PROCESS INSTRUMENTATION

Process Optimization and Energy Management in the Fertilizer Industry

Efficiency and profitability in plant operation

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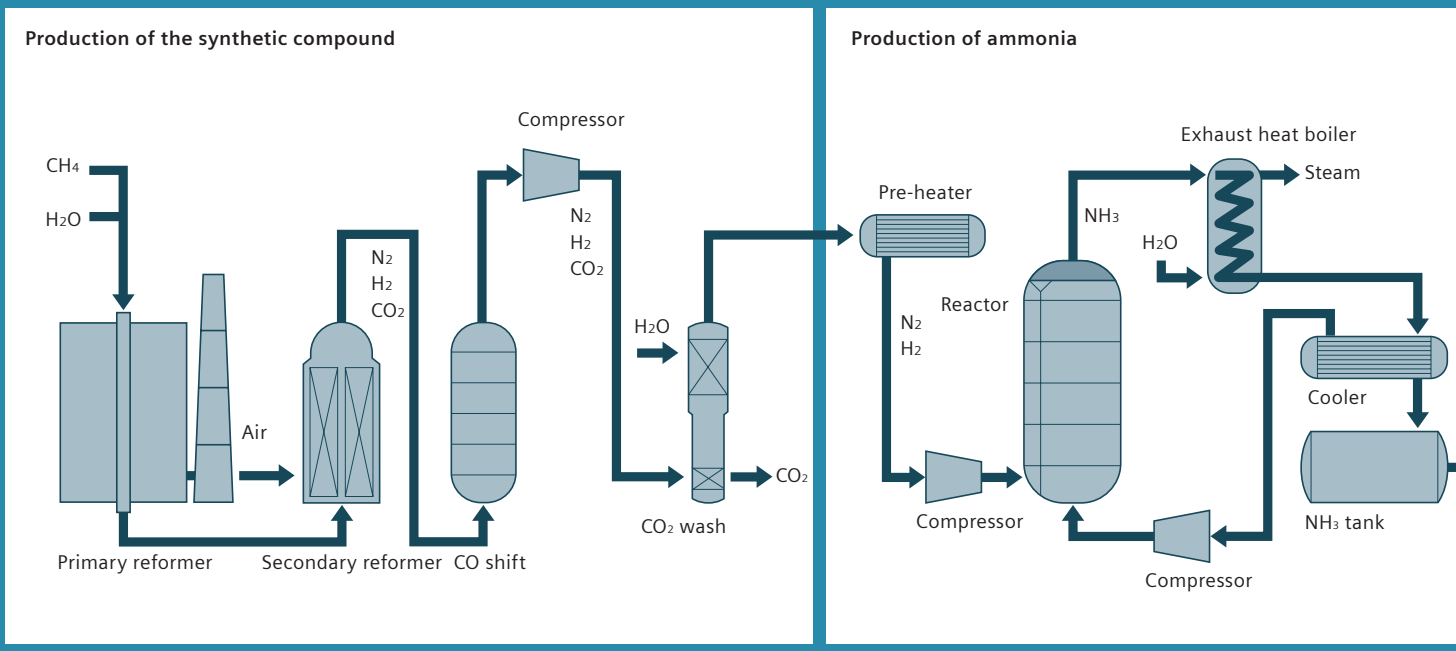
SIEMENS

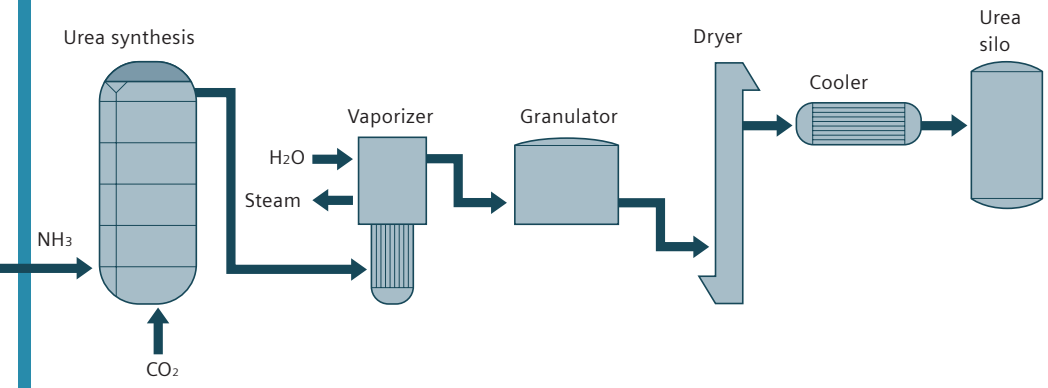


Secure supply – efficient plant operation

Though the demands on the global food supply have always been recognized, their recent has made the benefits of fertilizer more clear. As early as 2000 years ago, farmers applied growth promoting substances to their fields to increase yield. Industrial production of fertilizer began in the mid-19th century when the effectiveness of nitrogen, phosphate and potassium were recognized. The production of nitrogen compounds is based on ammonia, which has become one of the most widely manufactured chemicals in the world. Due to the population growth forecast and associated food shortfall, demand for ammonia is expected to increase further.

