Improving Safety and Optimization in the Mining Industry

Cutting-edge measurement instrumentation helps improve resource use and production efficiency, delivering strong return on investment and progress towards meeting environmental, social, and governance goals.

EMERSON™

The metals and mining industry is a key player in the global energy transition because it provides many of the raw materials needed for critical components, such as batteries and wind turbine blades. These materials must be mined and processed efficiently, while prioritizing safety, cost efficiency, and sustainability. Emerson's best-in-class solutions can help operations in all segments of mining operations increase efficiency, reduce emissions, and improve safety. By partnering with Emerson, facilities can thrive in this modern era of mining, ensuring a safe, smart, and sustainable future.

The key to success in any mining operation, whether small scale or part of a global corporation, depends on operating profitably at current market pricing. Therefore, most mine operators are constantly striving to improve their operational efficiency and reduce production costs, while ensuring that safety and environmental stewardship remain a priority.

Key performance indicators for mining operations center around price per ton of output, tons per day, and capital performance against cost and schedule. Sustainability is now also a growing part of the picture, looking at water and energy consumption per ton, along with overall carbon footprint and other emissions.

In this eBook, we will look at each phase of the mining process, including all operations typically located at the mine site (Figure 1).

Each area will indicate where Emerson's solutions empower mining companies to reduce emissions, water consumption, and energy usage—while improving overall efficiency, sustainability, and safety.

