Food & Beverage Industry Solutions

Accurate and Reliable Liquid Analysis

ROSEMOUNT® Analytical

EMERSON™ Process Management

Food & Beverage Liquid Analysis Solutions

Today, food and beverage manufacturers rely more on automated controls than previous generations, who believed that creating food was more of an art. The most important goal for today's food and beverage processor is to achieve a higher quality, consistent product. Other concerns leading to increases in automation controls include improving appearance (both color and texture), increasing shelf life, increasing yields, minimizing waste, and providing a safe product for the consumer.

With so much at stake, it is critical to use rugged, easy-to-maintain equipment that has been designed to withstand the challenges inherent in food and beverage processing. The liquid analytical professionals at Emerson Process Management are ready to put their 60 plus years of experience to work for you. We'll evaluate your application and deliver an optimal, real-world, customized solution for your specific requirements, using world-class Rosemount Analytical sensors and instrumentation.

On-line electrochemical fluid measurements, such as conductivity, pH, dissolved oxygen, ORP, chlorine, and ozone, provide significant improvements in the level of process control, quality, efficiency, and profitability that can be achieved in food processing.

Water is one of the most widely used materials in food and beverage production. Water is used not only as an ingredient in the final product, but also is used extensively in cleaning and rinsing operations. Today's regulations also call for treatment of wastewater before final discharge or reuse.

Raw water is treated prior to entering the food and beverage plant. Several technologies exist to treat water: reverse osmosis, distillation, ozonation, and micro-filtration. Measurements such as conductivity, pH, ozone, and ORP are used to optimize the purification process.

During food processing, analytical sensors ensure that the batch is within specified parameters. The sensors must be designed to last through the entire batch and notify key personnel if a parameter is off specification or if the sensor is not functioning properly.

Food preparation requires sanitary designs to ensure that the growth of undesirable microorganisms is controlled and prevented. Any component that comes into contact with either an ingredient or finished product must be designed to sanitary standards. This means the surface of the sensor does not contain contours that could trap residue from the product that could then decay or harbor microorganisms. The components must also be able to withstand clean-in-place cycles for sanitation.

The requirement that the instruments and controls used for measuring, regulating, or recording pH or other conditions shall be accurate and adequately maintained has led to the increased use of sensors and instruments provided by Rosemount Analytical.

At the completion of the production cycle, the waste effluent must be treated prior to discharge or reuse. Dissolved oxygen, chlorine and pH sensors ensure that the water has been sufficiently cleaned and sanitized to allow for reuse or disposal.

For these applications and more, count on Emerson Process Management. Our full line of Rosemount Analytical sensors and measurement solutions for food and beverage applications have been proven over time. When you bring your problem to Emerson, consider it solved.

Food & Beverage Industry Solutions

CORN WET MILLING

Corn Wet Milling is the process of separating corn into its many and varied components to create value-added products. Processing one bushel of corn requires at least 40 gallons of water. In addition to monitoring process water quality, liquid analytical sensors are used in many other plant operations.

- pH in fermentation, steeping tanks, isomerization processes, starch modification, dextrin roasters, filters/ ion exchangers, high fructose corn syrup, and rinse waters
- Conductivity in cleaning processes
- Dissolved oxygen in fermentation

BEVERAGES

Beverages often contain water as the largest ingredient. Liquid analytical instruments and sensors play a critical role in producing a consistently high quality product and maximizing production up time.

- Conductivity for water purification
- Ozone for bottle disinfection
- Dissolved Oxygen for aeration

BREWING

Brewing has traditionally been an art, but brewers now approach production with an eye on consistent quality; long shelf life and efficient production. Modern brewers use the following analytical measurements to achieve these goals.

- Dissolved oxygen in hot wort, fermentation, aging tanks, filtering, & packaging
- Conductivity for cleaning, and phase separation
- pH in water purification, wort, and fermentation

DAIRY

Dairy producers have unique analytical requirements for monitoring phases of product, as well as complying with 3A standards. The following measurements help ensure the processes run optimally.

- Conductivity for flavor additions, cleaning, and cheese production
- pH in yogurt processing, cheese making, and fresh milk
- Ozone for sterilization

Common Applications

Although each food and beverage production line is unique, many share a few common processes. These include Water Purification, Clean-in-Place sanitation and Ozone Sanitation.

