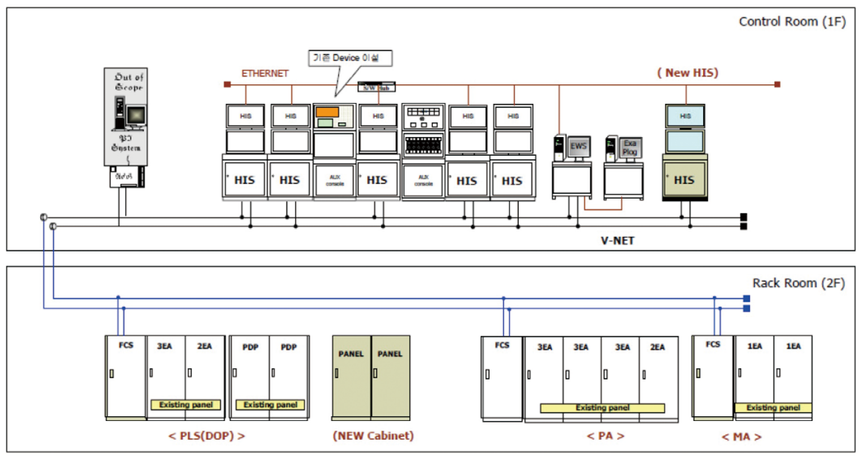
Executive Summary

Hanwha Chemical Corporation, a major Korean petrochemical company, produces polyvinyl chloride (PVC), vinyl chloride monomer (VCM), low-density polyethylene (LDPE), and other products. In 2009, the company acquired three plants from OCI Co., Ltd. that produce phthalic anhydride (PA), plasticizer (PLS), and maleic anhydride (MA) for both the domestic and international markets. Hanwha is continually striving to introduce new technologies that will help attain operational excellence and improve product quality.

The high cost of replacement parts and software modifications for a legacy control system together with the desire to improve availability motivated Hanwha Chemical to replace the system at one of the acquired plants with a Yokogawa CENTUM CS 3000 distributed control system (DCS).

The existing system included one engineering workstation (EWS), three controllers for PA, MA, and PLS, and five graphical user stations (GUS) within the same control network. There were approximately 2,000 I/O.

The new control system configuration is shown below.



CENTUM CS 3000 in central control room

The Challenges and the Solutions

Hardware replacement and software conversion

Replacement of hardware and conversion of software were complicated processes requiring careful coordination and teamwork by the Yokogawa Korea and Hanwha Chemical personnel assigned to this migration project. While all field wiring could be kept as is, the terminal boards, I/O cards, and controllers all had to be replaced. On the software side, all existing software needed to be converted over to the CENTUM CS 3000. An engineering tool was first used to convert the system database, then the graphic displays, control drawings, and sequence logic were all converted. Working together as one team, Hanwha Chemical and Yokogawa Korea project personnel completed all configuration work for the new CENTUM CS 3000 system in just four months. All functions were subsequently confirmed with a factory acceptance test (FAT) at Yokogawa Korea's Seoul facility. This replacement and conversion dramatically improved system availability to 99.99999% and automated 90% of the plant's operations, which previously had been all manual.

Plant downtime

To prevent any disruption in product deliveries, it was essential for Hanwha Chemical to minimize the amount of time this plant would have to be kept shutdown for the hardware installation and system cutover work. Working together, Hanwha Chemical and Yokogawa Korea project personnel completed this work on time and on schedule, in just 12 days. And to ensure a smooth transition to the new system, all plant operators and engineers received two weeks of comprehensive hands-on training on a demo machine at the Yokogawa Korea Training Center. As they already had 12 years' experience working with older Yokogawa systems at the company's other plants, they all soon were comfortable with using the new CENTUM CS 3000 DCS.

Efficiency of the batch process

With the legacy system, operators often had to make manual adjustments and batch times varied considerably depending on how experienced an individual operator was. This drove up labor costs, in addition to having an impact on productivity and product consistency. Thanks to the new CENTUM system's improved graphic displays, operators have a much better grasp of what is happening throughout the plant and errors have been almost completely eliminated. As a result, automated batch operations are much more efficient and labor costs have been brought down by over 30%.

Engineering work station (EWS)

Engineering efficiency

From an EWS in the central control room, engineers can easily make and confirm modifications to the system configuration. Modifications can be uploaded to the system without having to shut down the controller.

Utility costs

The Ulsan plant uses a lot of water, steam, and electricity. Thanks to the improvements that were achieved with the new control system, this plant has reduced its utility costs by approximately 5% over the past three years.

Customer Satisfaction

According to J.K. Choi, senior manager & head of the plasticizer production team at the Ulsan plant, "Our operators were worried about the new DCS because they had been using the legacy system for 12 years. But the Yokogawa system has proven to be user-friendly and it has operational benefits. Thanks to the Yokogawa system, our operators have become more skillful in our batch process." He went on to say, "We are very happy with Yokogawa's DCS and service support. Of all the DCS vendors in Korea, Yokogawa's service is the best."

