'Right First Time' Acetylene Bottle Filling

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SABIC Europe B.V has improved the efficiency of acetylene production at it's Geleen plant by 30 %, thanks to tight control enabled by Emerson Process Management's PlantWeb digital plant architecture. Costs have been reduced by 300,000 Euros due to predictive diagnostics, improved maintenance practices and lowered operator costs. In addition SABIC has increased throughput, gained better control over its business Key Performance Indicators, and - through a proactive maintenance programme - increased plant availability.

SABIC Europe B.V. is part of the Saudi Basic Industries Corporation (SABIC), the largest petrochemical company in the Middle East and the fourth largest manufacturer of polyolefins worldwide. In Europe, SABIC is a major producer of both polymers and chemicals employing around 3,300 people, with production facilities based in Geleen (The Netherlands), Teesside (UK), and Gelsenkirchen (Germany), annually producing 3.0 million metric tons of polyolefin and 5.7 million metric tons of chemical products like olefins, benzene, and acetylene, mainly for the European market.

Since 1975 Geleen has been home to two naphtha crackers and several polymerisation plants for the production of polyethylene and polypropylene. A by-product from these cracker processes is acetylene, which is removed and marketed throughout Europe. Acetylene is used in chemical synthesis and for oxyacetylene gas welding and cutting using a high temperature flame. Combustion of acetylene with oxygen produces a flame of over 3300 °C (6000 °F) and acetylene is also used for carburisation (hardening) of steel when the object is too large to fit into a furnace.

The market place for acetylene is highly competitive with an increasing number of suppliers and reduced usage because of the trend towards using flameless welding processes. In addition, many offshore and steel manufacturing companies are now moving outside of Europe to countries with lower production costs.

To help SABIC Acetylene remain competitive in this difficult market, the company follows a clear strategy of being a low cost provider whilst maintaining a high quality product through operational excellence and high quality services. It is very important to have total control of all business parameters to become a low cost provider. SABIC therefore looks to gain much tighter control of its business and uses Key Performance Indicators (KPI's) through a Management Information System to fine tune the business.

SABIC has put this strategy into practice by making a significant investment in information technology and research and development, installing further automation and by partly outsourcing the maintenance of the plant. Increased commercial and production data is crucial to stay competitive. Because of the high risks associated with acetylene cylinder filling, safety information is also required in the form of a monthly report.

Acetylene gas is fundamentally unstable and may explode, it is therefore shipped in special cylinders designed to keep the gas dissolved. The cylinders are packed with porous materials (e.g. kapok fibre or diatomaceous earth, monolitical porose mass) and then filled with acetone to half its total filling weight. When acetylene is introduced into the cylinders it dissolves into the acetone.

At the SABIC Acetylene production site at Geleen, empty gas cylinders varying in type and size are refilled with acetylene gas. This filling process can be divided into three separate stages. The first stage consists of manually loading and removing gas-bottles into a filling rack after weighing each cylinder two times, the second stage is the automatic filling with acetylene gas, and finally administrating and managing the filling data. All these processes have been integrated into a newly installed plant automation system. Based on Emerson's PlantWeb digital plant architecture and utilising FOUNDATION™ fieldbus digital communications technology, the plant architecture includes Emerson's DeltaV™ digital automation system and Micro Motion® Coriolis mass flowmeters.

The primary objective of SABIC was to have an automated process that uses intelligent devices to ensure "right first time" filling of the acetylene bottles. This means removing the possibility of any under-filling, which leads to time consuming rework (additional filling of the bottles), or over filling which could potentially lead to an explosion.

The filling of the cylinders is performed in three steps. Firstly the operator places individual cylinders on a weight sensor. Man-Machine-Interface (MMI) terminals mounted at the filling station enable the operator to enter specific information concerning the gas cylinder (type and tare weight) being weighed. These terminals communicate with the DeltaV system using serial communication (Modbus) and the data is used to find all necessary filling set points. The operator then places the weighed cylinder into a filling rack which can hold up to 24 cylinders. When the filling rack is full, the DeltaV system calculates the amount of gas required to fill all the cylinders in the rack.

The bottle filling is fully automated using FOUNDATION fieldbus networked instruments including Emerson's Micro Motion Coriolis flowmeter for direct measurement of mass flow. The real challenge was to measure a broad range of mass flow of between 0,2 and 20 k/h at high pressures of up to 25 Bar. The Micro Motion flowmeter was able to provide a measurement of 0.35 % to 0.5% accuracy rather than the 1-2% accuracy normally associated with conventional measurement solutions. The right amount of gas is then dosed through a FOUNDATION fieldbus control valve, a signal light alerts the operator when the filling is complete.

Using this process, over 50 racks, each with 24 gas cylinders, are continuously filled, with handling and the administration of the filling being managed by the DeltaV system.