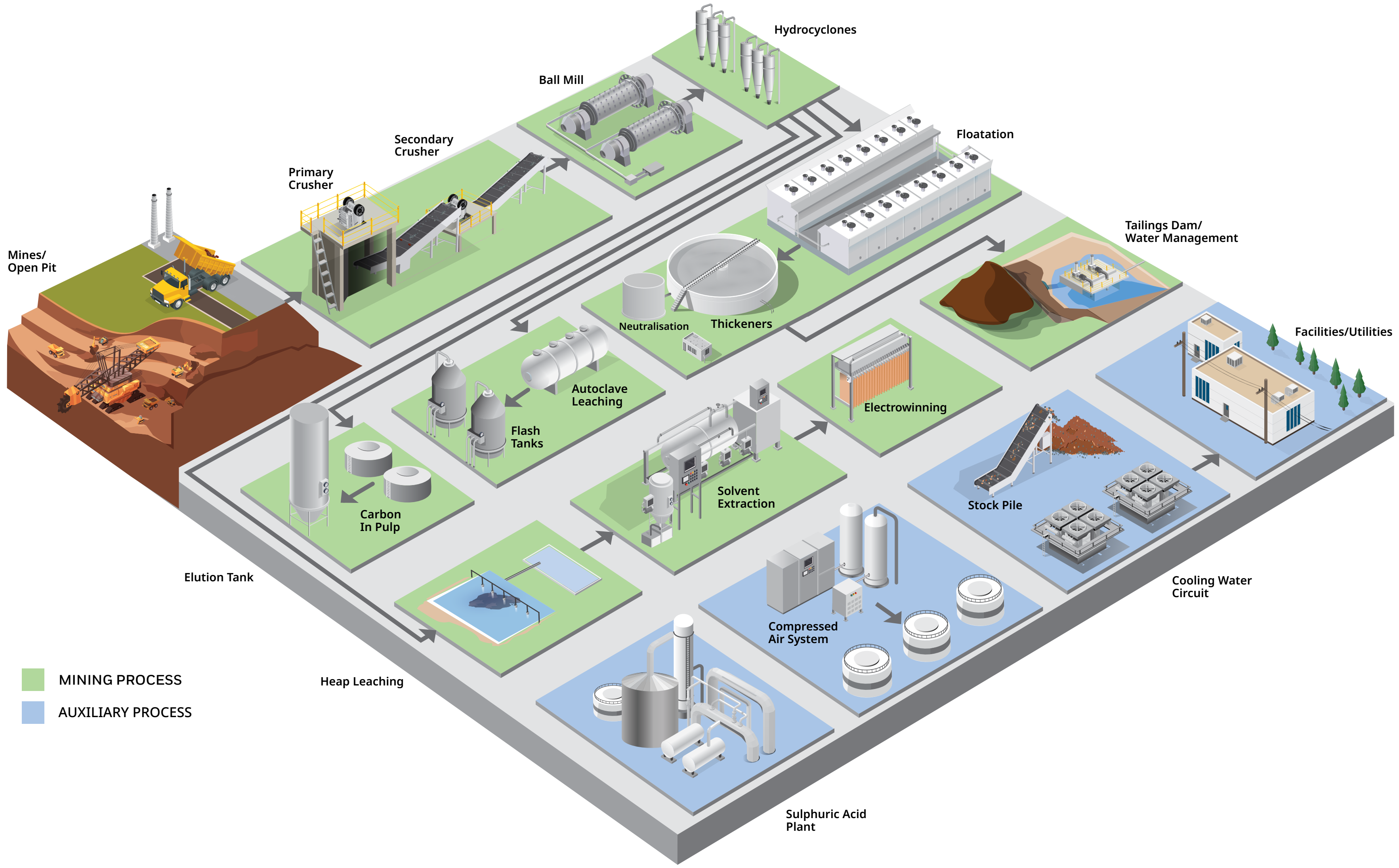


FIGURE 1
Processes typically located at a mine site.

Sensing and maximizing efficiency — Creating a strategy for sustainability requires measuring many variables throughout the full value chain of a process and its supporting utilities. It is impossible to pinpoint where a critical resource is being wasted if its use is not monitored. Typically, what gets measured, gets improved. Unfortunately, mine sites are generally located in remote areas, with harsh environmental conditions, and spread out geographically, making instrumentation difficult to deploy and support, with high wiring and network management costs.

Fortunately, Emerson's industrial wireless technology addresses this and other issues with a wide variety of *Wireless*HART® devices, along with Wi-Fi communication to cover these remote locations easily and economically.

This technology will be employed multiple times in the coming sections since it is so important for facilitating many individual solutions.