Achievement Summary

- Improved automation of batch process
- Reduced maintenance costs
- Stabilized process
- Increased capacity
- Improved customer service (faster response times)
- Reduced labor costs
- Improved product quality

Plant Information

- Location: Marl, Germany
- Order date: 2006
- Completion: 2007

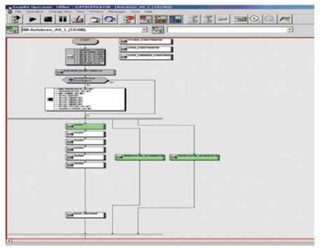
Evonik Stockhausen GmbH

Increasing Productivity by Means of Partially Automated Start-up and Load Change Procedures

Executive Summary

Evonik Stockhausen GmbH's acrylic acid plant in Marl has been operational since 1991 and currently consists of three production lines with a total capacity of approximately 200,000 tons per year. Acrylic acid is primarily used as a raw material for superabsorbent polymers, which are used to produce disposable diapers, among other things. The plant had already been fitted with a Yokogawa control system in 1999. In 2005, this ever-expanding plant was also fitted with Advanced Alarm Administrator, an intelligent alarm management system from Yokogawa.

Plant start-up, load changes, and other operational changes are complex, challenging processes that require experienced operators. Given the substantial commercial importance of this plant, initiatives to standardize operational procedures and automate its processes make complete sense. Exapilot is Yokogawa's solution to this challenge. This story describes how Evonik implemented the Exapilot solution at this large-scale acrylic acid plant and presents key outcomes and experiences.



Operation procedures in flowchart

ActiveX notification window

Implementation and Configuration

Evonik purchased the Exapilot package and connected it to the CENTUM DCS via an OPC interface. (Exapilot can be connected to any Control System via OPC.) A core feature of the software package is a symbol-oriented command language. This makes it possible to assemble clear and easy to understand flowcharts of operational procedures for complex operations in order to automate a process. To optimally configure such processes using Exapilot, data on the plant configuration and the process as well as input from experienced operators is required. During start-up, for example, logical information and parameter lists are loaded and processed step by step. The status of the procedure is indicated with a color code. At the same time, an ActiveX notification window provides the operator important information on the process and actions to be taken.

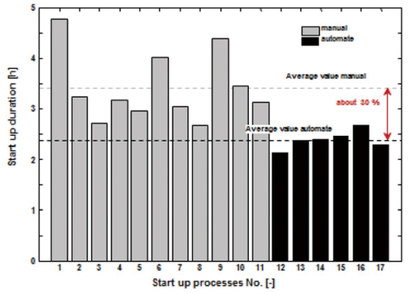
Evonik engineers devoted approximately two man-months to studying the process dynamics and developing a highly efficient configuration. Different from a classical approach of writing a full specification first and then implement the function in an automation system, the engineering process was an iterative process in which all stakeholders had been involved. While configuring the system, additional improvements were made within the normal process and control loops as well. With the completion of this process, up to 90% of all manual tasks can now be carried out automatically.
Projects of this sort can typically be broken down into two main stages:

- Determining and analyzing the current status, selecting best practices, and developing the procedure
- Implementing, testing, and configuring the procedure as well as training the operators

From Initial Testing to Rollout

During the second half of the project, initial testing of Exapilot was carried out by using it to execute a cascade sequence start-up of a distillation column. The first results were promising. It quickly became possible to minimize temporal variations during start-up and reduce the average start-up time by 30%. The column therefore reached full-load operation more quickly and reliable. When starting the complete cascade sequence, up to 90% less off-spec product could be achieved. An additional advantage is that individual start-up processes overlap, which further accelerates the overall process.

Following this successful test Exapilot was implemented for the plant's first distillation column, and subsequently for all other columns. At the same time, the reactors where the oxidation reaction takes place were also included.
The start-up of the catalyst-filled pipe reactors is particularly challenging as roughly half a dozen parameters are monitored systematically and gradually need to be adjusted in order to obtain the optimal temperature profile. On top of that, some parameters are partly dependent upon each other, individual control circuits react at different speeds, and safety-related parameters such as explosion limits depend on load. Especially here, Exapilot's strengths come forward.

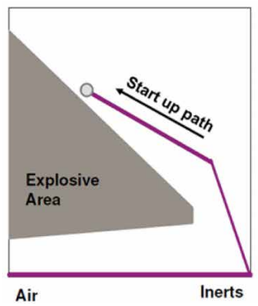


Startup duration manual vs. automated

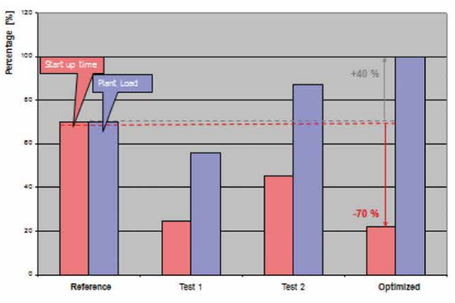
In total, the system tests approximately 600 important parameters and replaces more than 400 manual procedures during the start-up process. As the system requires numerous incremental changes to the parameters, Exapilot is more suited to carrying out the sensitive adjustments than manual interventions. At the same time, the system enables the user to use his/her experience to select the optimum route within the set parameters to provide additional commercial benefits. When controlled manually, an optimization task can be carried out on the basis of intuition. Exapilot, however, constantly observes all the key parameters such as the peak temperature and its geometric position in the reactor, the safety margin towards a potentially explosive atmosphere, and also the concentration of the reactants and the cooling capacity. Also here, already after the first test, Exapilot showed its value.
Average start-up times were reduced, in some cases by more than two thirds, as shown in the graph below. The fact that a manual start-up process can be very time-consuming highlights the relevance of this improvement. What is more, the process is considerably quieter, i.e. without large fluctuations in temperature.