To enable fertilizer manufacturers to fully capitalize on the potential of their plants, we offer comprehensive solutions for process automation and energy management – solutions that enable companies throughout the world to become more efficient and profitable.

Production of urea



Automation solutions from Siemens allow optimal monitoring and control of the complex processes involved in the production of fertilizers.

Requirements for safety, efficiency and quality

All known processes for producing ammonia require large volumes of fossil fuels. Optimized plant operation and the resulting economic use of energy and water determines both levels of efficiency and CO_2 emissions. At each site, the highest safety standards must also be maintained in the complex processes involved in order to avoid injury to persons and damage to equipment and the environment. Quality requirements have also increased considerably in recent years, requiring manufacturers to comply with exacting standards if they want to succeed in international markets.

The solution: an integrated automation system

Fertilizer plants, such as those involved in phosphate production, face similar challenges. To master them, plant-wide automation of production and packaging is essential. This controls the complex processes that characterize fertilizer production. In conjunction with communication-capable switchgear, it ensures the transparency that is necessary for assuring safety, quality and efficiency.

Fully integrated with TIA and TIP

You need a partner with international experience and extensive expertise for project execution of the automation and electrical engineering solution of your fertilizer plant. We take on responsibility as the Main Automation Vendor (MAV) and/or Main Electrical Vendor (MEV). Our concept comprises all essential technology, from the design phase through engineering, in maintenance, best device selection, commissioning, and integration. This ensures optimized operation of your plant from day one. To you this means: maximum process safety and product quality, fewer costs with regard to plant and project management and security of investment.

At Petrokemija in Kutina, Croatia, the complete safety engineering was modernized, including the Emergency Shutdown System (ESD) and alarm system.

With **Totally Integrated Automation** (TIA), we are the only supplier offering a holistic product and system spectrum for automating chemical production plants.

On the basis of the **Totally Integrated Power** (TIP) platform, we implement plant-wide, efficient and safe solutions for energy management.

Totally Integrated Automation comprises products and solutions from the field level, through the production control level, up to the enterprise management level.

With Totally Integrated Power, power distribution ranges from the medium-voltage incoming supply through to the low-voltage outlet.

The combination of TIA, TIP, and optimum interaction between all components used, offers both technical and commercial advantages:

- Less time is spent planning and implementing the plant, allowing production to start earlier
- More flexible automation results in reduced commissioning time
- Centralized engineering, operation and monitoring of the field technology as far as the motor control center and switchgear using a single system
- Lower engineering costs through integrated engineering tools such as COMOS
- Lower installation costs due to the use of bus technology
- Increased transparency thanks to automatic archiving and reporting of process and plant data
- Enhanced plant availability and reduced maintenance costs through integrated asset management functionalities and comprehensive online diagnostics
- Reduced total cost of ownership and therefore enhanced competitiveness for plant operators

A state-run fertilizer manufacturer in Tedjen, Turkmenistan decided in favor of an automation system from Siemens. The order also included engineering, installation and system testing.

One solution spectrum for all types of requirements

The high degree of integration of TIA and TIP, and interoperation of the implemented components, support faster commissioning. The automation solution offering comprises sensors and actuators at both the field level and the central controller, constituting the management level, through to production planning and materials management systems. The electrical engineering solution covers a wide range of transformers, medium- and low-voltage systems, as well as energy management systems.

Hardware and software from a single source as well as preconfigured and tested components ensure manageable investment costs, long-term supply of spare parts for the implemented components and therefore maximum availability of your plant.

Focus on efficiency

An important factor for the efficiency of your plant is its availability, and accurate information about the condition of the implemented components (assets) is essential for this purpose. TIA and TIP offer comprehensive diagnostic and monitoring functions for all field devices, automation components, and drive components. It is also possible to monitor mechanical components, such as pumps, valves, compressors, or heat exchangers using a condition monitoring system. This forms the basis for intelligent maintenance management and reduces costly downtimes.