Water Purification
Municipal water must be treated before use in food production. Many technologies exist, including reverse osmosis, micro filtration, and distillation. Each technology works differently to remove the impurities. Reverse osmosis (RO) removes minerals by forcing water through semi-permeable membrane. Micro filtration also removes particles. Distillation removes minerals by vaporizing water and then condensing it back into liquid.

Contacting conductivity sensors monitor the effectiveness of RO or distillation by measuring the salts remaining after treatment. Adding a conductivity sensor to the RO feed water allows calculation of percent rejection or percent passage – important gauges of membrane performance.

Some purification systems will use a pH sensor prior to the removal system. This is useful as the filtering element's efficiency can be lessened by scaling, a result of low pH, or damaged by high pH levels.

Clean in Place (CIP)
All process equipment that comes in contact with final food product must be thoroughly sanitized to eliminate bacterial contamination. CIP is also a critical safety concern for food processors that use allergens in some of their products, because cross-batch contamination must be avoided. Clean-in-Place systems thoroughly clean wetted components such as tanks, vessels, fermentors, process lines, and in-line sensors. The Clean-in-Place process controls the flow of pre-rinse, wash and post-rinse cycles, which include caustic rinse, acid rinse, and water rinse cycles.

Conductivity sensors are a critical component in the design of CIP systems. The various cleaning solutions have more conductivity than the water used for flushing and final rinse. Since many systems are a 're-used design', the sensor can monitor the strength of cleaning solutions as they become diluted by residual rinse water and the cleaning process itself. Conductivity measurements can indicate the need for replenishment.

Steam can be used in the sanitation process, so sensors must also withstand steam cleaning. To ensure that each piece of equipment has been thoroughly sanitized, conductivity sensors are used. Low conductivity indicates rinsing, as well as the completion of the cleaning process.

Ozone Sanitation
Ozone sanitation is growing in popularity due to its many benefits. Ozone has excellent cleaning characteristics and disinfects more powerfully than other chemical disinfectants. Unlike chlorine, ozone leaves no residual taste or odor. In addition, ozone is generated onsite and requires no hazardous material storage precautions.

Ozone sanitation applications in food processing plants include barrel washing, water treatment, surface sanitation, wash downs, bottle rinsing, CIP, transfer lines, mold control, and wastewater treatment.

Critical analytical measurements on ozone sanitation skids include residual ozone, ORP, pH and temperature. Rosemount Analytical sensors make a direct ozone measurement, unlike other technologies that use an inferred method using ORP and temperature.

Corn Wet Milling

Corn refiners are continually perfecting the process of separating corn into its components to create value added products such as starches, sweeteners, oils, fibers and proteins. Over 1.3 billion bushels are processed each year in the U.S. alone, and each bushel requires at least 40 gallons of water. The water must be treated, used in the process, and then treated again before discharge. Good process control in water treatment maximizes yields from every bushel.

THE PROCESS CONSISTS OF THESE SIX BASIC STEPS:

Steeping

Once the corn kernels are cleaned, the steeping process begins. The kernels are moved to stainless steel tanks holding up to 3,000 bushels of corn. The kernels are soaked in 50°C water for 30-40 hours. Sulfurous acid solution (normally 0.1% Sulfur Dioxide) is added to the water to prevent excessive bacterial growth. SO_2 addition is controlled by measuring pH. Too much acid may release the starch prematurely. As the corn swells and softens, the mild acidity of the steepwater begins to loosen the gluten bonds within the corn and release the starch. After steeping, the corn is coarsely ground to break the germ loose from other components. Steepwater is condensed to capture nutrients in the water for use in animal feeds and in later fermentation processes. The ground corn, in a water slurry, flows to the germ separators.

Germ Separation

Cyclone separators spin the low density corn germ out of the slurry. The germs, which are rich in oil, are pumped onto screens and washed repeatedly to remove residual starch. A combination of mechanical and solvent processes extract the oil from the germ. The oil is then refined and filtered into finished corn oil. The germ residue is used in animal feeds.

