Ethanol – Process Instrumentation for the Manufacturing Process

process INSTRUMENTATION

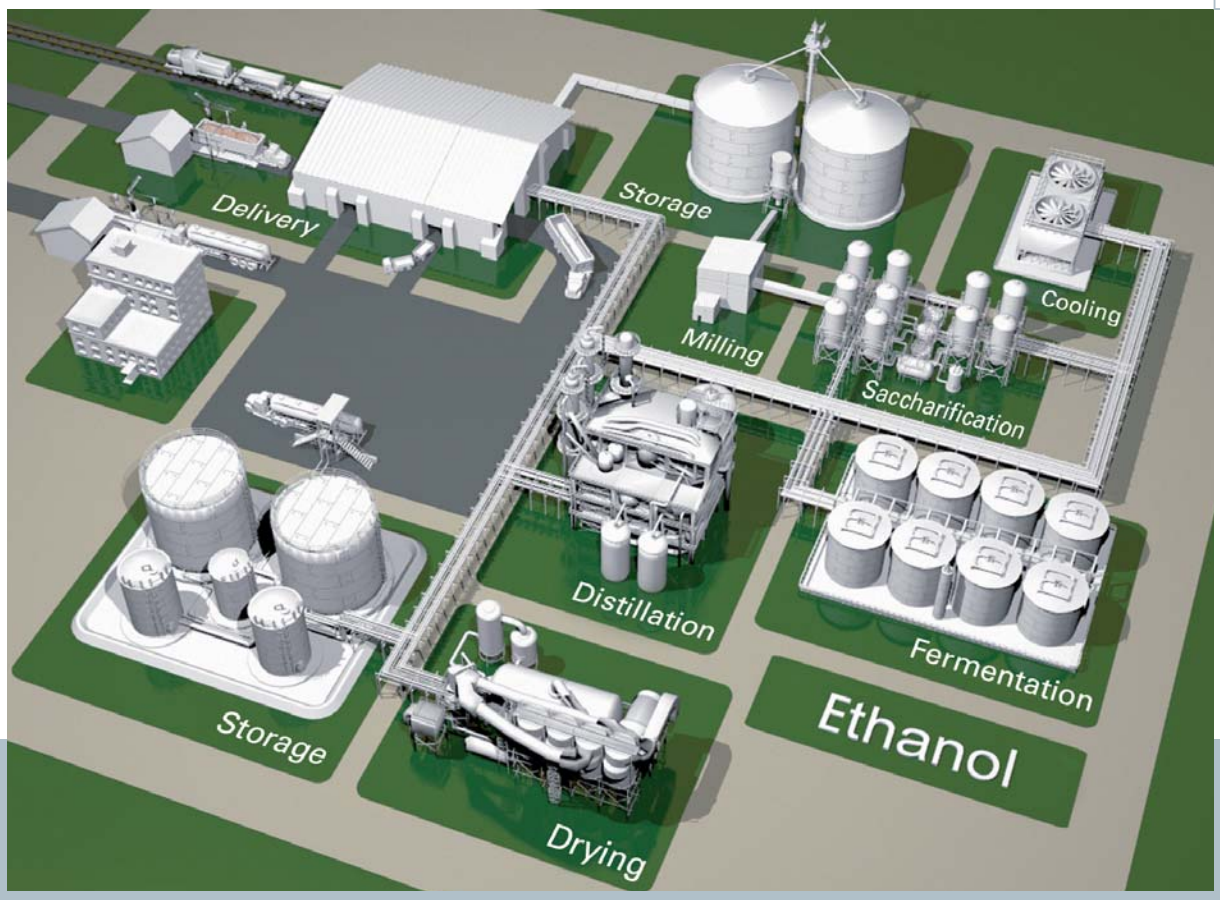
SIEMENS

Process instrumentation for the manufacture of ethanol

A large number of measuring tasks have to be carried out in a manufacturing plant for ethanol – starting with the receipt of raw materials and up to the delivery of the finished product. Selection of the correct instrumentation is very important for the efficiency of the complete plant. In addition to the technical specifications, the instruments must be safely integrated into the process automation. Reliability, long service life, and simple operation are also important. And in an emergency, a fast and trouble-free supply of spare parts must be guaranteed. In order to determine the process status in an ethanol manufacturing plant, continuous and reliable information is required on temperatures, flows, levels, pressures, and the alcohol content.