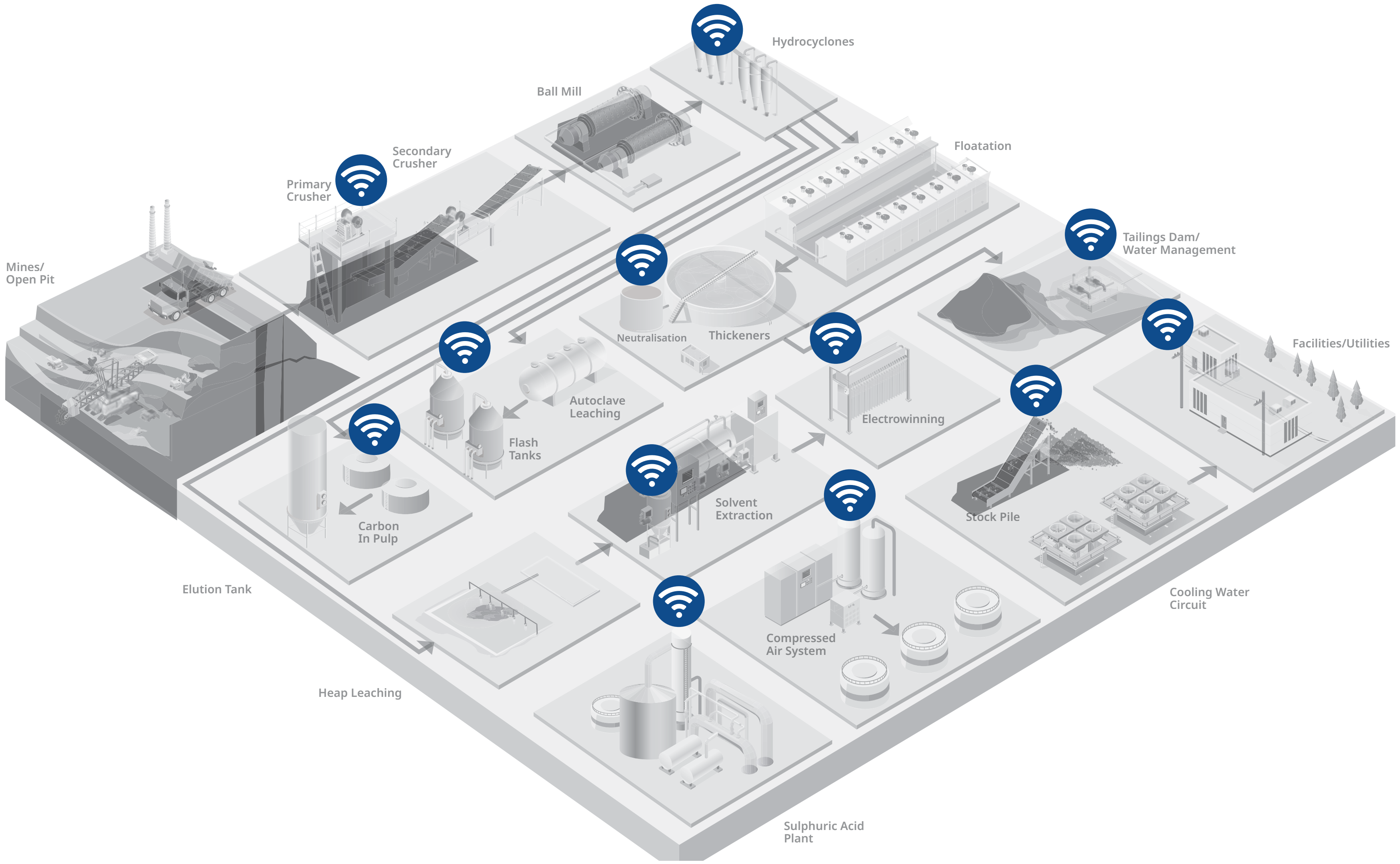


FIGURE 2
WirelessHART provides the mechanism for wireless sensing technologies to cover locations where cabling is costly and impractical.

1 Underground/ Open Pits

UNDERGROUND/OPEN PITS

Mining requires an excavation in the ground, either an open pit (open cast) mine, or underground via shafts and tunnels. The latter is particularly challenging as it is more complex and requires extensive infrastructure to keep workers safe, while performing their work.

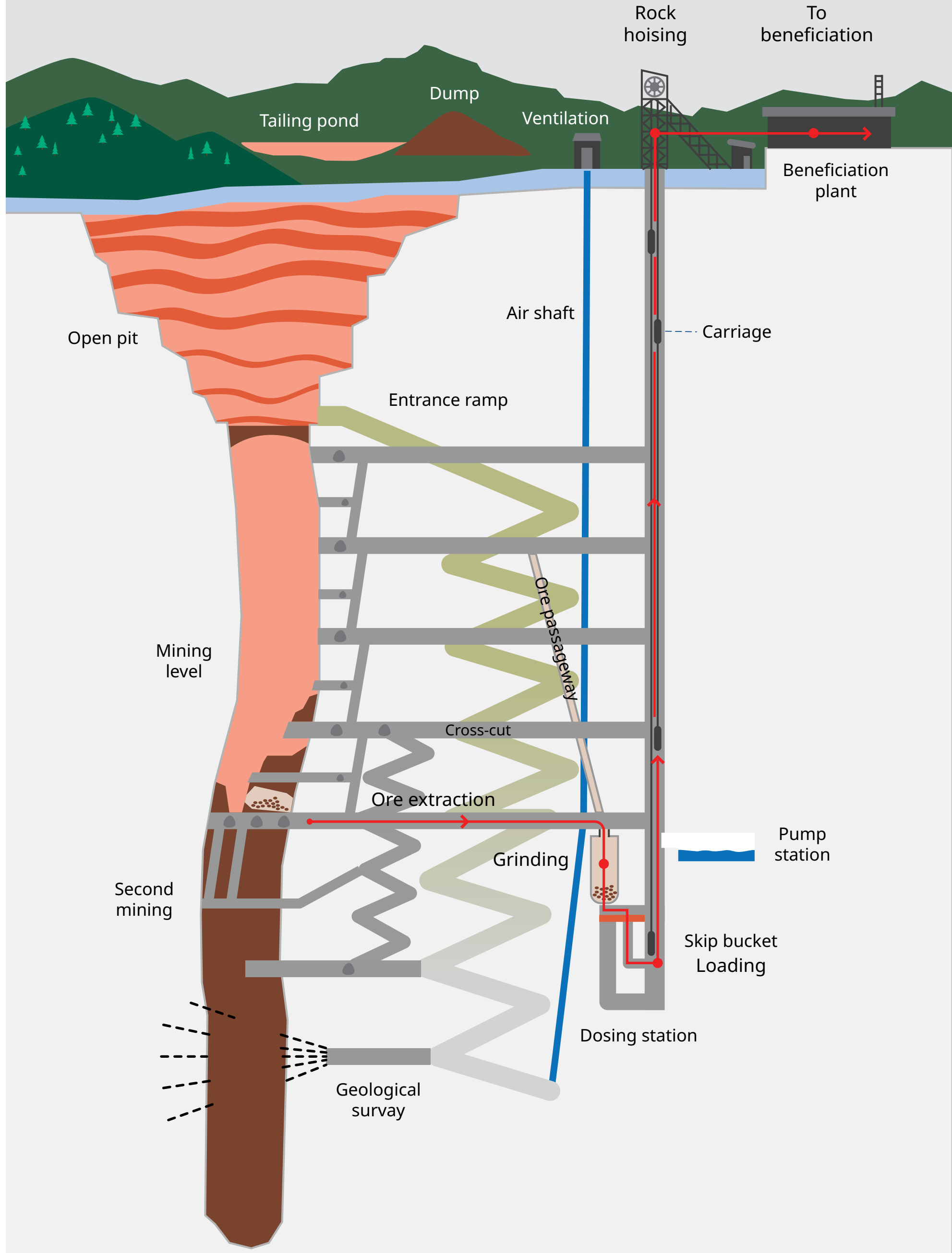
Hazardous gas monitoring — Underground mines have little natural ventilation, so it is critical to monitor carbon monoxide buildup, along with methane and hydrogen sulfide gas. Emerson offers its **Rosemount™ 928 Wireless Gas Monitor** (Figure 1.1), which can be fitted with sensors to measure oxygen depletion, along with the presence of carbon monoxide or hydrogen sulfide. These monitors use *Wireless*HART communication, so no wiring is necessary.