Fine Grinding and Screening

The corn and water slurry leaves the germ separator for additional grinding in an impact or attrition-impact mill to release the starch and gluten from the fiber in the kernel. The fiber is collected, slurried, and screened again to reclaim any residual starch or protein, then piped to the feed house as a major ingredient of animal feeds. The starch-gluten suspension, called mill starch, is piped to the starch separators.

Starch and Separation

Centrifuges separate the gluten, which is used in animal feed, from the starch. The starch, with just one or two percent protein remaining, is diluted and washed to remove the last trace of protein. This produces high quality starch, typically more than 99.5 percent pure. The starch can be further processed and sold as unmodified corn starch, specialty starch or corn syrups and dextrose.

Starch / Syrup Conversion

Suspended starch in water is combined with acid and enzymes, which converts the starch into dextrose. Throughout the process, refiners can halt acid or enzyme actions at key points to produce the right mixture to meet different needs. The syrup is refined in filters, centrifuges and ion-exchange columns, and excess water is evaporated. Syrups are sold directly, crystallized into pure dextrose, or processed further to create high fructose corn syrup. The pH is maintained between 3.0 and 5.5 based on the enzymes used and the final product composition.

Fermentation

Many corn refiners pipe dextrose to fermentation facilities where the dextrose is converted to alcohol by traditional yeast fermentation or by yeast and bacterial fermentation. After fermentation, the resulting broth is distilled to recover alcohol or concentrated through membrane separation to produce other bioproducts. The by-products of carbon dioxide and nutrients are captured for sale. Critical control measurements include pH and dissolved oxygen.

Brewing

Beer has been popular with every major civilization for the last 8,000 years. Water, barley, hops, and grains are the primary ingredients in beer. Over the centuries, brewing has been considered an art form, but today's brewers are also concerned about consistent quality and maximizing shelf life. Modern brewers use a scientific approach to brewing through on-line analytical and measurement devices resulting in better process control. Here are the key steps in creating a consistent beer.

Milling and Mashing
First the barley grains are malted, producing enzymes that catalyze the breakdown of starch into fermentable sugars. The malted barley is transferred to the mash tun. Mashing is complete when all starches have been converted into fermentable sugars. Mash pH is a critical control point.

Lautering and Brew Kettles
After mashing is complete, the mash slurry is delivered to the lauter tun, where liquid wort is strained from the insoluble grain husks. An internal rake circulates to distribute the mash solids within the lauter tun. After the lauter tun is filled, the mash slurry is allowed to settle, and the wort flows through the filter bed. The wort is drawn from the bottom of the tun and recirculated to the top of the bed until the first wort reaches the desired clarity. Hot water is sprayed into the lauter tun to recover as much fermentable extract as possible. Turbidity is a critical measurement for wort clarity. Conductivity may be measured for cleaning and disinfection purposes.

The sweet wort run-off from the lauter tun is delivered to the brew kettle. The brew kettle prepares the wort for fermentation. The wort is brought to a vigorous boil for sixty to ninety minutes to sterilize it, coagulate proteins, and vaporize undesirable volatiles and excess wort. After the boil, the bittersweet wort is pumped into the whirlpool. The wort is drawn off from the edge of the tank, and passed through a heat exchanger, which cools the wort from 200°F to 65°F. Now the wort is ready for delivery to the fermentation cellar. Hot wort pH and wort pH are monitored to determine hop solubility, as this affects body, palate and clarity of the beer.

Fermentation and Aging
Yeast is pitched into the tanks, initiating the primary fermentation. Fermentation converts the cold wort into alcoholic beer. Sterile air or oxygen is injected into the bottom of the tank to support the living yeast and ensure all sugars are converted into alcohol. The process takes 3 to 5 days. Carbon dioxide is generated during this phase and recovered for use in other areas of the brewery or sold. Once primary fermentation is complete, the beer is aged. The lagering tanks are sealed and fermentation continues for 7 to 24 days. Dissolved oxygen is a critical control point during fermentation. Too little oxygen will not allow all the yeast to ferment, and too much will over stimulate the yeast, creating shelf life issues. pH levels are also controlled to optimize the conversion to alcohols and ensure consistent product quality.