Early contact with the correct supplier

Where measurements are concerned, different approaches to the same solution may all lead to a good result. It is important to select the optimum measuring technique, not only to achieve a reliable measurement, but also to keep operating costs low. Can a level measurement be implemented at lower cost using a radar system, or hydrostatically with a differential pressure transmitter? How reliable are my measured values? What advantages are offered by which technology? It is important to engage an experienced solution partner early in the planning phase who possesses the appropriate process and instrumentation know-how.



Siemens – experience counts!

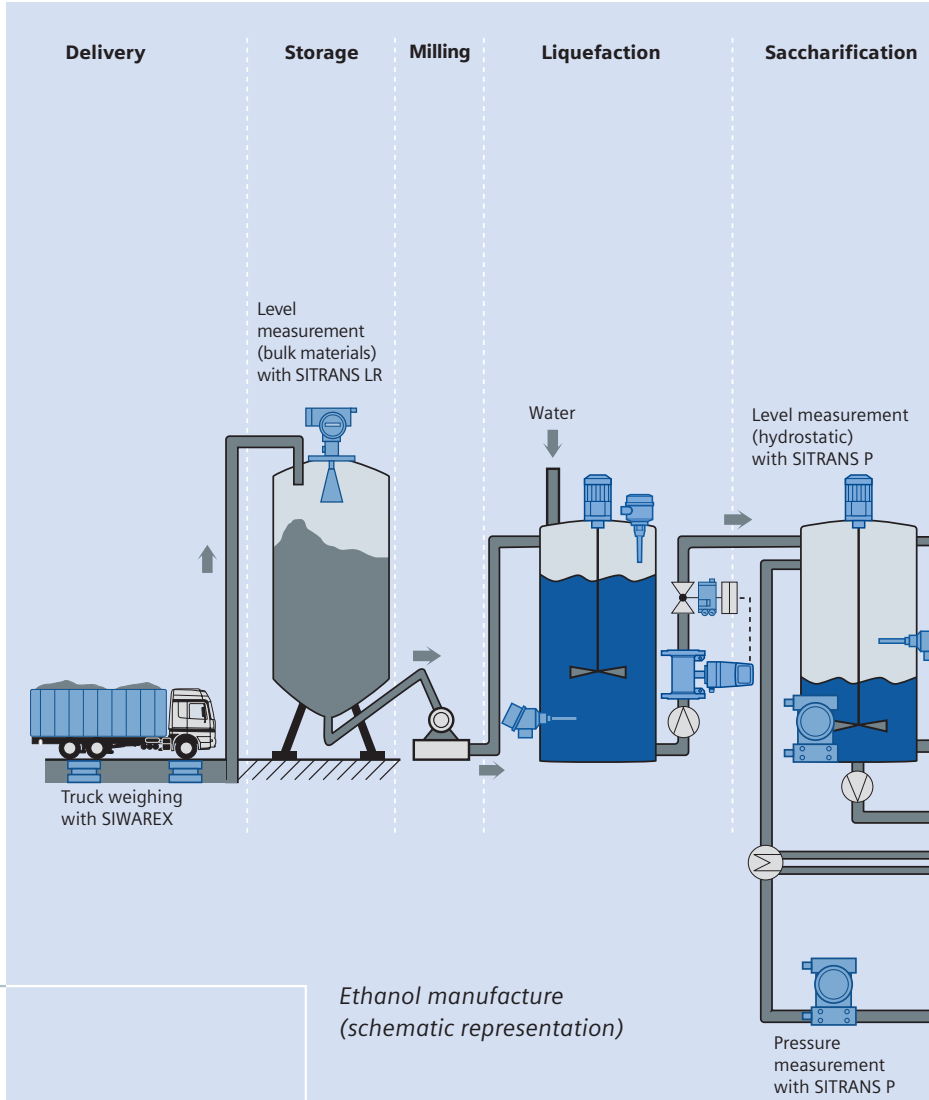
As a result of widespread experience in the process automation of ethanol plants, Siemens possess comprehensive process know-how. We can explain the advantages and disadvantages of the various measuring technologies, and provide competent advice. We understand the details of the ethanol applications – from the measuring conditions in the process to interfacing the devices with the host controller. Because of Siemens experience and comprehensive process instruments portfolio for manufacturing ethanol, we are able to offer a variety of solutions to our customers.