Additionally, the **Rosemount 925FGD Fixed Gas Detector** and the **Rosemount 625IR Fixed Gas Detector** can monitor combustible gases, such as methane to help keep mines and workers safe.

FIGURE 1.1
The Rosemount 928 Wireless Gas Monitor can be fitted with sensors to measure oxygen depletion, hydrogen sulfide, and carbon monoxide.

FIGURE 1.2
The Rosemount 485 Annubar Primary Element is well suited to measuring fresh air flow.

Ventilation monitoring — Maintaining breathable air in an underground mine requires monitoring the amount of fresh air being fed into the mine shaft and working areas. The **Rosemount 485 Annubar™ Primary Element** (Figure 1.2) can be inserted into the ducting driving air underground. This is more effective than conventional pitot tubes or thermal mass sensors since the Annubar is resistant to clogging from dust and does not require a high-velocity air stream to provide an accurate measurement. Annubar is also less sensitive to humidity variation, or potentially even liquid impingement, than thermal mass sensors. In some cases, the Annubar only needs to extend one-third of the way into the main duct to provide an accurate reading.



2 Run of Mine/ Crushing

RUN OF MINE/CRUSHING

The first size reduction process after the ore has been loaded and hauled from an open pit or underground mine is crushing.

The primary crusher must do significant work as it is the first stage of processing (Figure 2.1). From an operational standpoint, it receives ore in its least uniform state, with the largest and heaviest chunks. Ore may be dumped into the primary crusher from trucks, skip cars, and any other haulage method the facility has available.

To keep a crusher effective and efficient, it is best to operate within a specific flow window, which can be determined by measuring the depth of product in the entry stage. The **Rosemount 5408 Level Transmitter Non-Contacting Radar** can monitor this process variable in real-time, with no concerns regarding interference from dust and vibration. Using information from this instrument, operators can slow-down and speed-up feed rates as necessary.

FIGURE 2.1
The primary crusher is a truly punishing application, and it depends on careful throughput control, optimized using a Rosemount™ 5408 Level Transmitter Non-Contacting Radar

To detect potential blockages, it is essential to employ the **Rosemount™ 5408 Level Transmitter Non-Contacting Radar** downstream of the feed entry stage in plugged chute detection applications. This transmitter effectively monitors the crusher discharge to ensure a smooth flow of crushed ore onto the conveyor belt. Moreover, it plays a crucial role in confirming that the next production step can handle the full output rate. Also, its unique capability for measuring solids level by providing accurate and reliable data allows for improved operational efficiency.

The product of crushing (crusher run) is then conveyed to the second stage of the size-reduction process, grinding, or milling.

Belt conveyor monitoring — Belt conveyors offer versatility and cost benefits when moving ore over long distances, particularly where elevations change. Usually, a rubber coated belt rides on rollers set into pairs to form a low “V” channel to keep the product centered. Rollers can be problematic if they become seized, causing the belt to drag across the surface, creating friction and heat. In many instances, these seized rollers develop sharp edges that can cut the conveyor belt.

In addition, some pulley bearings may fail, and if not caught promptly, these failed pulley bearings have potential to cause conveyor belt fires. Maintenance technicians may walk the belt to look for bad rollers, but this type of inspection can be infrequent because many conveyors are quite long, often over a kilometer, and this task may expose workers to potentially hazardous conditions.

A more reliable way to discover hot spots is by monitoring temperature and vibration using wireless technology at each section. The **Rosemount 848T Wireless Temperature Transmitter** (Figure 2.2) can send data from up to four resistance temperature detectors (RTDs) on a single signal. An **AMS Wireless Vibration Monitor** can sense changes in patterns resulting from rollers that aren’t turning.

FIGURE 2.2

Using an RTD to monitor bearing temperature helps identify rollers that aren’t turning. The Rosemount 848T Wireless Temperature Transmitter can spot which rollers are jammed.