Dealing with Complex Processes in a Efficient and Reliable Manner

Dr. Mosler production manager summarizes, "Exapilot is an efficient and sustainable solution and has fulfilled all of our expectations. We have seen a return on investment in less than a year." At the same time, he stresses that the system cannot be used as an "autopilot" and will not substitute an experienced, vigilant operator. But he explains, "It does however enable the operator to spend more time on 'intelligent' tasks, in addition to observing the constant or step-by-step changes to these parameters."
Exapilot is particularly useful in processes that are not part of standard operations and need to be partially automated in accordance with best practice. Even for less experienced operators, Exapilot achieves consistent performance.
In addition to reducing operator workload, Exapilot presents three key economic advantages – It saves time (increased plant availability), reduces the required quantity of raw materials, and, last but not least, reduces the amount of waste.



Criticality startup process



Startup time vs. plant load

Plant Information

- Location: Ulsan, South Korea
- Order date: January 2012
- Completion: October 2012

Samsung Fine Chemicals

Fine Chemical Plant Automates All Operations and Reduces Production Losses with Yokogawa's Exapilot

Executive Summary

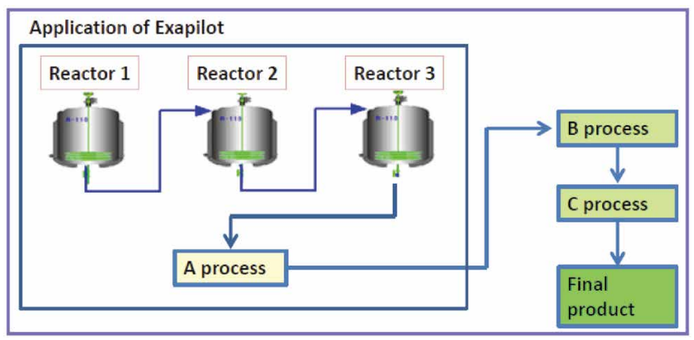
SAMSUNG Fine Chemicals (SFC) produces many kinds of fine chemicals that have been well received both in Korea and the global market. SFC's products include mecellose (methylcellulose), epichlorohydrin (ECH), dimethylformamide (DMF), methylamines, tetramethylammonium chloride (TMAC), barium titanate powder (BTP), and AnyCoat. SFC also produces a range of general chemical products such as ammonia, urea, melamine, methylene chloride, methyl chloride, formic acid, and caustic soda. One of SFC's primary next-generation strategic businesses is the production of electronic chemical materials (ECM) such as BTP.

SFC has four BTP plants in Ulsan that, altogether, produces 4,000 tons per year of this material. One of these plants, plant C, was built in 2010 and uses Yokogawa's CENTUM CS 3000 distributed control system to control all of its operations. In 2012, SFC introduced Yokogawa's Exapilot package solution to automate processes throughout this plant. As a result, SFC has been able to reduce operator workload, improve product quality, and reduce production losses.

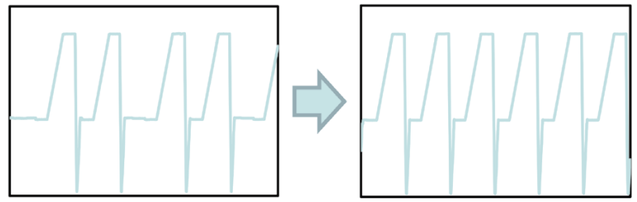
The Challenges and the Solutions

Improved productivity

The BTP production process employs three batch reactors that process materials in sequence. The overall process is a complex mix of batch and continuous operations that requires numerous manual interventions and the operation of many different valves. This was demanding work for the operators, each of whom had to specialize in carrying out different parts of the operation.

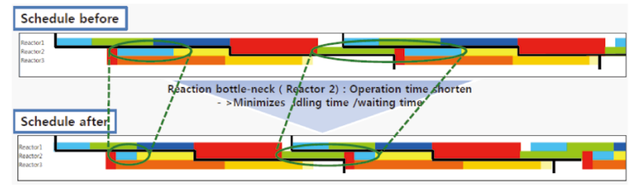


Overview of processes at plant C



Reactor 2: reaction time without Exapilot — Reactor 2: reaction time with Exapilot

Reactor 2: temperature without Exapilot — Reactor 2: temperature with Exapilot



Reactor 2 operation time shorten

Based on a careful review of all operational procedures and the operator roles in this production process, SFC's production technology engineering team created new standard operation procedures (SOP) based on its existing SOPs. They then configured these SOPs in Exapilot to automate them. As a result, reaction times have been drastically reduced and nearly all unstable conditions have been eliminated. Less hot water is now required to heat the reactors, batch operation waiting time has been eliminated, and operator workload has been reduced. Reactor temperature control plays a very important role in determining the quality of the final product. With Exapilot, the reactor temperature always stays within the control limits. In addition to improving product quality and yield, this uses less hot water.