Siemens – the right partner!

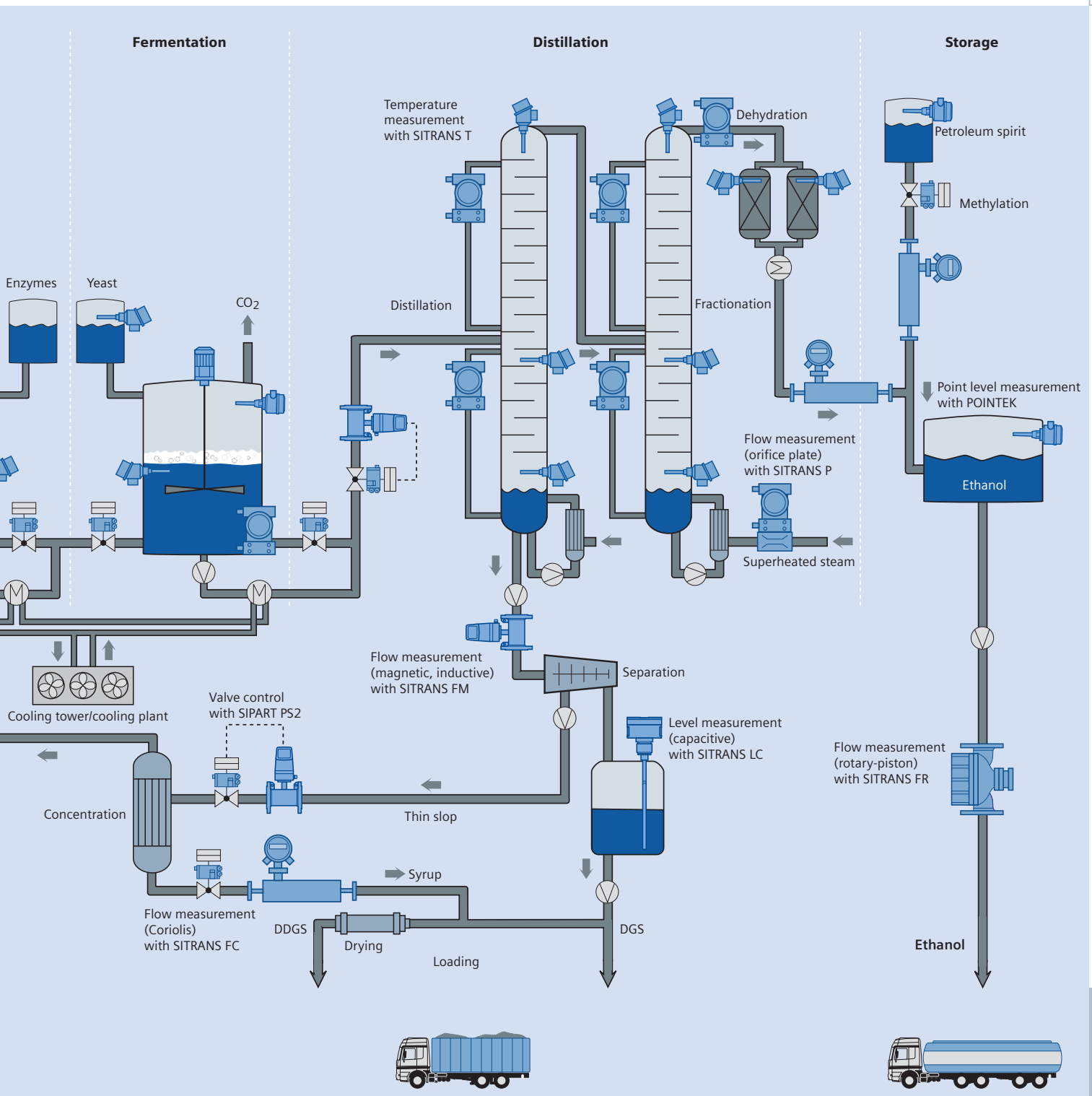
With our wide product portfolio and our global network of regional offices, we can offer a fast and comprehensive scope of services ranging from consulting and supply up to commissioning. We are there for you around-the-clock – and worldwide. Customer support is a matter of course for us – even years following the purchase. Siemens has many field devices in stock and can quickly deliver what you need. On the other hand, Siemens has the experience to help you with custom solutions which may not be included in the catalog. We will find the most appropriate solution for your specific requirements.