Finishing and Packaging
After fermentation, the beer is blended for attenuation and alcohol content. Regulation of diluting water, CO_2 and other additives is performed. Blended product is transferred to large cylindrical vessels in rooms called "Ruh" cellars, where yeast and other materials settle out. Next the beer is pumped through clarified filters into finishing cellars. For bottled or canned beer, proteins are added to precipitate out colloidal solids. Beer remains in the finishing tanks for 10 to 14 days. Prior to packaging, the beer is passed through pulp filters and is delivered to the filler bowl. It is then bottled, canned, or placed in kegs and sealed. Oxygen exposure must be minimized to prevent dimethyl sulfide (DMS) formation. Measuring dissolved oxygen optimizes quality and maximizes shelf life.

Beverage

The beverage segment includes products such as bottled water, juices, and carbonated beverages. Water is the largest ingredient in many of these products. Water purification systems play a critical role in producing a consistently high quality product and maximizing up time.

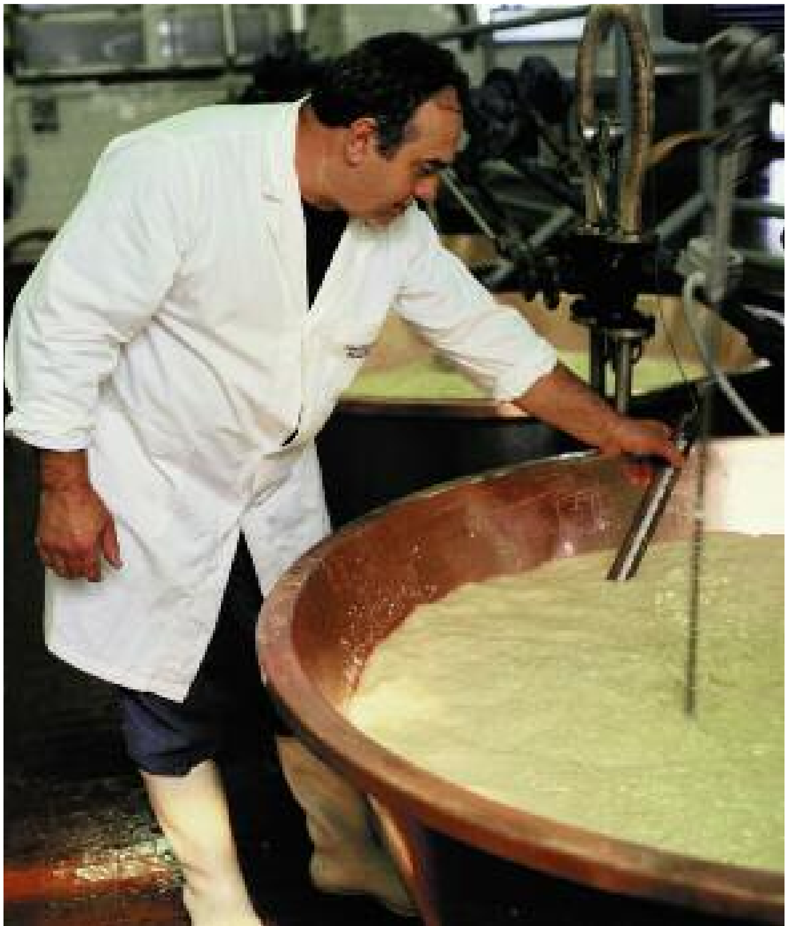
Typical analytical measurements are pH and conductivity in orange juice; dissolved oxygen in carbonated water and soft drinks; conductivity in bottled water; and ozone in the bottling plant. Beverage plants require highly accurate analytical devices with minimal maintenance requirements to keep the plant up and running.

Dairy

Dairy applications include fluid products (milk) and cultured dairy products (cheese and yogurt), and others (ice cream, butter). Dairy plants have unique analytical requirements to ensure the processes are running optimally.

Conductivity is a critical measurement and sensors are used to monitor flavor additives, to differentiate between different phases of production, and types of products, whether it is a type of milk (non-fat, whole milk) or cheese. Conductivity also determines cleaning cycles and how well tanks, transfer lines and agitators have been cleaned. Conductivity sensors must be designed to 3A standards.

Ozone is the technology of choice for sanitation applications in dairies. Typical sensors supplied on ozone generating systems are dissolved ozone, ORP, and temperature.