Efficient scheduling

Each reactor processes several batches a day and requires the performance within a specified time period of procedures such as raw material feeding, agitation, heating, cool down, and discharge. To ensure the smooth operation of all these processes in the three reactors, it is very important to optimize their scheduling. With Exapilot, SFC was able to automate all of the SOPs for these complex processes. As a result, it has minimized idling and waiting time and eliminated production bottlenecks. The overall operation is much smoother now and operators are more productive, with a drastically reduced workload.

Customer Satisfaction

KyungChul Park, senior manager of the product technical team, said, "First of all, we carefully evaluated many software packages for the procedural automation and finally selected Yokogawa's Exapilot. We are very happy with Exapilot and have used it to fully automate all of the complicated procedures at this plant. Exapilot brings us many benefits such as increased productivity, shortened batch times, fewer operator errors, zero loss, a stable process, easy documentation of all procedures, improved operator training, reduced use of utilities, and consistently high product quality."

"We are striving to make further improvements by introducing a second Exapilot package and using this together with an advanced process control (APC) package and other software. In so doing, we hope to make our products more globally competitive. We will keep working with Yokogawa."

Central control room

Chemical
(Fine & Specialty Chemical, Biofuel)
& Pharmaceutical

Plant Information

- Location: Sydney, Australia
- Order date: December 2009
- Completion: September 2010

The University of Sydney

Yokogawa Provides STARDOM and FAST/TOOLS for Biomass Pilot Plant

Executive Summary

The University of Sydney's School of Chemical and Biomolecular Engineering is world renowned for cutting edge technology innovation. The university has obtained funding from the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS) Program to build an advanced hydrothermal biofuel research plant on its campus that converts non-food biomass resources to biofuel under hydrothermal conditions (i.e. in water at up to 300°C and up to 250 atmospheres). The first semi-automated, continuous-flow kilo-scale research facility of its kind in Australia, this pilot plant will research how non-food feed stock biomass such as woody plant matter can be used to produce biofuels and other chemicals more efficiently.

As this facility runs semi-continuously for days at a time at high temperatures and pressures, it was essential to have a control system and SCADA interface that would be able to safely control the process while allowing researchers to change trending, reporting, batch, and test conditions without having to stop the process. This allows researchers to modify tests as research progresses, while having on-demand access to reports. They are also able to access the SCADA operation and engineering screens remotely, via a Web browser, and can receive reports emailed by the system that update them on the status of a test. This last feature is quite convenient as it frees researchers to go on to other tasks while waiting for a test to complete.

The remote asset management capability drives down operating costs while optimizing the sharing and exchange of information. This is made possible by the incorporation of the latest Web technologies in the Java-based FAST/TOOLS engineering and maintenance environment.

About the University of Sydney's School of Chemical and Biomolecular Engineering

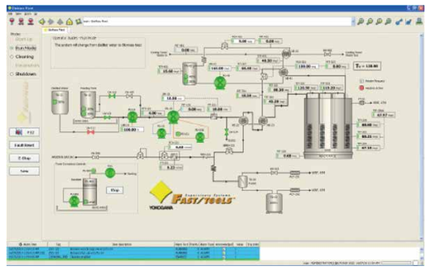
Established in 1946, the School of Chemical and Biomolecular Engineering at the University of Sydney was Australia's first university-level chemical engineering program. The school is very active in carrying out a wide variety of cutting edge research in the chemical and biomolecular engineering fields.

The Challenges and the Solutions

The first challenge for the university was the limited funds available to procure a control solution for this project. Pressures of up to 250 atmospheres at temperatures as high as 300 °C require quality equipment that is highly reliable. Yokogawa partnered with the university to provide the required instrumentation, control system, SCADA software, and control solution engineering for a state of the art, research friendly control solution that was within the available budget. Yokogawa also provided ongoing engineering support including several major control strategy modifications as the development work on the research plant progressed.

With this pilot plant, researchers can test many different substances under a wide variety of test conditions, then rerun the tests for verification purposes. This requires the ability to quickly and easily obtain and modify trends and reports in response to changing research requirements. Yokogawa's FAST/TOOLS SCADA software is ideal for this purpose, allowing the researchers to do this directly and online, thereby greatly facilitating their efforts to improve biofuel production and develop it into a commercially viable, sustainable energy source.

One of the benefits for the university is that FAST/TOOLS is an "all in one" SCADA solution that functions as a data historian, allows the local customization of trending functions, and has a reporting function.
All data is stored by FAST/TOOLS. Data can also be exported as a CSV file for basic analysis in Excel and long-term storage.
Reports are generated after each batch and the researchers can compare the results with their criteria for that particular test. As the individual batch tests are usually run by different researchers from a variety of companies, there is usually no need to compare results from different batches.



Main FAST/TOOLS screen in running mode

Pilot plant

Customer Satisfaction

Joint leader of the NCRIS project, Professor Brian Haynes of the School of Chemical and Biomolecular Engineering was looking for companies who could work with the research requirements of the university. Yokogawa's capability to partner with the university on the project showed that the company is dedicated to providing quality solutions and is able to engineer these solutions to meet changing research requirements.

The advanced control capabilities of the integrated Yokogawa solution provide an excellent research solution which can easily be customized as the research evolves. Yokogawa pressure, temperature, and Coriolis mass flow transmitters were utilized because of their reliability, ease of configuration, and accuracy.