Ethanol – the correct measuring system for all process steps

We understand your process! Regardless of the applications for which you require instrumentation, various measuring technologies are available for the wide variety of processes all through your plant.



Ethanol manufacture (schematic representation)


Fermentation
Distillation
Storage
Temperature measurement with SITRANS T
Dehydration
Petroleum spirit
Methylation
Enzymes
Yeast
CO_2
Distillation
Fractionation
Point level measurement with POINTEK
Flow measurement (orifice plate) with SITRANS P
Ethanol
Superheated steam
Flow measurement (magnetic, inductive) with SITRANS FM
Separation
Cooling tower/cooling plant
Valve control with SIPART PS2
Level measurement (capacitive) with SITRANS LC
Flow measurement (rotary-piston) with SITRANS FR
Concentration
Thin slop
Syrup
Flow measurement (Coriolis) with SITRANS FC
DDGS
Drying
DGS
Loading
Ethanol

Application examples in main plants

Example of delivery

Weighing

In the case of incoming and outgoing goods, the exact quantity must be determined – whether for the receipt of raw materials or the delivery of manufactured ethanol in transport containers. At the weighing stations for trucks and trains, the load cells can be directly connected via SIWAREX to the SIMATIC automation system.

Already incorporated into SIMATIC PCS 7, the SIWAREX weighing solution avoids complex integration work. This reduces engineering costs, and offers comprehensive diagnostics functions. You can be assured that you have integrated a system with the facility for carrying out custody transfer measurements.

Weighing station for railway wagons with SIWAREX load cells

Example of storage tanks

Level measurement

What is the actual stock of raw material on hand? If raw materials, like corn or wheat, are transferred into the silo, extreme amounts of dust can be produced. Conventional radar level sensors are unable to determine the exact filling height because the heavy dust produces interfering signals that do not allow the instrument to "see" the surface. How can an exact measurement be made?

A good answer to this question is provided by the SITRANS LR 400. This radar level transmitter has been specifically designed for applications in bulk materials. It can accurately determine the filling height in the silo even in extremely dusty conditions – exact to the millimeter!

Storage tanks for corn. In each silo, a SITRANS LR 400 measures the actual level in the hazardous dust area

Example of saccharification

Temperature measurement

Before the mash is passed on to the fermentation process, cooling may be necessary using special cooling units. A certain temperature range is needed to permit optimum execution of the subsequent fermentation process.

The temperature is monitored using transformers from the SITRANS T product line. Integration of the measurement point is implemented over PROFIBUS PA.

Temperature measurement with SITRANS T on a mash cooler

Intermediate storage vessel in an ethane plant

Example of fermentation

Valve control

The saccharified mash is fermented over several days with the addition of yeast in various reactor tanks. The tanks are filled and emptied by opening and closing valves. The valves are controlled by SIPART PS2 positioners whose main task is to control the exact valve position and to immediately diagnose any faults on the valves.

The SIPART PS2 electropneumatic positioners for linear and part-turn actuators can be used for valves from almost all manufacturers. Their negligible air consumption and numerous diagnostic features – for example the ability to determine the existence of pipeline deposits or wear of the valve seat or cone – help to keep operating costs low.

Fermentation tanks of an ethanol plant in Nebraska

Valve control with SIPART PS2 in a continuous fermentation plant

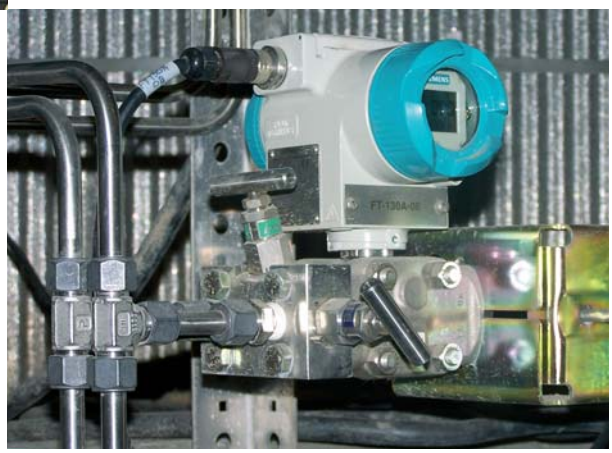
Distillation plant for ethanol

Example of distillation

Pressure measurement

The sour mash obtained following fermentation is heated in the distillation plant. The distillation products are largely an alcohol/water mixture, and a residue free of alcohol called the slop.