Another factor for increasing efficiency is process optimization using Advanced Process Control. With the integrated, multi-variable predictive controller, effective closed-loop control concepts can be implemented that aside from other benefits also increase utilization of the plant.

Tailor-made automation concepts

Fertilizer plants vary considerably from the automation engineering viewpoint. There are small plants and enormous complexes. Some plants are integrated into other process engineering processes, and some run autonomously, close to the source of raw materials. European plants are often over 40 years old, but, following modernization, still able to keep pace with "greenfield plants" in terms of productivity.

The main factor for success is long-term experience in the production process and its secondary processes, such as filling, packaging and palletizing. We can also offer you the right products and solutions here. A wide spectrum of training and lifecycle services rounds off our offering – for reliable and efficient fertilizer production over the long term.

The safe way to a reliable plant

Safety should never be compromised – especially in fertilizer production. High pressures and temperatures, caustic and corrosive media, as well as potentially explosive atmospheres demand the full attention of plant operators. The highest precept is compliance with IEC 61511, which requires certification of the entire safety loop, from the sensor through to the controller, as far as the actuator. The separate products are not simply regarded in isolation here – instead, the complete system is taken into account over the entire plant lifecycle. From risk analysis through planning, installation and operation, up through decommissioning.

We support you throughout the lifecycle of your safety system and offer a comprehensive portfolio of products, systems and services:

- System-wide, uniform safety system comprising controller, engineering with the SIMATIC Safety Matrix safety lifecycle tool and reliable process instrumentation
- Range of services for all phases of the safety system lifecycle, for example, risk analysis, HAZOP study, training, documentation and 24/7 service

The full potential of Safety Integrated

The likelihood of a safety event and its consequences can be considerably reduced by means of appropriate measures, such as use of a Safety Instrumented System (SIS). We offer a safety system that ranges from the sensor and controller through engineering with SIMATIC Safety Matrix, as far as the actuator. The ability to integrate SIS into our process control system SIMATIC PCS 7 is unique.

The modularity and flexibility of Safety Integrated allow the degree of integration to be individually determined. You can decide whether the I&C and safety functions are executed in a single controller or in separate controllers. The safe, fault-tolerant controller can be operated in a single-channel or redundant configuration (up to SIL 3). The potential of Safety Integrated is best utilized to the full in combination with SIMATIC PCS 7.

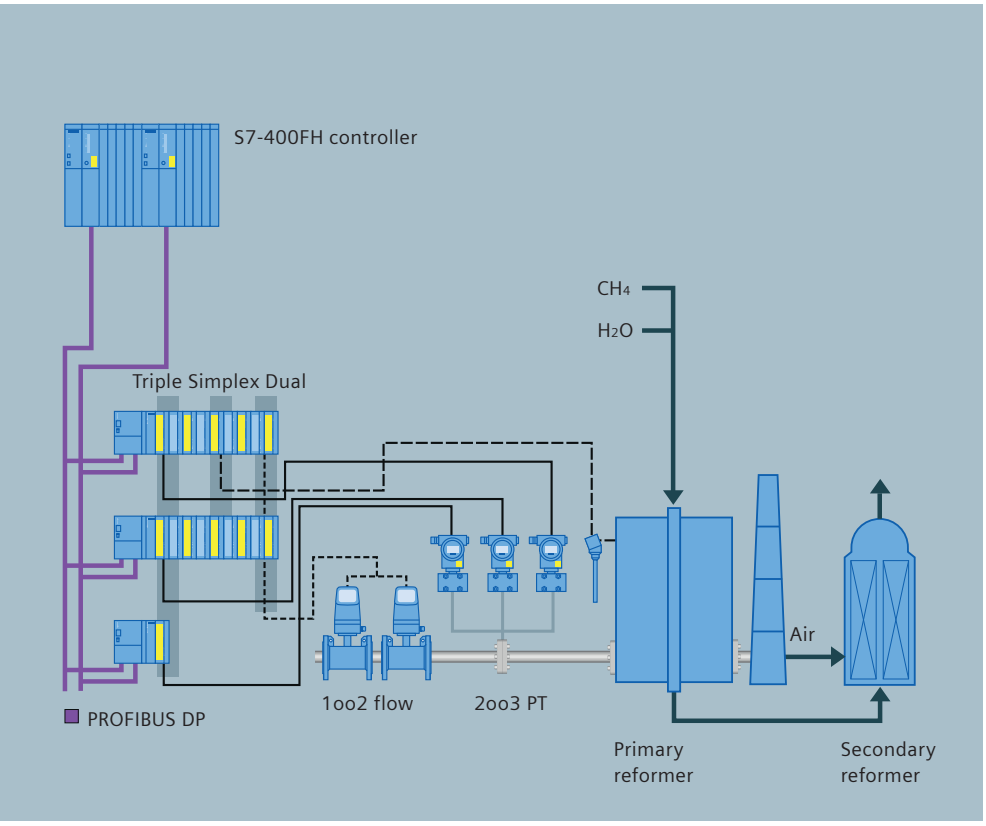
Whichever components you use, and whatever degree of integration you choose – we will accompany your fertilizer plant through all phases of its lifecycle.