These two technologies can help mine operators avoid lost production and costs associated with unplanned belt repairs or replacements. Repairs can cause shutdowns for a full day or more, bringing the process to a halt. Therefore, avoiding these costs can easily pay for the monitoring system, particularly when taking the savings from reduced required manual inspections into account. Also, unplanned downtime brings with it potential safety exposures that come with required reactive maintenance interventions.

The **Rosemount 3408 Level Transmitter - Non-Contacting Radar** is a reliable solution that gives you the approximate level of loading on the conveyor belts, preventing excessive weight that could lead to conveyor belt malfunctions and overloads. Moreover, it can detect under loads or lack of ore on the belt, providing important indications of potential production losses.

Semi-autogenous grinding (SAG) and ball mill lubrication system — A SAG or ball mill (Figure 2.3) is usually the second step of the size-reduction process. These installations have complex forced lubrication systems to handle the enormous loading on the bearings. Keeping these working properly calls for an instrumentation system to perform several critical measurement functions:

- **Rosemount 2088 Absolute and Gauge Pressure transmitter**
- **Rosemount 648 Wireless Temperature Transmitter**
- **Rosemount 5300 Level Transmitter**
- **Rosemount 3051SFC Compact Orifice Flow Meter**
- **Flexim FLUXUS® 721 Ultrasonic Flow Meter**
- **Micro Motion F-Series Coriolis Flow Meter**

These instruments work together to make sure enough oil is available and flowing as it should to maintain production and ensure full bearing life.

Motor, gearbox, and pump monitoring — Mine sites invariably have a wide range of rotating equipment, including electric motors driving equipment directly, such as pumps and air compressors, or via gearboxes driving mills and conveyors. This is typically a very severe service due to abrasive dust and variability of loading.