Since explosive gases can develop in the distillation plant, all process instruments installed there must be suitable for hazardous areas, such as the differential pressure transmitters used for fractionation. Pressure instruments are also frequently used to record the levels of liquids using the hydrostatic measuring procedure, as required in storage tanks following the molecular sieves.



Differential pressure measurement with SITRANS P in an ethanol plant, connected over PROFIBUS

Storage silos for ethanol

Example of storage

Limit level measurement

There are many different types of storage tanks in an ethanol plant. Raw materials such as wheat or water, intermediate products, end products such as ethanol or slop, or additional material like enzymes must be stored, and their level monitored.

Tanks must not overflow. Monitoring of tanks for minimum and maximum levels, which can also be used for overfill protection, is carried out using different methods of point level detection. Some of the technologies capacitive, with ultrasonics or electromechanical. Point level sensors can be used both in storage silos (yeast) and in process tanks (fermentation).

Monitoring of minimum level on a tank using POINTEK

Application examples in ancillary plants

Process instrumentation also plays an important role in the ancillary plants, whether for pressure regulation during the generation of superheated steam or monitoring of overflow basins in cooling plants. Measurements are also necessary during the separation of slop in the filling equipment for manufactured ethanol. Special country-specific regulations may also apply to the measurement and recording of the alcohol quantities produced. Siemens extensive experience and devices approved for custody transfer make us a very competent partner in this field.

Example of alcohol concentration

Fraction measurement

Some of the central questions are: How high is the concentration of alcohol currently being produced? Are all my processes working correctly? Is the alcohol content high enough after the mixture has passed through the molecular sieves?

Very expensive instruments with special density measurement capabilities are frequently installed in order to determine the alcohol concentration. A fraction measurement is much simpler and cheaper. This measurement is already included in the SITRANS FC Coriolis flowmeter. The device measures density, temperature, and mass flow. Using the fraction measurements, the respective densities of the alcohol/water mixture can be determined, and the user is provided with a reliable statement on the produced quantity of alcohol. And, all this is accomplished with just one measuring instrument.

Example of drying

Flow measurement

Following the concentration plant, the viscous syrup is passed on to the dryer. It is important to obtain a statement on the introduced mass of syrup. A mass flowmeter, the SITRANS FC, operating according to the Coriolis principle is preferably used here.

Flow measurement with the Coriolis measuring principle on the drying plant

Selected process instruments for manufacture of ethanol

Temperature measuring instruments

The measurement required most in plants for the manufacture of ethanol is temperature. Here you can benefit from our comprehensive range of temperature measuring instruments – for the complete plant and for all typical processes. Siemens temperature transmitters are highly accurate, intrinsically-safe, and can be connected to all usual types of sensors. The SITRANS T temperature instruments provide you with sensors, field transmitters, and head-mounted transmitters either individually or as a complete measurement setup.

Field transmitters SITRANS TF

- Remote installation possible
- 3-key operation
- Aluminum or stainless steel housing
- IP68

Head-mounted transmitters SITRANS TK / T3K PA

- Bus capability (PROFIBUS)
- HART communication
- For sensor head form B
- Electrically isolated

Sensors

- Many different thermocouples and resistance thermometers
- Versatile mounting possibilities
- Customized designs

Pressure measuring instruments

Level, pressure, process pressure, differential pressure, and flow: the SITRANS P pressure transmitters cover all these applications which can be found throughout ethanol production plants. We will provide the appropriate version, whatever the conditions of the use. The SITRANS P series are accurate, rugged, user-friendly, and have superior diagnostics and safety functions. All these features help you increase your productivity and reduce costs.

Pressure transmitters SITRANS P DS III

- 3-key operation
- Comprehensive diagnostics functions
- HART and PROFIBUS
- High accuracy
- Measuring cells for critical media
- SIL 2

Pressure transmitters SITRANS P 300

- Stainless steel housing as standard
- Diaphragm flush at front
- 3-key operation
- Comprehensive diagnostics functions
- HART and PROFIBUS
- High accuracy

Flow measuring instruments

Regardless of the flow application anywhere in the ethanol plant, we have the appropriate SITRANS F flowmeters for your process, from the mash up to the finished ethanol. We offer flow measurement solutions using several different technologies. These include electronic devices using the following principals: electromagnetic, Coriolis, ultrasonic, mechanical rotary-piston meters, or an orifice plate in association with the SITRANS P pressure transmitter.