Configuration of safety applications

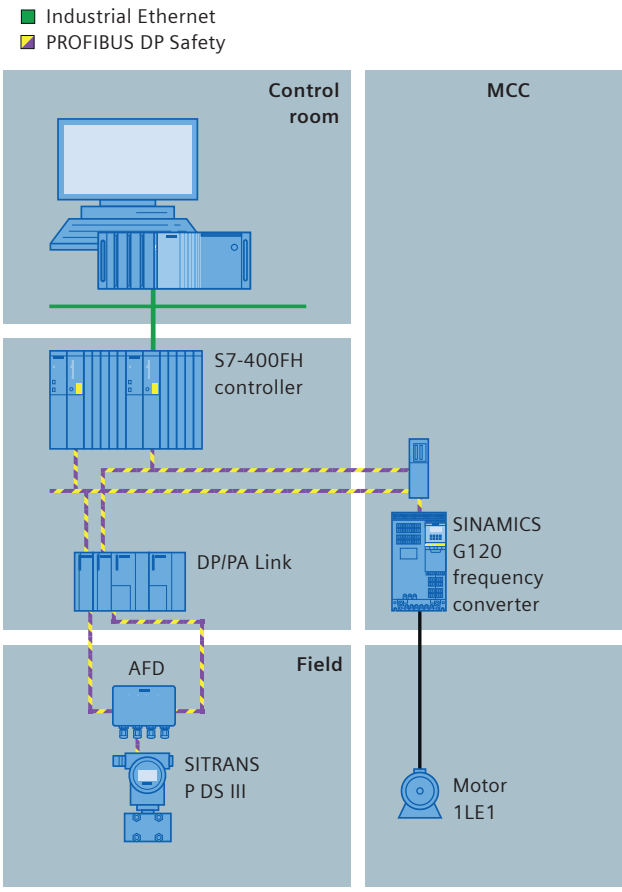
The result of the risk analysis forms the basis for subsequent plant planning, which is presented in the form of a cause and effect matrix. The SIMATIC Safety Matrix safety lifecycle tool is ideally suited to processes in which defined states demand specific safety responses. SIMATIC Safety Matrix makes configuring safety logic easier, more convenient and faster.

Safety check on the operating process

Emergency shutdown (ESD) valves for Safety Instrumented Functions (SIF) must work correctly should a safety event occur, making periodic function tests and essential safety checks. In the Partial Stroke Test for the SIPART PS2 position controller, free movement of the valve is checked by means of partial opening and closing during normal operation. This user-friendly solution extends the maintenance interval for a constant SIL level, saving time and costs while simultaneously increasing plant availability.



Safety loop on the reformer – Flexible Modular Redundancy (FMR) in a safety-related, fault-tolerant plant configuration.



Redundant configuration and therefore safe communication across all levels, as far as the field and the pressure transmitter.

Safe fieldbus communication up to SIL 2

When safety-related I/O modules and devices are connected, we rely on the well-proven fieldbus technology of PROFIBUS DP. These modules are installed centrally in the control cabinet, or intrinsically safe with the SIMATIC ET 200iSP module family in a distributed configuration in the field. It is also possible to connect safety-related sensors, such as the pressure transducer SITRANS P DS III (up to SIL 2), over the PROFIBUS PA fieldbus. Like PROFIBUS, the Foundation Fieldbus (FF bus) is an open fieldbus with a large installed base. A number of Siemens process instruments can be connected over the FF bus.