From the left, Professor Thomas Maschmeyer of the School of Chemistry, Professor Haynes, Senior Process Research Engineer Sergio L. Londono of the School of Chemical and Biomolecular Engineering, and Mark Biggin and Jonathon Lee from Yokogawa

Plant Information

- Location: Sao Miguel dos Campos, Alagoas, Brazil
- Order date: October 2013
- Completion: February 2014

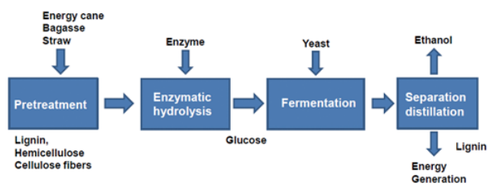
GranBio Investimentos SA

Second-generation Ethanol Plant in Brazil Automated with Yokogawa's CENTUM VP, Batch Package, and PRM Solutions

Executive Summary

GranBio Investimentos SA is a Brazilian industrial biotech company that was born out of the vision of bringing about a green revolution through the con-struction of second-generation ethanol plants that will produce cheap, clean-burning biofuel from readily available biomass. Following its establishment in June 2011 by Gran Investimentos S.A., a holding company in which the Gradin family are the primary investors, the company built Bioflex 1, the first commercial second-generation ethanol plant in the Southern Hemisphere. Bioflex 1 started operation in early 2014 and is able to produce 82 million liters of biofuel per annum, making it one of the largest such facilities in the world.

As the main automation contractor (MAC) for the Bioflex 1 project, Yokogawa South America was in-volved from the front end engineering design (FEED) stage, performing the basic design for a control system and field instrumentation solution that will reduce costs and improve production efficiency throughout the lifecycle of the plant. Yokogawa in-stalled the CENTUM VP integrated production control system; the csTUNER control loop tuning software; the CENTUM VP Batch package to control the plant's pretreatment, enzymatic hydrolysis, fermentation, and distillation/separation units; field instruments including FOUNDATION™ Fieldbus-enabled ADMAG AXF magnet-ic flowmeters, DPharp EJA series pressure/differential pressure transmitters, and control valves; and the Plant Resource Manager (PRM) asset man-agement package. Yokogawa South America was responsible for product delivery, engineering, and operator training.



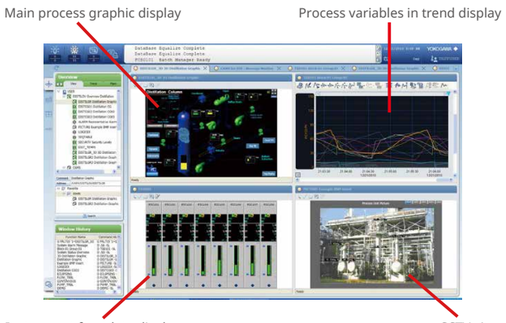
Overview of second-generation ethanol process

The Challenges and the Solutions

Improving productivity

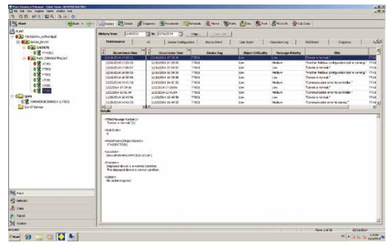
Second-generation ethanol and other chemical pro-ducts are produced from non-food agricultural ma-terials and industry waste. The cost of producing biofuel with this method compares favorably to fossil fuels such as oil and natural gas, and it produces fewer greenhouse gases. The GranBio plant produces ethanol from energy cane, bagasse, and straw, all of which are readily available in Alagoas State.

The raw materials used in this production process must first be pretreated to make the cellulose in the plant cell walls easier to break down with enzymes (hydrolysis) and solubilize hemicellulose sugars. The cellulose in the plant cell walls is in a matrix with other polymers, primarily hemicellulose and lignin, and the pretreatment of biomass with heat removes



"All in one" high density HMI display

FieldMate parameter setting



PRM device status and diagnostic data

these polymers from the cellulose core. During the cooking process, great care must be taken to keep the biomass at a steady temperature. The pretreated cellulose fragments are then broken down using enzyme preparations to obtain double glucose molecules, which are then split into single glucose residues. In a fermentation reactor, these residues are converted to ethanol using microbes.
Based on whichever raw materials are being processed, the pretreatment and fermentation settings have to be automatically selected and executed. All important parameters for these processes are preconfigured in the CENTUM VP Batch package. When an operator selects a recipe from the package menu, all of the preconfigured settings are au-tomatically selected and downloaded to the individual controllers so that each sequence can be auto-matically started. At a human machine interface (HMI) terminal, an operator can monitor the status of the reactions in ergonomically designed process graphic display, trend display, alarm summary display, and control display windows. When each batch operation is completed, the operation data are compiled for an automatically generated batch report (provided as a standard function). In these ways, the CENTUM VP Batch package improves productivity at GranBio.

Reduction of operator workload and safe operation

Many different field devices, including magnetic flowmeters, DPharp EJA series pressure/differential pressure transmitters, and control valves, are installed at this plant, and it has nearly 2,000 I/Os. Some of the devices are exposed to high temperature processes and other harsh conditions and/or are mounted in high, narrow, and other difficult to access locations.