Waste Treatment

Food-processing wastewater consists of wash down of products (fruits and vegetables), run-off from equipment and tank cleaning, chemical cleaning solutions, and other food byproducts such as spent grains. With the exception of some toxic cleaning products, wastewater from food-processing facilities is organic and can be treated by conventional biological methods. Wastewater from meat processing plants may have high pathogen levels and must be disinfected prior to discharge. Chlorine is the typical disinfectant, although ozone is becoming more popular as regulations governing chlorine in wastewater become stricter.

Food-processing plants consume vast amounts of water, some in the range of 1,000,000 gallons of potable water per day. Many food-processing plants are located in rural areas where the water treatment systems (i.e., potable and wastewater systems) are designed to serve small populations. As a result, one medium-sized plant can have a major effect on local water supply and surface water quality.

Critical analytical measurements in wastewater treatment include residual chlorine or ozone, pH, dissolved oxygen, and conductivity. Waste water treatment plants must be optimally managed and robust sensors must be used to maximize up time. Diagnostic information determines sensor health and ensures the sensors perform optimally.

Common Sensors


225 CIP Toroidal Conductivity Sensor


Model 245 Flow-Through Toroidal Conductivity Sensor


Model TF396 Non-Glass pH Sensor

225 CIP Sensor
The Model 225 Clean-in-Place (CIP) sensor is designed for applications in the food and beverage industries where processing equipment is routinely cleaned with 2% caustic at temperatures up to 100 degrees C. Process installation is made with a customer supplied two-inch TriClamp®. The Tri-Clamp design in unfilled PEEK meets 3A sanitary standards and is FDA compliant for repeated food contact applications.

245 Flow-Through Conductivity Sensor
The Model 245 Sanitary Flow-Through Toroidal Conductivity Sensor is available in 0.5, 1.0, 1.5, and 2 inch TriClamp sizes. Wetted materials are 21 CFR, parts 170-199 compliant. The sensor clamps into the process piping between TriClamp flanges. Special grounding rings are not needed because contact rings are built in. A separate temperature sensor is available as an accessory.

TF396
The industry proven, patented TUpH™ reference junction of the TF396 sensor sets a new standard for cost-of-ownership of pH and ORP in harsh applications. The TUph reference junction resists the effects of process coating, reducing costly maintenance and downtime. The non-glass ISFET pH electrode has a rate of response that is faster than glass electrodes, which means better process control. It is most suitable for use in cold processes like brine or water for cooling.

Model Bx438 Dissolved Oxygen Sensor
The Model Bx438 sensor is designed to monitor trace levels of dissolved oxygen in beer and other carbonated beverages. The sensor utilizes a robust membrane and is designed to withstand significantly more clean-in-place (CIP) cycles than other dissolved oxygen sensors.

The design of the membrane is the key to achieving high performance and decreased maintenance. The electrode construction guarantees excellent stability even after numerous sterilization cycles. The cost to maintain the Bx438 sensor is approximately one-third the cost required to maintain competitive dissolved oxygen sensors.


Bx438 Dissolved Oxygen Sensor

Common Sensors

Model Hx338 Steam Sterilizable pH Sensor

Model 499ADO Sensor

Model 399 pH Sensor

Model Hx338
Steam Sterilizable pH Sensor

The Model Hx338 Sensor is specifically designed for biopharmaceutical and food processes. The sensor's unique tri-triple reference technology helps to maintain a drift-free pH signal and performs exceptionally well against poisoning agents (sulfides, proteins, or sugars), even after numerous sterilization cycles. The Hx338 can also withstand high protein and salt concentrations. These features make the sensor ideal for purification processes.

ENDURANCE™ Conductivity
403 Sensor

The sensor has titanium electrodes with a PCTFE (Neoflon®) insulator, providing stability and ruggedness without sacrificing accuracy. This provides a reliable sensor for the food and beverage industries. The sensor is available with either a 1½ -inch or 2-inch Tri-Clover fitting.

The sensor also features a 16 micro inch Ra surface finish to meet the demand for hygienic finishes in the food industry. All wetted plastics and elastomers are compliant with 21CFR177.