Upon completion of the filling phase, the third step is re-weighing the cylinders as a quality control check to ensure they have reached their target weight. When complete, the data concerning the cylinders, such as type, customer name, net gas dosed and operator is written to a PI (process historian) SQL database. Using the DeltaV system as the Management Information System this data is made available for management and administrators. To make it easy to generate reports and queries, a user-friendly access application was built on top of the SQL application.

In comparison with the previous manual method of weighing and filling which often required cylinders to be reworked, throughput has increased by 25%. The man hours required for the filling process has been reduced by 20% and the physical work required has been reduced considerably. With cylinders weighing up to 80 kilos each there is substantial physical effort required to position them for filling. With 'right first time' filling there is never any need for rework which would require additional handling of the cylinders. As a consequence, the safety, health and welfare of the operators has been improved.

"The use of Micro Motion Coriolis mass flowmeters ensures bottles are filled to the set point every time without exception," said Eric Heetkamp, Manager Operations and Marketing, SABIC Acetylene. "Previously, about 95% of the cylinders would have been filled correctly first time round and the operator would then have had to follow up with time consuming rework. The choice of mass flow technology combined with FOUNDATION fieldbus communications has been proven to be an excellent investment."

Heetkamp continued, "Although Acetylene production is not a `core-business' for SABIC, we were aware of the need to modernise our procedures in a competitive market. As well as meeting the objectives of the project we have gained valuable experience in the use of the FOUNDATION fieldbus technology.

Apart from the ability to minimise AD-DA conversion differences and further increase the accuracy of the

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measurements, FOUNDATION fieldbus devices are being used as an enabler of condition based maintenance strategies. Each valve has a built in alert, which, when networked using FOUNDATION fieldbus can warn operators when recalibration is necessary.

The introduction of predictive maintenance has removed the downtime required for checking the accuracy of the flow meters and valves. Previously valves had to be checked as part of a planned shut down on average 24 times a year. This has been reduced to just 2 planned shut downs. By using a system of valve alerts, the availability of the filling process equipment has been increased and this has improved overall efficiency of the plant by some 30%. Annual savings of 300,000 Euros have been made at the filling station because of the increase in operator efficiency, reduction in the number of planned shutdowns and increased plant availability. Another major contributing factor to these cost savings is lower maintenance costs.

The acetylene filling station has very different maintenance needs than the rest of the plant at SABIC. As a result, Emerson has been awarded the contract to maintain the automation/process instrumentation. Support is required for the FOUNDATION fieldbus elements as well as the Management Information System. It is important that the filling station works at the same speed as production and the information collected from it forms the basis of monthly production reports. For this reason it is essential that there are no unexpected shutdowns and maintenance periods are kept to a minimum. SABIC's filling plant has an excellent safety track record, and it was essential that the cooperation with Emerson completely fitted in with the safety philosophy of the filling plant, and that Emerson by its behaviour supported this record.

SABIC also wanted to keep the system up to date with life cycle management support. This includes managing engineering changes; release status of components; configuration of product variations; document management; planning project resources and timescale and risk assessment. Safety is the most important criteria of SABIC's maintenance philosophy and a regular customer/vendor relationship was deemed to be unsuitable. It was felt that a partnership relationship was more appropriate and Emerson could offer the high service levels of support SABIC desired.

"At Geleen we have a number of excellent onsite maintenance personnel looking after process automation," continued Heetkamp. "But the specific properties of Coriolis mass flowmeters and FOUNDATION Fieldbus and the relatively small setup compared to the rest of the SABIC installation meant that it was not significant enough for them to take ownership."

Emerson Process Management provides a total care service for the site. This means that it is responsible for the complete system performance. As part of this all encompassing agreement, a 24hours/7 days/365 days a year on-call service is provided for all applications and hardware. This includes the complete DeltaV system with its applications (filling logic and database). It also includes the FOUNDATION fieldbus equipment including the network components and all instrumentation. Finally it includes the field equipment such as the end-switches and hand valves.

As a result of the introduction of the Emerson maintenance programme, where the plant previously required 24 days shutdown a year, the plant now runs for a minimum of 363 days with a maximum of 2 days for scheduled shutdowns per year. The number of unplanned shutdowns has been reduced to zero. This has enabled SABIC to concentrate its efforts on developing new products and improving production and product quality without the concerns of maintaining the process instrumentation.

"In the six years since the new set-up was installed we have seen the number of jams considerably decreased," concluded Heetkamp. "The number of unplanned plant-wide shutdowns has been reduced to zero and we have total clarity concerning the costs of maintenance."