With the PRM asset management package, the health of these devices can be monitored from the central control room (CCR), eliminating the need for difficult and time consuming physical inspections. The PRM device navigation window displays the status of plant-wide assets with a Windows Explorer-like interface, enabling maintenance engineers to quickly identify devices that require online diagnosis. This is an especially valuable time-saving tool during plant start-up, when engineers and operators must check many loops and control valves. The centralization of the management of these plant assets ensures that maintenance information gets immediately to the right persons, depending on the type and criticality of the diagnostic data analysis. This changes the main-tenance engineer workflow and enables a more proactive maintenance approach.

Other valuable tools provided by Yokogawa include FieldMate, which can be used from the CCR to set field device parameters, and csTUNER, which simplifies the task of tuning PID loops. With its ability to optimize tuning parameters and generate a tuning report, csTUNER is particularly useful during the plant start-up and commissioning phases, reducing the workload of both engineers and operators.

The use of these tools helps to ensure that GranBio's operators and engineers are able to comfortably operate and keep this plant safe 24/7.

Customer Satisfaction

Manoel Carnauba, a GranBio vice president, com-ments as follows:
"Brazil is a dominant player in the bioethanol market. The biofuel market is steadily growing, and second-generation biofuel is attracting attention as an environmentally friendly energy source. We appreciate Yokogawa's modern and highly reliable control system and field instruments, and value their engineering capabilities, and believe we made the right decision to rely on them as the MAC for the construction of this large-scale commercial second-generation ethanol plant. As we were able to complete the basic specifications at an early stage and maintain consistency with all the specifications, this reduced the total cost of the control system and the instrumentation. We completed our project on schedule and on budget."

Plant view

Shift operators in central control room

Plant Information

- Location: Vevey, Switzerland
- Order date: 2007
- Completion: September 2012

Merck Serono Biotech Center

Highly Advanced Biopharmaceutical Plant Uses CENTUM VP, VP Batch, Exaquantum and PRM

Executive summary

The Merck Serono Biotech Center (MSBC) in Corsier-sur-Vevey, Switzerland, is the center of Biotech Manufacturing & Process Development of Merck Serono. It produces biopharmaceuticals, which are composed of large molecular structures such as proteins that are created from live cells using recombinant DNA technology. Operational since 1999, the MSBC is one of the largest and most technologically advanced biotech centers in the world, producing biotech products for clinical trials and commercial phases, and is also engaged in the development of high-performance processes.

This site has particular expertise from small to large scale mammalian cell culture technologies, and uses many different technology platforms. The site currently produces the active ingredient for Merck Serono's multiple sclerosis treatment, Rebif® (interferon beta-1a) and for the targeted cancer therapy Erbitux® (cetuximab).

An expansion project to increase capacity at the site was recently completed in order to allow for world-scale production of monoclonal antibodies as Erbitux® and other biopharmaceuticals. The new facility is comprised of an upstream plant (USP), a downstream plant (DSP), a utility area for supplying clean media as water, air and steam for the production and moreover an on-site waste water treatment plant. For this new large-scale biotech (LSB) production facility, Yokogawa Deutschland GmbH of Ratingen, Germany installed the CENTUM VP production control system, VP Batch package, Exaquantum/Batch plant information management system, and PRM plant resource management package along with more than 2,000 FOUNDATION™ Fieldbus devices and nearly 6,500 PROFIBUS™ control valves. To assist in this undertaking, Yokogawa Deutschland enlisted the support of its Swiss branch office (established in 1999) and also entered into strategic partnerships with local engineering and service partners. Merck Serono later concluded a lifecycle maintenance agreement with this Swiss office.

Operator guided by electronic batch record (EBR) at USP

The Challenges and the Solutions

Total system integration for LSB production

Merck Serono's target was to have an "integrated e-plant from vial to bulk," necessitating the complete computerization of processes from ERP to automation system. Many different kinds of software packages are used in this highly advanced pharmaceutical facility, and various systems like PLCs with PROFIBUS interfaces are integrated with CENTUM VP, the plant's core automation system.

Recipes with numerous parameters are all managed using the VP Batch package, and clean in process sequences are configured in the system by means of the sequential function chart (SFC) function. Many different graphic displays allow operators to identify at a glance the current status of a particular phase of a batch process. Operators are thus able to see clearly, know in advance, and act with agility at any time and place in this facility.

Production data from every batch operation is collected by Exaquantum/Batch for the generation of automation batch reports required under 21 CFR Part 11 of the US Code of Federal Regulations. This allows operators to see clearly the result of each batch activity. This package exchanges important data with the manufacturing execution system (MES) relating to material management, dispensing, cell cultures, purification, and total quality management. The data is also used to analyze the quality of the products and to check the efficiency of every operation, which is essential for the achievement of operational excellence. The visualization of all production data also allows improvements in the usage of water, electricity, and other resources.

Computerized systems validation

Automation system vendors that supply products and/or engineering services to pharmaceutical companies that follow good manufacturing process (GMP) procedures are required to support computerized systems validation (CSV). Toward this end, Merck Serono audited Yokogawa Deutschland to assess its GMP compliance. Yokogawa Deutschland has implemented quality and training system that complied with revision 5 of the good automated manufacturing practice (GAMP5) procedures audited. Merck Serono audited the quality system and indicated complete satisfaction with the results that were achieved.