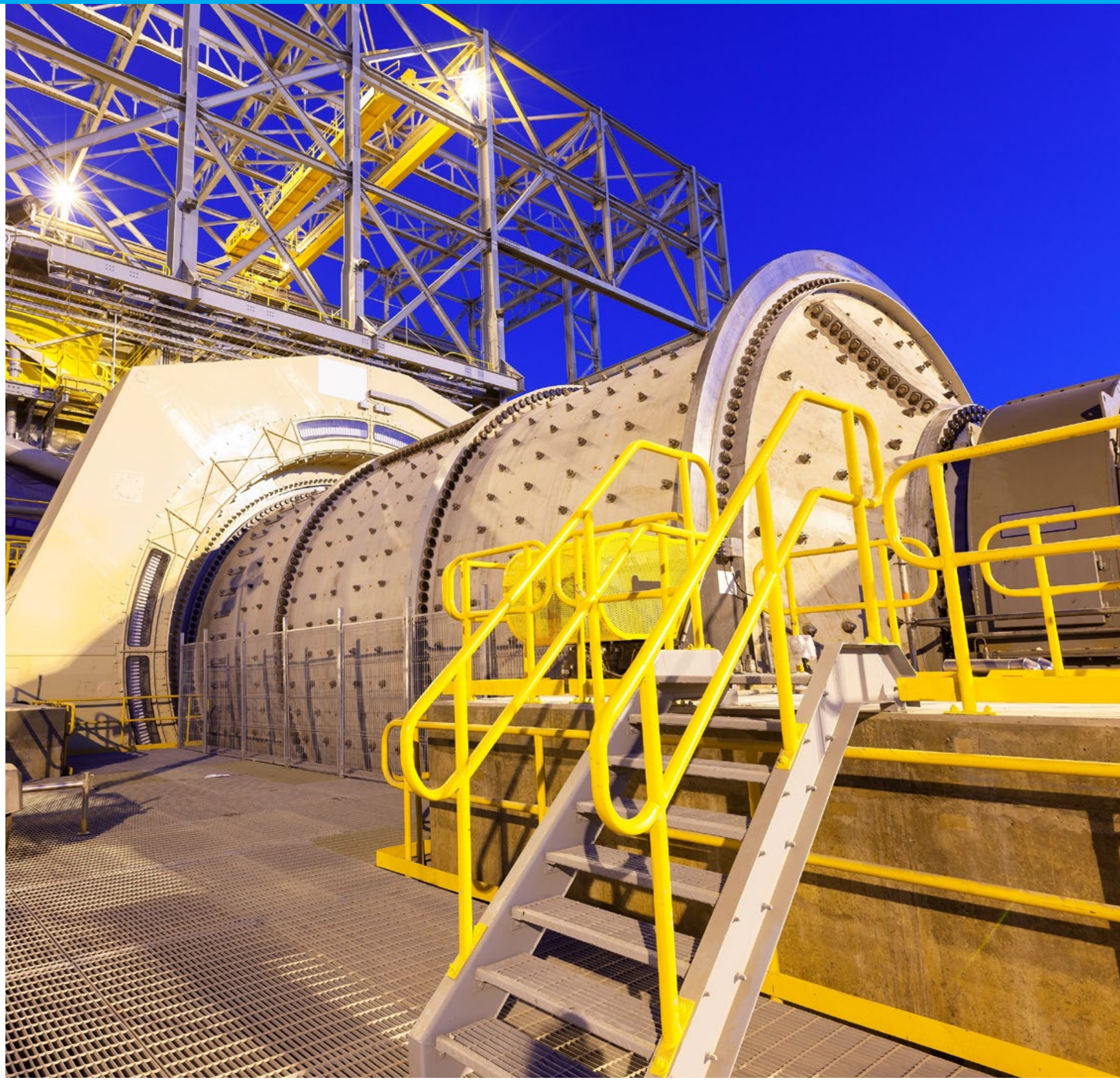


FIGURE 2.3
SAG and ball mills put enormous pressure on their bearings, so lubrication systems are critical. Emerson offers several key wireless technologies to ensure correct operation.

Lubrication — Correct lubrication of large equipment, such as mills, is important to ensure smooth operation in the mine. The Flexim **FLUXUS 721** uses ultrasonic waves to measure the flow, which are ideal for working with non-conductive fluids. Due to its clamp-on mechanism, these meters can be quickly installed during running production and are immune to contamination in the lubricant.

Emerson offers a range of wireless sensors (Figure 2.4) to measure vibration and bearing temperature. When data from these are compiled and analyzed by a platform, such as the **Plantweb Insight™**, a data analytics software, it is much easier to avoid unplanned shutdowns while guiding maintenance efforts effectively.

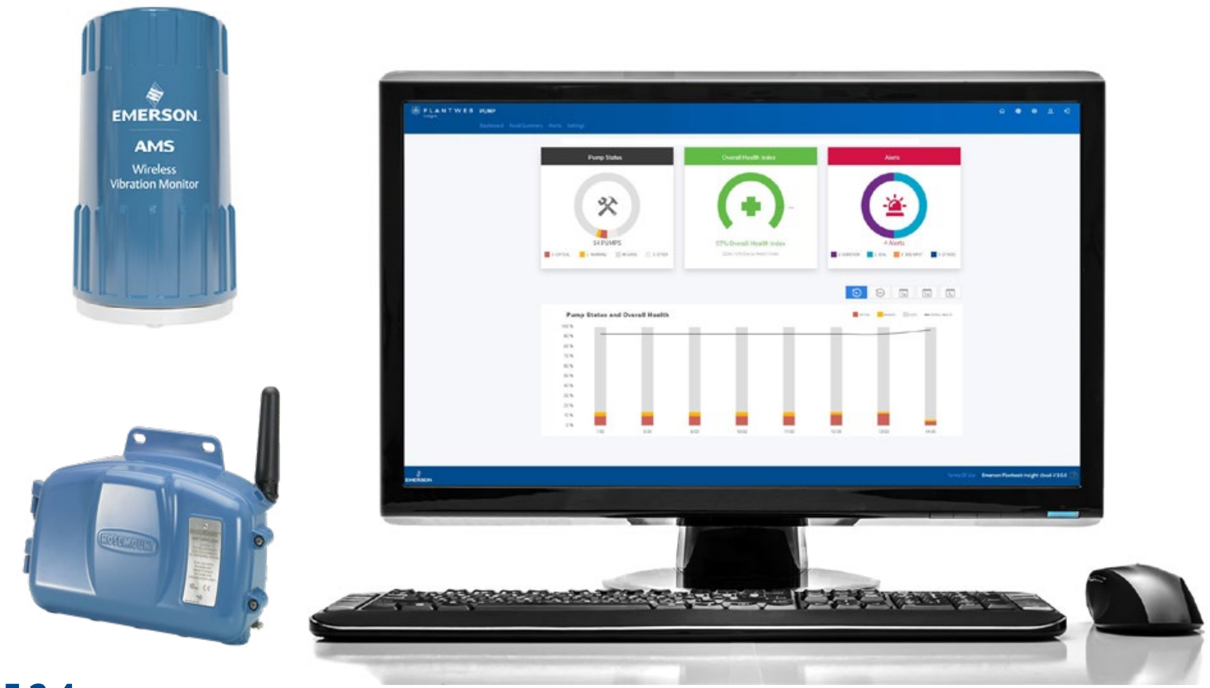


FIGURE 2.4

Monitoring sensors (AMS Wireless Vibration Monitor + Rosemount 848T Wireless Temperature Transmitter + Plantweb Insight) sending data to an analytics platform, empower maintenance and reliability teams to minimize outages and optimize scheduling.