Electromagnetic SITRANS FM

- For liquids, pastes, and slurries
- Comprehensive diagnostics functions
- HART and PROFIBUS
- NOVOLAK lining for extreme demands

Coriolis SITRANS FC

- HART and PROFIBUS
- For large or very small flows
- Highly accurate measurement
- No inlet or outlet pipe sections required
- Fraction and density measurements

Rotary-piston SITRANS FR

- Approved for custody transfer
- No inlet or outlet pipe sections required
- Independent of corrosive or highly viscous materials
- Not influenced by flow profile, conductivity or damping

Point and level measuring instruments

Our SITRANS L product line for continuous level measurements or our POINTEK sensors for detecting point levels includes a portfolio perfect for applications associated with the manufacture of ethanol. We can always select the optimum device. Whether ultrasonic or radar, whether capacitive, hydrostatic, or electromechanical, we are the leader in level measurement technology!

Level measurement with SITRANS LR 400

- Non-contact measuring procedure
- For bulk materials
- For storage tanks
- For extreme production of dust

Level measurement with SITRANS Probe

- Non-contact measuring procedure
- For liquids and slurries
- For storage silos and process tanks

Capacitive level measurement with SITRANS LC

- For liquids and slurries
- For storage silos and process tanks

Selected process instruments for manufacture of ethanol

Point level switch POINTEK

- Capacitive, electromechanical, or ultrasonic
- For interfaces, liquids, powders, bulk materials, foams, viscous media etc.

SIWAREX

There are various applications in an ethanol plant in which weight has to be determined. Weighing tasks integrated in the system (with SIWAREX) and dynamic weighing tasks (with the tried and tested Milltronics weighing systems) can be carried out easily and precisely using our weighing and dosing systems. SIWAREX is then tailored for integration with a SIMATIC PLC up to a SIMATIC PCS 7 process control system.

SIWAREX weighing electronics

- As function modules in SIMATIC or distributed over PROFIBUS
- For custody transfer
- Comprehensive application software

SIWAREX load cells

- 6 different series for many different applications
- For custody transfer
- Highly exact
- Large measuring range up to 280 t

Milltronics belt scales

- For measurement of flow, total weight, belt load and belt speed
- High precision
- Easy loading
- With SIWAREX integration in SIMATIC and PROFIBUS communication

Positioners

The SIPART PS valve positioners are the most widely used intelligent positioners for linear and rotary actuators. In an ethanol plant, valves from different manufacturers are often used. Our positioner not only allows uniform parameterization and operation, its low air consumption permits significant cost savings. It is available on short notice from stock. The corresponding mounting kits are available for many valve suppliers. The valve can often be ordered from the valve manufacturer including the SIPART PS2.

Positioner SIPART PS2

- Versatile diagnostics functions possible
- 3-key operation
- Plastic, Aluminium or stainless steel housing. Optional explosion-proof housing available
- Minimum air consumption
- For linear and rotary valves

Worth knowing about our process instruments

Approvals

Different areas and processes in the plant require that process instruments have defined approvals. For example, only the use of devices with explosion protection is permissible in the distillation area. Or, there are zones, like storage tanks, where devices must have dust explosion protection. Our process instruments have all required worldwide approvals for such plants.

Communication

The process instruments used in an ethanol plant deliver the measured data to the host controller. The transmission is either "classical" over the 4–20 mA connection with superimposed HART protocol, or over intelligent bus connections such as PROFIBUS. Our process instruments are available for HART, PROFIBUS, and other buses.

Diagnostics

Information on maintenance requirements and process status early in the application is a big advantage. Siemens process instruments include comprehensive diagnostic capabilities which help you to correctly react to critical requirement as quickly as possible.

Parameterization

SIMATIC PDM (Process Device Manager) from Siemens is a uniform parameterization software tool for central access to all process devices with communications capability in a plant. It is vendor-independent and allows operation, adjustment, maintenance, and diagnostics of the process devices.

Your Siemens partners worldwide

Further information at:

www.siemens.com/processinstrumentation

www.siemens.com/weighingtechnology

www.siemens.com/chemical

www.siemens.com/bioethanol

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