Asset management

The ongoing maintenance of the thousands of FOUNDATION™ Fieldbus devices and PROFIBUS control valves installed at this complex LSB production facility is key to ensuring accurate measurement and control. Yokogawa's PRM package was utilized at the plant start-up stage to check loops, parameters, and the different types of control valves (each with different characteristics), and to diagnose devices. This allows for a proactive maintenance approach and the scheduling of field device checks. Also, as all device data can be monitored online using PRM, the plant can be operated with a smaller field workforce.

Customer Satisfaction

Dr. Ande Overmeyer, Project Director Merck Serono, said, "Our plant employs very complicated batch process and flexible production is required at all times. This LSB project was a world-scale and world-class project, and we needed world-class suppliers. Many packages are used and many different systems are located all over the Vevey plant. So we are always looking for ways to automate processes as much as possible. The core process control system is Yokogawa's CENTUM VP, and all systems are required to integrate with it. This system is connected to the MES to send and receive data essential for material management, dispensing, cell cultures, purification, and quality management. We are very happy with CENTUM VP because of its high reliability and good support from Yokogawa. Yokogawa is one of our best partners for process automation and software engineering."

Mr. Nicolas Martin Clement, ePlant Manager Merck Serono, went on to say, "Our target for the Vevey facility is for it to be an 'integrated e-plant from vial to bulk.' We continue to strive to automate plant operations and make this a highly efficient operation that has less of an impact on the environment. In this 'integrated e-plant,' engineers and operators have ready access at any location to information on what is going on with the plant processes and can thus make quick and timely decisions."

Yokogawa engineering team proudly celebrates the project success before Christmas 2010

Plant Information

- Location: Geel, Belgium
- Order date: March 2006
- Completion: September 2006

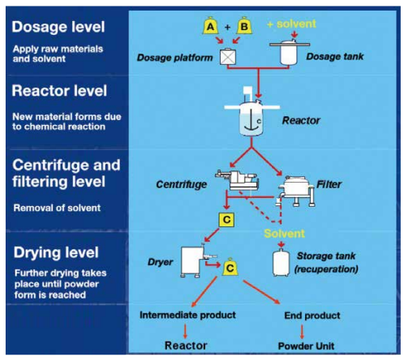
Janssen Pharmaceutica

Accurate Measuring of Solvents

Executive summary

The Geel plant of Janssen Pharmaceutica is a chemical synthesis plant which makes primary API's. This is done through use of an extensive number of solvents. In order to load the batch reac-tors with the right quantity of solvent, there was a need for highly precise mass flow meters. Even though this customer had no experience with RotaMASS, we succeeded in selling 18 pieces.

Janssen Pharmaceutica is part of Johnson & Johnson, the largest company in the world in the field of healthcare. The company has three facilities in Belgium. The facility in Geel is known for the production of active substances (called API or Active Pharmaceutical Ingredients) for the medicines that are manufactured in the facility in Beerse. The facility in Olen only provides quality research.



Four production plants

The facility in Geel has four production plants in which various reactions can be carried out: for this reason they are called multipurpose plants.
The process generally consists of the following components:

- Various raw materials, originating from tanks or storage are brought together with the necessary solvents and auxiliary substances.
- Large reactors of between 1000 and 6000 liters form the heart of the production process. Here chemical reactions take place between the different raw materials and a new substance is formed.
- By means of centrifuges or filters, the solvents that are required for the reaction are separated out of the remaining product. The majority of these solvents are recycled and stored in tanks.
- Finally, the product is dried to remove the last traces of solvent: resulting in a dry powder.

For the final products, the story hasn't finished yet. In order to be able to measure these powders correctly and add them to medicines in small quantities they have to have the right consistency and grain size. To that end, the facility in Geel has a separate department, the powder unit, where the active substances are ground and sifted.

A Yokogawa RotaMASS is used to precisely measure the recuperated solvents that are pumped from the tanks to the various reactors. RotaMASS is a mass flow meter based on the Coriolis effect.

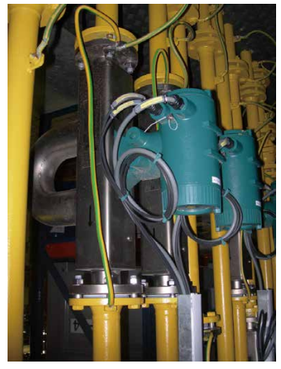
The reasons why a Coriolis mass flow meter was chosen speak for themselves:

- Working with weight measurements and/or differential pressure transmitters for extremely accurate measurements, from tanks of 10,000 up to 16,000l with a product density variation of between 0.7 kg/l and 1.5 kg/l, is very difficult.
- The customer recognized the following advantages: reliability, accuracy, guaranteed draining system, easily cleaned system, no moving parts, directly built into the pipelines, low pressure losses.

The advantages of Yokogawa on top of the arguments mentioned above were:

- Where other suppliers offered several types of equipment to meet the demand, the Yokogawa solution consisted of one type of equipment from the same product range.
- Bad experiences with 304 stainless steel housings (brown deposits) were an argument for looking at alternatives. Yokogawa was the only manufacturer who was prepared to take a flexible approach to the manufacturer of the measurement pipe housing in 316L stainless steel and who could also manufacture this model.
- Sufficient incidental quality-related arguments in favour of a compact equipment with a low weight, small dimensions and simple installation instructions even under mechanical stress conditions.
- Rapid transportation (24 hours) of basic components.
- The guarantee that measurement would not fail in the presence of gas bubbles. A simulation showed that up to 50 volume percent air in a two inch meter results in a measurement error, but the meters kept functioning. The measurement error can be reduced most by holding the last correctly measured value when larger quanti-ties of air pass through the meter. When the gas bubbles disappear, the actual correctly measured value is adopted again.