3 Hydrocyclones

HYDROCYCLONES

The first separation stage after milling takes place in the hydrocyclones. This stage has high solids concentration in slurry and a very wide range of particle size distribution. Consequently, it is especially challenging to separate larger particles from smaller ones, depending on specific gravity.

Flow monitoring — Input of slurry into hydrocyclones must be controlled to maintain maximum throughput without overwhelming the process. Consequently, flow must be monitored, but this is a very difficult application due to the highly abrasive nature of the slurry. Magnetic flow meters are a natural choice since they have no internal restrictions. The **Rosemount MS Magnetic Sensor** and **8782 Transmitter for Slurry Applications** (Figure 3.1) are designed to withstand the abrasiveness, plus the excessive process noise characteristic of slurries. It overcomes these challenges to deliver a stable and responsive flow measurement in pipe sizes of 4 to 36 inches.

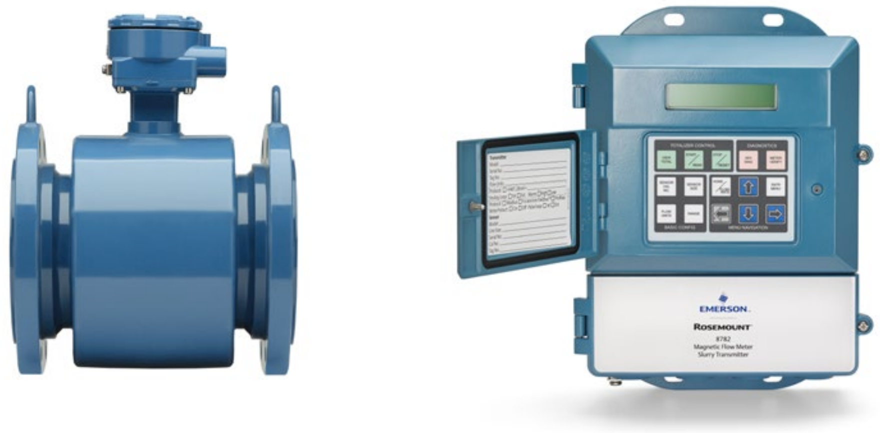


FIGURE 3.1
Rosemount Magnetic Flow Meters for Slurry Applications are designed to withstand abrasion and process noise, providing long service life and accurate readings.

Where flows are often low and fluid velocity may not be sufficient for a dependable magnetic meter reading, the **Rosemount 9195 Wedge Flow Meter** (Figure 3.2) can withstand the harshest process media, even with abrasive fluids, high-viscosity fluids, and high temperatures. It uses proven differential pressure measuring technology but with a specialized primary element to minimize pressure loss and resist clogging. It is available for pipe sizes from 4 to 8 inches.

FIGURE 3.2
The Rosemount 9195 Wedge Flow Meter offers a second technology designed for slurry flow measurement where a wide flow range measurement may be necessary.

Vibration — When a hydrocyclone is operating correctly, it generates a characteristic sound due to the internal turbulence. Some of this is audible, but the sound spectrum extends well into ultrasonic frequencies. If upset conditions begin to disrupt the flow, choking (solid clogging of the main discharge), and roping (where the inner air core collapses and the discharge forms a solid stream of coarse material) can occur, reducing throughput.

When mounted on the inlet pipe, the **Rosemount 708 Wireless Acoustic Transmitter** or **AMS Wireless Vibration Monitor** (Figure 3.3) can monitor the sound of each hydrocyclone continuously. This sensor uses wireless sensing concepts with *Wireless*HART to eliminate the need for signal or power wiring. An algorithm determines if the sound has changed due to an upset condition, sounding an alarm, and making it easy for technicians and operators to identify which unit needs attention.

FIGURE 3.3
The Rosemount 708 Wireless Acoustic Transmitter and AMS Wiureless Vibration Monitor can differentiate between a hydrocyclone working properly, and one experiencing an upset condition.

4 Flotation

FLOTATION

Slurry is pumped into a tank where ore particles attach themselves to frothy bubbles injected from the bottom so they can be skimmed off the surface.