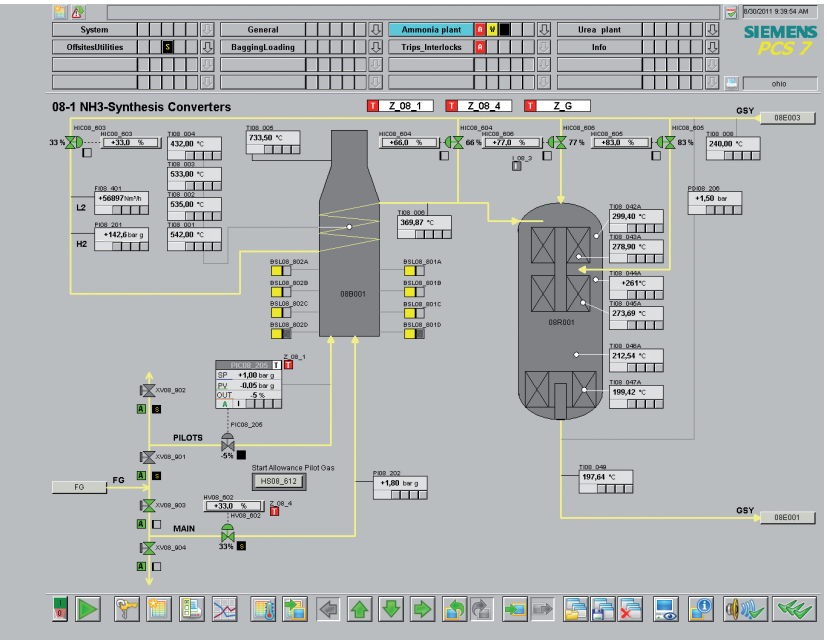
If fixed-speed drives are implemented in combination with motor starters featuring the SIMOCODE Safety motor management system or with SINAMICS frequency converters, a safety loop can be established plant-wide with bus technology. This considerably reduces the installation costs. Safety Integrated fieldbus technology with PROFIsafe supports certified communication between controllers, distributed safety I/O, and safety-related process instruments. Redundancies and ring structures at all levels of fieldbus communication support maximum availability.

Combustion processes under control

Burner management systems (BMS) are defined according to EN 298 and NFPA 85 (2001) as control systems for safe combustion, which support the operating personnel with starting and stopping fuel conditioning and incineration plants, as well as prevent malfunctioning and damage to these plants.

The spectrum ranges from extremely small systems for boilers with single burners, through to large-scale systems for power plant vessels, and also includes ammonia plant reformers.

We offer burner libraries as well as complete solutions with function blocks certified by the German Technical Control Board (TÜV) for the SIMATIC S7-400FH and S7-300F controller platforms.



A plant-wide automation system, such as SIMATIC PCS 7, ensures data transparency throughout the entire plant.

Consistent, cost-effective process control

Fertilizer production is one of the most energy-intensive processes in operation today. Energy-efficient and resource-saving process control and the associated long-term, cost-saving benefits are only possible when precise information is available on the process parameters, from the field through to data supplied from the higher-level management systems.

Intelligent functions for process automation

Intelligent production of this type is built on uniformity in the automation: at the control and visualization level over the SIMATIC PCS 7 process control system with its scalable architecture, and at the field level, largely through distributed process I/O. This modularity allows flexible adaptation of the plant structure.

Intelligent production also requires state-of-the-art alarm management that complies with widely used standards, such as ANSI/ISA 18.2 and EEMUA 191. Smart Alarm Hiding – a tool in SIMATIC PCS 7 – relieves the operator's workload noticeably. It only displays the alarms that are relevant to the situation, such as plant start-up or fault situations. Filter functions, troubleshooting and evaluation tools are also available for the operator to make continuous improvements during operation.

Increased efficiency through modernization

Many fertilizer plants have been operating for decades. To ensure that they comply with modern requirements for energy efficiency and low CO_2 emissions, a large number of systems and plants are now requiring expansion and modernization. In order to retain the installed base in terms of hardware, application, and knowledge of the operating and maintenance personnel, we have developed intelligent migration strategies for updating older plants to state-of-the-art technology. This ensures that the plant operating company can protect existing investments long-term, and maximize the total return on capital.

At BASF in Ludwigshafen, Germany, material flow is controlled through valves, in some cases with positioners. Overall monitoring of the ammonia plant takes place in the central control room.

Transparency in energy management

Optimum energy consumption requires transparency regarding energy requirements – whether for gas, steam, or electrical energy. Meaningful comparisons can only be generated, and targeted measures for improving efficiency subsequently implemented, if accurate consumption values and performance data are available over a long period of time. We offer a range of different measuring instruments for this purpose, including the magnetic-inductive SITRANS F flowmeters for precise flow measurements, and SENTRON PAC for the acquisition and display of all electrical consumption values.

The SIMATIC powerrate software package acquires, calculates, and logs all the energy data for targeted optimization of energy consumption. The SIMATIC B.Data energy management system optimizes workflows by automating all the processes relevant to energy and energy supply.