In the meantime, the meters have already been operating for several months to the great satisfaction of the users.



Yokogawa RotaMASS

Plant Information

- Location: Dossenheim, Germany
- Order Date: July 2008
- Completion: July 2009

Evonik Technochemie

Yokogawa Provides CENTUM VP with Batch Recipe Management Package for New API Plant

Executive Summary

Evonik Technochemie is a custom synthesis specialist in Dossenheim, Germany, where it operates a plant that produces pharmaceutical intermediates and active ingredients. In line with Evonik's focus on the pharmaceutical business, and due also to the reason that this plant was operating at capacity limits, the company decided in 2008 to build a second active ingredient plant in Dossenheim. Key technical requirements for the new facility included the need to comply with good automated manufacturing practices (GAMP V) and to have greater flexibility in active ingredient production, which is mainly sequentially controlled.

At the Dossenheim plant, active pharmaceutical ingredients (API) are produced in a three story building. The filling level step of this production process is done on the top floor, the reactor level step on the second floor, and the solid-liquid separation layer step on the first floor. The final product filling step is done in the basement. Both the filling and the final product filling steps are done under Class D clean room conditions.

To control production operations at this new facility, Evonik selected Yokogawa's CENTUM VP production control system and the CENTUM VP Batch recipe management package.

The Challenges and the Solutions

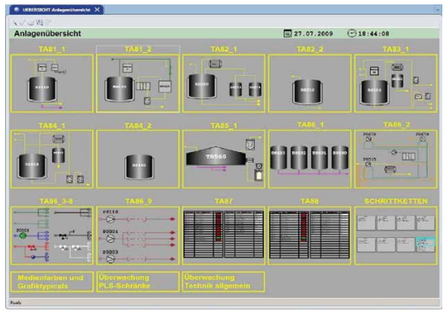
- **Good automation manufacturing practices (GAMP)**

GAMP V compliance is mandatory in the pharmaceutical industry. For any systems project, this requires the electronic record and electronic signature capabilities specified in the EU GxP Guide Annex 11. The system software that has been developed to automate all process functions is typically validated and qualified by engineers and operators using predefined test procedures. Yokogawa's CENTUM VP complies with these requirements.

- **Flexible and safe operations**

Although it has been used as a single-purpose facility, the Dossenheim plant was originally intended to be a multi-purpose facility and has space available for future expansion. The CENTUM VP production control system has all the capabilities for handling multi-purpose operations. To accommodate the very tight production schedules of these processes, the CENTUM VP Batch recipe management package gives operators the flexibility to control the recipes for all basic module functions such as filling, heating, and cooling. CENTUM VP's human machine interface (HMI) is also very easy to operate. The graphic display shown below gives an overview of each unit and sequence, and also shows the parameter settings, giving operators all the information they need at a glance to make timely and safe decisions. In addition, the system's batch report function is very useful for product tracking and quality control.

In the central control room



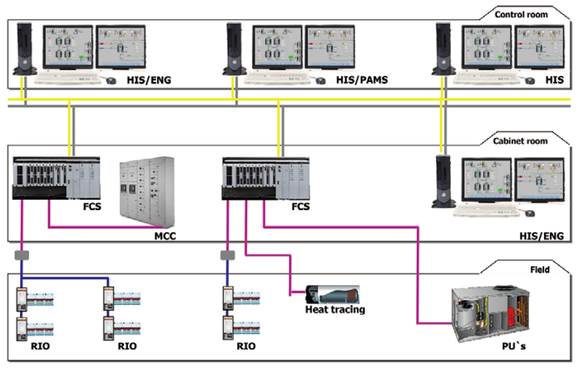
Plant overview graphic display

- **Field instrumentation**

All field devices for the plant's filter dryers, vacuum pumps, vacuum bagging, plant pumps, and evaporators are connected to field control stations (FCS) and monitored using Yokogawa's Plant Resource Manager (PRM). Although the bus system initially had numerous problems with wiring errors and data incompatibility, they were all successfully resolved using PRM. PRM monitors all of the field devices during normal operation and has functions that track how long the devices have been in use and identify in advance when preventive maintenance should be carried out. This allows a more proactive maintenance approach that helps to minimize plant operation costs.

Customer Satisfaction

Dr. Simone Reinhard, Evonik's Operations Director, commented that "The project was a success: not only the budget was kept, but also a very tight schedule was met. Surely there's little difference between planning and execution. Thanks to the dedicated effort and intense cooperation of everyone on the project team, the new plant was able to start production operations in July 2009." Dr. Reinhard went on to say " We made a precise landing for this pharmaceutical and active ingredient plant, in spite of this very ambitious schedule, and were on time in starting delivery to our customers in late 2009. We also very much appreciate Yokogawa's commitment to supporting the system throughout the plant lifecycle."



System Configuration by CENTUM VP

Dr. Simone Reinhard, Operations Director