New Mini CORI-FLOW is Smallest Coriolis Instrumentation Yet

Bronkhorst High-Tech (UK), has introduced its new highly compact and accurate Mini CORI-FLOW series, believed to be the smallest Coriolis effect instruments on the market. Offering a range of purpose-made meters and controllers, as well as dedicated liquid dosing systems, Mini CORI-FLOW has been specifically developed to precisely measure very low flow rates, down to a few grams an hour, although larger models will handle up to 30kg/hr and beyond. The unique design of the Coriolis sensor delivers unsurpassed performance, irrespective of changing operating conditions with regard to pressure, temperature, density, conductivity and viscosity.

Suitable for both liquid and gas flow applications and capable of bi-directional measurement, Mini CORI-FLOW instruments are equipped with robust IP65 weatherproof housings and available with ATEX approval for use in hazardous areas; while the controllers feature adaptable PID controls for regulating integral or separately-mounted electronic control valves. Typical applications include research laboratories, pilot plants and fuel cell processing, analytical installations and anywhere requiring direct mass flow measurement, independent of fluid properties. Prices are highly competitive.

The Coriolis effect, first identified by a French scientist of that name, is the tendency for any moving body to drift sideways from its course, due to the earth's rotation. A major practical application of this effect is mass flow measurement and, in the Mini CORI-FLOW series, the fluid flows through a vibrating tube, causing a variable phase shift, which is detected by sensors and fed to an integral PC board, with the resulting output exactly proportional to the mass flow rate. Whilst other flow measuring principles require correction for changes in fluid temperature, pressure, viscosity and density, Coriolis devices are independent of these properties and will exactly measure fluid throughput, no matter whether it is in a gaseous or liquid state.

Notable for their high accuracy and fast measuring signal, traditional Coriolis mass flow meters tend to be large, requiring robust mountings and sizeable concrete plinths, and are typically applied to medium-to-high flow rates, with measurement of low rates usually complicated and costly. Now, building upon the success of its existing CORI-FLOW design, which is a quarter the size of standard units, Bronkhorst's new Mini CORI-FLOW is around 16x smaller than normal, with a basic footprint of just 80mm x 32mm and an overall height of 144mm. Moreover, both meters and controllers have been developed to cover the needs of the low flow market, at a fraction of usual costs, with different models providing overlapping maximum flow rates up to 30kg/hr.

The new Mini CORI-FLOW series features state-of-the-art digital technology, offering standard fieldbus interface options and additional functions such as totalisation and alarms. The PC boards on the range's mass flow controllers (MFCs) additionally allow fast and smooth control of electrically-driven valves, either integrated onto the device or separately mounted for special tasks. The flow controllers have the same footprint as traditional thermal MFCs and feature the same options for analog and fieldbus communications, enabling quick and easy instrument exchange.

For applications where a control valve is not appropriate, such as when a liquid cannot be pressurised, a Mini CORI-FLOW liquid dosing system can be supplied in various flow capacities. This comprises a virtually pulse-free gear pump, close coupled to the Coriolis flow meter, complete with check valve, filter and interconnecting pipework, in a simple, compact assembly. Again, the pump is regulated by the onboard PID controller, via a voltage output signal.

Bronkhorst UK has identified a number of interesting applications for this unique Coriolis technology and can assist in the development of customised solutions. These include the measurement and control of additives being dosed into a main product stream; the supercritical measurement of difficult-to-monitor fluids like carbon dioxide and ethylene, where they are midway between a liquid and a gas; the delivery of precursor fluids, either as gases or liquids, in deposition processes; and as a batch process counter, where each batch can be programmed into the integrated counter limit value, then the valve closed until reset.

KROHNE Offers Solution for Accurate Bulk Measurement in the Oil and Gas Industry

KROHNE (Germany) has launched the Optimass 2000, a large diameter Coriolis mass flowmeter that offers a solution for accurate bulk measurement in the oil and gas industry.

The tried and tested twin straight tube design of the Optimass 1000, has been extended to provide accurate measurement for the bulk market. The Optimass 2000 is available in 3 sizes: DN100 (4"), DN150 (6") and DN250 (10"). All wetted parts of the Optimass 2000 are manufactured from NACE compliant duplex Stainless Steel (ANS 31803) and the meter is supplied with standard flanges up to 1500 lbs (12").

PED approval offers process pressure capability up to 150 barg and the Optimass 2000 also offers flow rates from 7,000 Kg/h to 1,200,000 Kg/h, with a measuring accuracy of 0.1%. In addition, the stainless steel outer cylinder has a burst pressure in excess of 100 bar.

Aimed at the oil and gas industries, the low flow rate capability of the Optimass 2000 prevents the build up of static in hydrocarbons, whilst at the same time offering accurate measurement. The low flow rate capability is also a benefit for custody transfer applications.

The Optimass 2000 uses the successful MFC300 converter and is available as a compact or remote version. All signal processing is carried out by the MFC300 which converts the meter output to a MODBUS RTU communications signal and the "split architecture" of the MFC300 allows dual redundancy of all calibration data. The meter can also be supplied with DDC (Direct Digital Communications) where the application doesn't require a converter.