Simple closed-loop control concepts for efficient processes

The Advanced Process Control (APC) functions integrated into the SIMATIC PCS 7 process control system also contribute towards optimized energy consumption. Sophisticated control algorithms describe even complex relationships between process parameters, and can be used to drastically reduce undesirable variations in critical processes.

The right application for energy savings

In fertilizer production, it pays to determine during the planning stage whether using fixed-speed drives with SIRIUS switchgear, or motors with frequency converters will be the most energy-efficient solution. This ensures a more accurate conveying and dosing process, protects mechanical systems and piping, and often results in considerable energy savings.

The SIZER software can be used to compare different drive solutions in terms of their energy efficiency in order to determine savings potential. A conversion function makes it easy to modify already-engineered drive configurations, so that the effect on energy consumption can be determined, and a more economical variant selected.

The STARTER engineering software efficiently supports the commissioning, optimization and diagnosis of motors and frequency converters.

As a component part of TIA, all our drive systems can be integrated into the automation system over PROFIBUS and PROFINET.

At the Petrochemical Industries Company (PIC) in Kuwait, motor management is integrated into the Instrumentation & Control and creates the basis for condition-based maintenance and preventive diagnostics.

Intelligent switching with our switchgear

We offer turnkey switchgear for medium and low voltage. Our product portfolio stretches from air- or gas-insulated, medium-voltage switchgear for distribution networks and motor control applications, transformers, low-voltage switchgear with motor starters, and frequency converters through to a comprehensive range of services.

Safe and efficient power distribution

In the fertilizer industry, the air-cooled and metal-cased medium-voltage switchgear system NXAIR-M is, for example, an ideal solution for equipment with a rated voltage of 24 kV, because there is normally sufficient room available.

If space is at a premium, however, or if the switchgear system is to be supplied as a turnkey container solution, gas-insulated switchgear is the right choice. You profit here from our 40 years of experience in SF6 technology, with more than 26,000 switchgear panels installed worldwide.

Solutions for IEC and NEMA

The low-voltage switchgear SIVACON S8 also offers diverse application possibilities. It sets the standard as either a power distribution system or Motor Control Center (MCC). The switchgear system offers up to 7,000 A for easy, plant-wide power distribution, and ensures the highest levels of safety for personnel and equipment.

The tiastar MCC motor control centers meet the requirements of the NEMA market and provide a robust industrial design. The modular units implement all the motor protection and control functions, determine all motor data, and allow communications between the automation system and the motor feeder.

Intelligent motor management

Motors for drives, fans, and pumps can be integrated through SIMOCODE pro. This motor management system combines all motor protection, monitoring, and control functions in a single system. It determines the operating, diagnostic, and statistical data of motors, and makes them available to the automation system. This approach supports both intelligent motor management and future-oriented energy management. A cost-effective alternative to SIMOCODE is the space-saving Slimline distributed digital I/O module. It normally uses three signals to control the motor – On/Off, contactor status and overload relay status – and communicates with the process control system over PROFIBUS.

Compressors for high productivity

The use of compressors with a high degree of efficiency is essential in fertilizer factories. The stability of the compressors used in ammonia production has an important effect on productivity. Due to the flexible and rugged design, the STC-SH single-shaft centrifugal compressors are ideally suited to numerous processes and gases, such as nitrogen. As air converters, they are ideal for medium pressures and high volumetric flowrates. We also offer the STC-SH with a flying impeller – as an economical alternative for applications with high volumetric flowrates and steam turbine drives.

Compressors for high pressure compounds

The STC-SV centrifugal compressors are our answer to the complex challenges of pressurizing in industrial processes. Its well-proven aerodynamic construction supports a perfect balance of compressor performance and impeller dynamics in compound gas plants. This compressor is ideally suited for compressing the ammonia compound gas to a pressure of over 200 bar.

Geared turbine compressor with a high degree of efficiency

The geared turbine compressor is designed for a variety of challenges and a broad spectrum of gases. It is compact, equipped with a highly effective water extractor, and is therefore suitable for all air fractionation processes.

Our compressors are characterized by an extremely high degree of efficiency, a rugged and flexible design concept, and low operating and maintenance costs. All models correspond to the API 617 standard of the American Petroleum Institute.

Our compressors ensure a high level of productivity in numerous plants, especially in ammonia production.