Model 403 Sensor

Model 499ADO
Dissolved Oxygen Sensor

The Model 499A Dissolved Oxygen (DO) sensor accurately measures dissolved oxygen in a variety of applications, particularly industrial wastewater. For process liquids that foul and coat the membrane, the Air Blast Cleaner System is available.

Model 499ACL
Free Chlorine Sensor

The Model 499ACL is important in measuring residual chlorine from final disinfection runs. This sensor measures free chlorine without messy and expensive reagents and sample conditioning systems. The sensor measures free chlorine in samples having pH between 6.0 and 9.5. A Model 399 pH sensor may be required.

Model 399 pH and ORP Sensor

This is a general purpose sensor that features an annular ceramic junction surrounding the pH/ORP sensitive membrane. The double-junction reference cell is resistant to contamination by processes containing ammonia, chlorine, sulfides or other poisoning agents.

Retractable Sensor
Mounting Assembly

Designed for use with Rosemount Analytical steam sterilizable pH and DO sensors, the assembly is built to withstand clean-in-place cycles. The sensor can be withdrawn without interrupting the process. An integral safety mechanism prevents the assembly from being inserted into the process without the electrode being installed. While in the retracted position, the sensor can be cleaned with water or buffer solutions. The retractable assembly is manufactured with 316 stainless steel and FDA approved EPDM o-rings.

Hx Retractable Sensor Mounting Assembly

Rosemount Analytical Instrumentation

The optimum solution for the process relies on selecting the right sensor to match the process needs. In most cases the instrument is simple to select and depends on the power, control and communication requirements. In addition to other desired features, communication protocols FOUNDATION® fieldbus and HART® are available. Both offer the industry's most comprehensive sensor diagnostics. Choose the one that meets your needs. Food and Beverage production can especially benefit from FOUNDATION® fieldbus devices, offering electronic data capture for calibration and configuration changes per 21 CFR Part 11. New plant start-ups are accelerated with smart, host-accessible transmitters.

Features	SoluComp II, 1055 Series	54e Series	5081 Series	SoluComp Xmt Series
Power Requirement	115 - 230 VAC or 24 VDC	115 - 230 VAC or 24 VDC	24 VDC	24 VDC
Number of Sensor Inputs	Two	One	One	One
Number of 4-20 mA Outputs	Two	Two	One	One
Available Measurements	pH, ORP, Conductivity, Resistivity, Dissolved Oxygen, Ozone, Chlorine, Flow	pH, ORP, Conductivity, Resistivity, Dissolved Oxygen, Ozone, Chlorine	pH, ORP, Conductivity, Resistivity, Dissolved Oxygen, Ozone, Chlorine	pH, ORP, Conductivity, Resistivity, Dissolved Oxygen, Ozone, Chlorine
HART Compatible	No	Yes	Yes	Yes
FOUNDATION Fieldbus Compatible	No	No	Yes	Yes
Multi-lingual	Yes	Yes	No	No
Relays	3	4	0	0
PID Control	No	Yes	Yes/Ff	Yes/Ff
Advanced Diagnostics Capability	Some	Complete	Complete	Complete
Hazardous Area Classifications	Class I, Div. II	Class I, Div. II	Class I, Div. I and Div. II, Explosion proof	Class I, Div. I and Div. II
Available Approvals	FM, CSA, CE, UL	FM, CSA, CE	FM, CSA, CE, ATEX	FM, CSA, CE, ATEX

Turbidity available in Model T1055/Clarity II

Emerson Process Management: The Proven Source

Emerson Process Management is the proven supplier of Rosemount Analytical on-line electrochemical sensors and instrumentation with over 60 years experience in process control and waste treatment. In recognition of our dedication to customer service, product excellence, and quality, we have received the #1 Readers Choice Award from Control Magazine for the thirteenth consecutive year.

Incorporating a properly defined and validated water system will benefit food and beverage facilities through quality control and by reducing capital costs, lifetime maintenance costs and monitoring costs.

