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Demand-driven combustion gas supplies in chemical parks

Calorimetry allows conditioning of process gases for further use as combustion gases

Process gases from chemical plants are regarded as a valuable energy source today and are being further used as combustion gases. As a result, service providers have come into being in chemical plants that, as gas suppliers, analyze process gases produced on-site for energy content, process them if necessary, supply them to resident facilities, and perform accounting of the energy quantities supplied. The basis for this activity is process-compatible device technology based on directly measuring combustion calorimeters.



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The competitiveness of German chemical companies is not least a consequence of the structural change of this industry sector within the last two decades. What began almost 20 years ago with the demerger of Hoechst AG, has led to the setup of over 50 chemical parks in Germany today. Under the management of an operating company, these provide other resident companies at the site a package of modern infrastructure, services of all types, and integration in a single energy and mate-



In the calorimeter measuring station the combustion value of the produced process gases is determined using three calorimeters.

rial network. As a result, these companies become „customers“ of the operating company and can dispense with construction and operation of their own supply units and establishment of their own speciality departments, which reduces costs and increases efficiency.

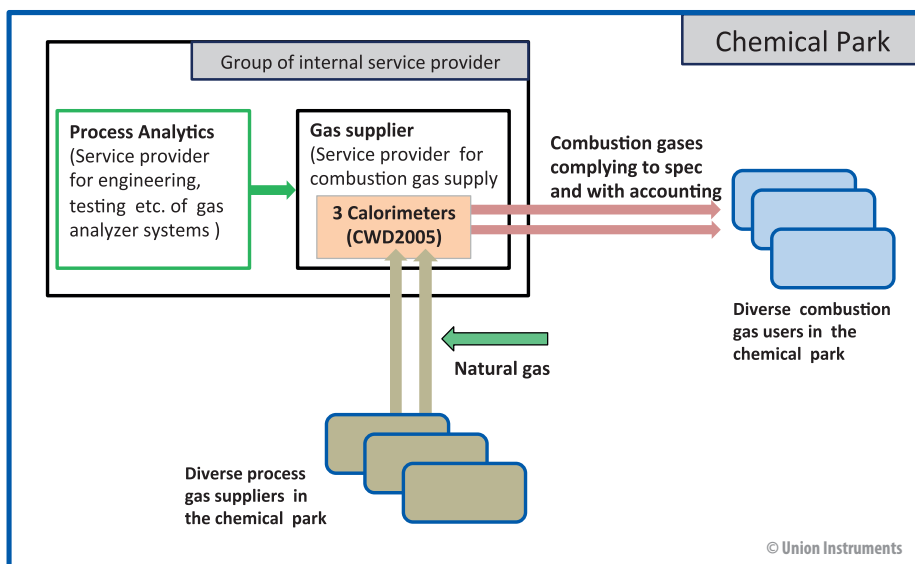
100 facilities in one chemical park

One of the largest German chemical parks comprises around 100 production facilities, which are closely networked in terms of energy and materials. The operator of the Chemical Park is a broadly diversified Technology & Infrastructure company, which provides all services related to operation of the chemical process facilities.

This ranges from supply and disposal services, technical services, logistics and process technology to engineering of new measurement solutions, as will be shown below using the example of process gas utilization.

Utilization of process gases in the chemical park

Energy-containing (combustible) process gases are currently playing an increasing role in the energy network of chemical parks. In a striking transformation, unused process gases have become an attractive energy source, which can be used on-site for heat or electricity generation. That reduces or eliminates the otherwise requisite purchase of natural gas. The ty-



Processing of process gases for use as combustion gases in a Chemical Park

Calorimeter device series CWD2005

CWD stands for Calorimetry, Wobbe-Index, and Specific Density and, together with the addition of 2005, designates a modularly designed device series for determination of calorimetric quantities in gases in various application areas including custody transfer measurements and measurements in hazardous areas. The CWD2005 devices of Union Instruments directly determine the Wobbe index as the typical controlled variable for the combustion value. The measurement method is based on continuous determination of the temperature increase of a carrier medium (air) caused by the energy released during combustion of a defined gas flow. The relative density is measured separately and used to calculate the heating value and combustion value. Unknown or unexpected combustible components of the process gas are also detected during combustion and taken into consideration in the measurement. This property of the CWD is essential for achieving reliable measurement results for process gases from chemical processes with rapidly changing gas composition or for synthetic gases in the steel industry.

pical variation of the material composition and energy content of process gases can be reliably measured with currently available measurement technology and corrected if necessary. At the same time, the measurement technology provides the data needed for accounting of the supplied energy quantity and thus ensures demanded cost transparency.

Gas supplier invests in new measurement technology

The gas supplier obtains the process gases from various facilities at the site and ensures continuous determination of their combustion values and adjustment, if necessary, to customer specifications by addition of natural gas. For this task, older devices would have to be replaced by process-compatible, fast-response measurement technology that is suitable for con-

nection to a control system. The Process Analytics department of the service provider was tasked with the selection, engineering, installation, and commissioning of this measuring technology. Calorimetry was chosen for the measuring method. Process gas chromatography, the other possible alternative, was not considered due to its much higher cycle times.

Calorimetry is a measurement method for measuring combustible gases that has been known for over 100 years and which today's device manufacturers are converting into modern technology. The measure for the energy content of a gas and thus for its process-related and fiscal value is the Wobbe-Index (dimension: kWh/m³). Today's calorimeters determine this value, depending on the design, either directly (as an instantaneous measurement) or indirectly (from another measured value using a correlation method). In light of the problem of strongly

fluctuating gas compositions, the direct measurement method was judged to be significantly more advantageous, since uncertainties are inherent when using the correlation method on gases with highly-variable compositions. The choice was therefore the continuously measuring combustion calorimeter CWD2005 Plus with its direct Wobbe measurement. Three devices were purchased, which are set to a Wobbe range of 5 to 15 kWh/m³ based on the requirements of the gas customers.

Measurement concept and results

The continuous 24/7 measurements and status values are output via a 4–20 mA and a Modbus interface and transmitted to a control system. They are used for closed-loop control of the addition of natural gas as required for adjustment of the specified energy content, for accounting of the energy quantity supplied to the customer, and for quality assurance. According to specifications, the maximum permissible measurement uncertainty of the combustion value of the supplied gas is less than 1 percent. This is achieved by the entire measuring equipment. The CWD contributes to this result through its independence from thermal environmental conditions and manually-started, automatically-running calibration with calibration gas. From then on the upper measuring range limit is verified with test gas.

Conclusion

The use of continuously operating combustion calorimeters and their integration into a blending control enables conditioning and further use of process gases from chemical plants. This unlocks additional energy sources and opens up new opportunities for increasing energy efficiency during plant operation, especially for chemical parks. The concept as described provides a convincing example.

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