Measuring and analyzing systems for higher quality and efficiency

The ammonia production process runs through several phases – from desulfurization and the primary reformer, through to the compound reactor. The material flow passes through these stages and must constantly be analyzed to determine its composition. The slightest variation would affect all subsequent steps downstream, resulting in serious consequences for process quality and efficiency. For this reason, process gas chromatographs and gas analyzers are standard equipment in every fertilizer factory. They continuously monitor the composition of the material flow and their measured data are decisive for achieving product quality and plant efficiency.

Gas analysis made easy

One example is the natural gas analyzer SITRANS CV. Nitrogen is obtained from natural gas for ammonia production, and the quality of the natural gas is important. Within 180 seconds, the natural gas chromatograph supplies all the necessary information regarding the quality of the natural gas and its specific properties, such as calorific value and density. With the Set CV (calorific value), we offer a standardized system that meets all requirements from sampling through pressure reduction, sample conditioning, quality determination, and supply of carrier and calibration gases, as far as expansion with communications interfaces.

Tailor-made process monitoring

For environmental protection reasons, the exhaust gas from the primary reformer or purging gas from the synthesizing stage must be carefully monitored. Our solutions comprise continuous (extractive and in-situ) gas analyzers, process gas chromatographs, as well as systems for extracting and conditioning samples. To ensure that the analyzers will function reliably over many years, they are adapted exactly to suit local conditions and are available in numerous versions, such as for installation in the cabinet or field, or with explosion or corrosion protection. A flexible networking concept supports connection to control systems and maintenance stations over PROFIBUS, OPC, Modbus or Industrial Ethernet.

Intelligent process instruments for precision results

Not only the control system, but the measuring equipment too must be tailored to the prevailing situation. In fertilizer production, rugged and reliable flowmeters are required. In addition to safety, measuring precision also plays an important part, as even small inaccuracies can result in invalid calculations, which result in higher costs.

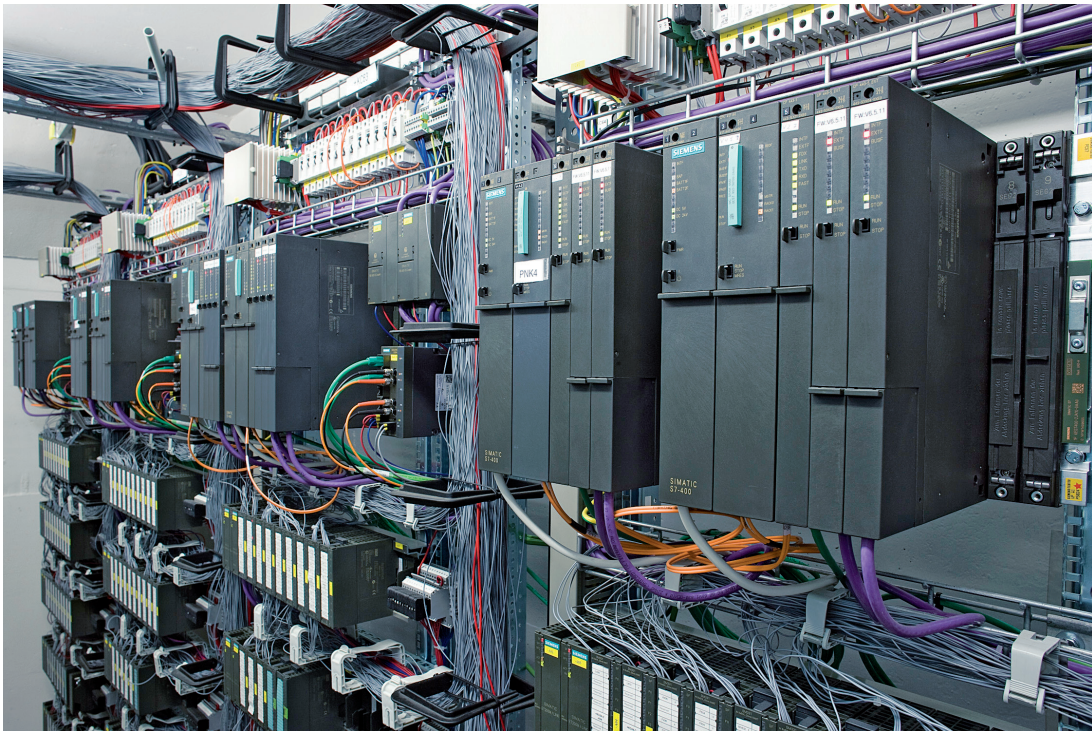
The Coriolis flowmeters such as SITRANS F C MASS 2100 solve this problem by acquiring the mass flow as well as the respective fractions for the substance.