Accurate, on-line electrochemical measurements, such as pH, dissolved oxygen, conductivity, chlorine, and ozone, provide substantial improvements in the level of process control, quality, efficiency, and profitability that can be achieved in food and beverage processing. These measurements also play a critical role in meeting regulatory compliance at the local and federal level. Count on Emerson for the systems and solutions you need in an ever-changing, dynamic world. See us on the web at ***RAIhome.com.***

Gas Analysis

Emerson is the world's premier provider of process gas, combustion and environmental analysis solutions featuring products with unmatched accuracy, superior performance and worry-free dependability. Our leading edge instruments and applications expertise, along with unbeatable customer service and support worldwide help our customers maximize process performance, productivity, and profitability. Our solutions provide reduced installation and maintenance costs while improving process quality.

Call your Emerson Process Management representative for more information on all our process analytical solutions.

PlantWeb® Brings It All Together

Rosemount Analytical's instruments are part of Emerson Process Management's PlantWeb® field-based architecture: a scalable way to use open and interoperable devices and systems to build process solutions. The PlantWeb architecture consists of intelligent field devices, scalable platforms and standards, and integrated modular software, all working together to create, capture, use, and distribute information and process control data.

This architecture can reduce your capital and engineering costs, reduce operations and maintenance costs, increase process availability, reduce process variability, and streamline regulatory reporting. When combined with FOUNDATION fieldbus, new plants get the benefits of accelerated plant start-ups due to less wiring demands and easier analyzer configurations.

To see what PlantWeb can do for *your* operation, call or visit us at ***PlantWeb.com/RunSafe***

> COMPLETE PROCESS ANALYTICAL SOLUTIONS

GAS CHROMATOGRAPHY

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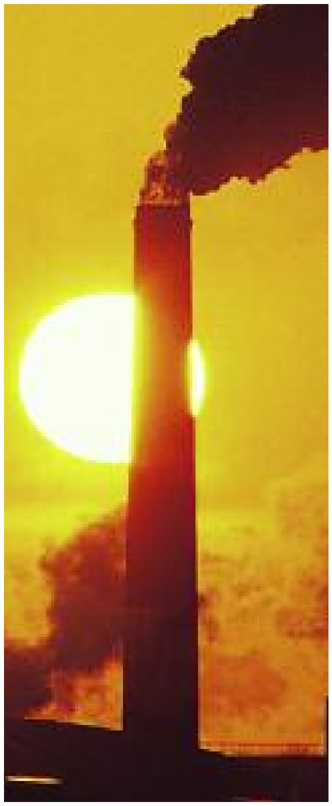

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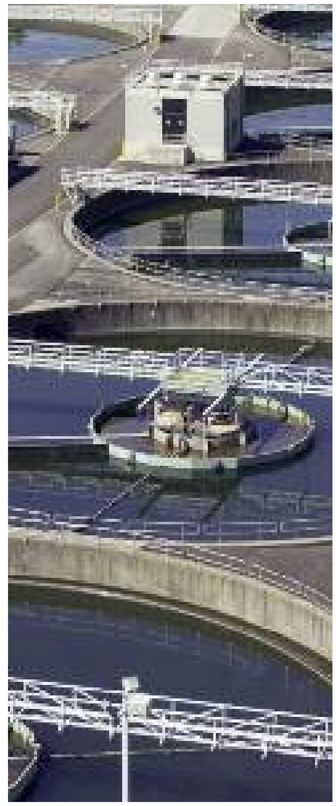

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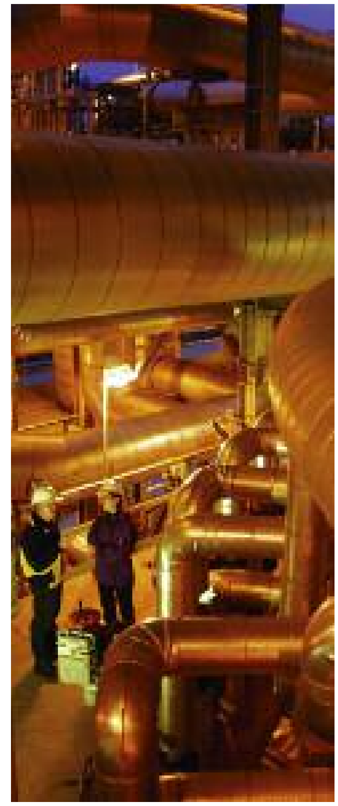

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