Rugged and reliable meters are absolutely essential, such as those of the SITRANS family: SITRANS TH gauge heads mounted directly in the field, the Coriolis flowmeter SITRANS F C MASS 2100 or the classical SITRANS F M.

Reliable water conditioning systems

We offer a wide range of efficient and reliable water conditioning systems and services for fertilizer production. This includes products for water conditioning processes, wastewater recycling plants, membrane bioreactors, UV disinfection systems, as well as concepts for cooling water circuits. In one ammonia plant, for example, we implemented a process based on chlorine dioxide (ClO_2) to reduce microbiological growth in the cooling water circuits.

Nearly any process automation task can be resolved using SIMATIC PCS 7. The slimline open rack architecture saves a lot of space in the switchgear room.



Modern plant control desks and uniform operating and visualization concepts facilitate reliable, problem-free operation.

Data transparency over the entire value chain

Fertilizer processes are hybrid processes. In ammonia production, for example, gas conditioning and synthesizing are process engineering processes. Storage and packaging, by contrast, are discrete processes. Even so, they also have an important part to play in the production sequence and require data transparency for production planning.

Integrated weighing systems

With SIWAREX weighing cells and electronics modules for weighing systems, in combination with belt weighers, dosing belt weighers and solids flowmeters, we offer you the optimum weighing system for practially every filling task imaginable. In addition to accuracy and calibration capability, you benefit from seamless integration of SIWAREX weighing technology in the SIMATIC PCS 7 process control system – and therefore from the highest degree of uniformity and transparency.

Smooth material transport

The availability of raw materials and problem-free material transport are important preconditions for safe processes. SIMATIC Route Control directs, monitors, and analyzes material transport in piping networks or on conveyor belts. The SIMATIC PCS 7 can automate not only the production processes and the associated storage facilities, but also the interconnecting material transports. SIMATIC Route Control is ideally suited to small plants with simple transport routes, as well as plants in the mid and high-end performance range with extensive, complex transport and piping networks.

Fast response capability

Customer-supplier relationships in the fertilizer industry have become more complicated, compounded by new competitors, increasing raw material prices, relocation of plants, and construction of new production sites. Demands for a problem-free supply chain can only be fulfilled by means of maximum process transparency, real-time access to precise data combined with an accurate image of the processes, and a functioning IT architecture.

All data is available at all times

We supply you with the ideal basis for a perfectly tailored Manufacturing Execution System (MES) that you can use to access process information throughout the company. SIMATIC IT ensures automatic data acquisition in real time, resulting in optimized equipment management, reduced downtimes, and improved throughput. Our MES ensures interoperability between the plant and ERP (Enterprise Resource Planning) environments for flexible production management and process transparency, as well as improved decision-making.

Whether you are involved with gas conditioning or packaging, process safety or energy efficiency – you will always benefit from an integrated, plant-wide automation system. The perfect interplay of all components results in the optimum utilization of raw materials and a high degree of efficiency.

Your reliable partner – worldwide

With offices in 190 countries, we are a genuine global player. Our extensive experience in the chemical industry make us the right partner for constructors and suppliers of automation and electrical engineering solutions all over the world. We accompany our customers on site during all phases from planning, through construction and commissioning as far as service during the operating phase.

For decades, we have offered perfectly harmonized, modular solutions for automation, drive systems and power distribution. We guarantee long-term spare parts availability and provide, if necessary, suitable follow-up components over the entire lifecycle of your plant, and offer qualified, specialized support locally.

The benefits for plant operators

We are the only manufacturer to offer a complete spectrum of integrated products, systems, and solutions for automation and electrical engineering, that also includes energy management. During operation, you benefit from our modular concepts for plant analysis and process optimization. Together with our worldwide service team, this forms the basis for improvements in the efficiency and profitability of your plant – now and in the future.

The benefits for plant constructors

Lower installation costs, less engineering efforts, shorter installation times, and a minimal effect on the environment play an important part in the successful implementation of projects. With a global network of experts, we are able to concentrate on your specific requirements in the fertilizer industry.

"Thinking global, acting local"

In automation and electrical engineering, international business demands globally active solution partners with specific knowledge of local conditions. A partner such as Siemens is therefore a considerable advantage – with its worldwide presence and extensive network of service and support. We are familiar with country-specific standards, guidelines, and regulations, and offer a suitably adapted product portfolio for IEC and NEMA. This is extremely useful for smooth execution of global projects and forms the basis for ensuring that your plant satisfies every expectation from day one.

During both planning and commissioning, we link the activities of a wide range of different partners – whether for small or large-scale plants. We work extremely closely with plant constructors and system integrators.

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