Sparger monitoring — Creating the desired bubble size depends on controlling spargers at the bottom of the flotation vessel, where compressed air is pumped into the solution and released through small orifices. These can clog, but clogs are difficult to detect, so each sparger is monitored by a mechanical pressure gauge. This works, but it requires a human operator to see a change indicating clogging. Using wireless sensing, Emerson suggests replacing mechanical gauges with the **Rosemount Wireless Pressure Gauge** (Figure 4.1). It can provide the desired local display, but also send its data via *Wireless*HART to the maintenance team, so technicians and operators can tell at a glance which spargers are underperforming.

Slurry flow monitoring — Input of slurry into flotation vessels must be controlled to maintain maximum throughput without overwhelming the process, so flow must be monitored, but this is a very difficult application due to the highly abrasive nature of the slurry. Magnetic flow meters are a natural choice since they have no internal restrictions. The **Rosemount MS Magnetic Sensor** and **Rosemount 8782 Transmitter for Slurry Applications** (Figure 3.1) are designed to withstand the abrasiveness, plus the excessive process noise characteristic of slurries. It overcomes these challenges to deliver a stable and responsive flow measurement in pipe sizes of 4 to 36 inches.

Maintaining froth — To maximize mineral capture, foaming agents are added to the solution to ensure desired particles stay at the surface so they can be skimmed off. Maximizing the effectiveness of these agents calls for a specific pH level in the solution, so this must be monitored and controlled.

The **Rosemount 396P pH/ORP Sensor** (Figure 4.2) is especially recommended for pH control in the high-solids environment of flotation processes. The reference junction is rugged and highly resistant to coating, resulting in reduced maintenance and process downtime. It is compatible with all Rosemount transmitters, including the **Rosemount 5081 Explosion-Proof Transmitter.**

FIGURE 4.1

The Rosemount Wireless Pressure Gauge is ideal for monitoring sparger pressure since it provides a local display, while also transmitting its reading via WirelessHART. The gauge can also be used for compressed air and gas receiver tank applications, where remote monitoring is particularly important because safety regulators can levy fines if they find malfunctioning pressure gauges in these applications.

FIGURE 4.2

The Rosemount 396P pH/ORP Sensor can be used with any Rosemount transmitter to monitor pH in the flotation vessel.

5 Thickeners

THICKENERS

Waste solids that remain in the slurry after both the hydrocyclone and flotation stages are normally captured in the thickener. This is one of the most critical steps for clarifying process water so it can be recirculated for reuse. Controlling this process depends on maintaining the necessary residence time to minimize suspended solids in clarified water.

Monitoring underflow density — The flow of solids from the thickener bottom must be measured to ensure it has the highest possible density. The **Micro Motion Fork Density Meter** (Figure 5.1) provides continuous, real-time density data to maintain desired output and flocculant dosing, even when throughput is highly variable.

FIGURE 5.1
Micro Motion Fork Density Meters can verify density in the thickener stage.

6 Heap Leaching

HEAP LEACHING

Heap leaching has become the primary mechanism for extracting many metals at mine sites, depending on the type of ore. For instance, copper is recovered most effectively from copper oxide ore using leaching, while sulfide ores are best treated using floatation.

Raffinate distribution — Capturing the maximum amount of metal depends on even and consistent leach solutions across the active heap leach area (Figure 6.1). Since this can potentially involve millions of square feet, drip irrigation techniques are used to spread leach solution over the surface at a typical rate of a few hundredths of a gallon per minute per square foot. Emerson has created portable skids using wireless sensing strategies and fitted with *Wireless*HART pressure and flow transmitters, each monitoring a section of the surface to ensure consistent distribution over all segments. These can be moved as necessary to follow development of the heap over time to work with the newest deposits.

By monitoring flow and pressure, it is easy to determine which segments are developing clogs, or where individual lines may be damaged and leaking, all without requiring potentially dangerous manual operator rounds. Skids can be equipped with valves that can be closed remotely via the same wireless network in the event of a serious leak, using the **Rosemount 702 Wireless Discrete Input or Output Transmitter** in conjunction with the **TopWorx™ GO™ switches** (for monitoring), for example. This strategy provides the highest possible recovery without increasing leach solution use. This is important because excessive raffinate application in specific areas can contribute to geotechnical instability. The leaching monitoring skid also contributes to safe operations of the heap leach pile.

Sulfuric acid-based leaching solutions are commonly used for leaching non-ferrous metals. Due to the corrosive nature of the acid, flow meters requiring product contact have a limited service-life. The clamp-on ultrasonic flow meter Flexim **FLUXUS® 721** offers a solution to address this issue as it requires no product contact, and it is therefore suitable for irrigation leaching solution and fresh acid supply measurement applications.

Installed outside of the pipe, the meter is unaffected by corrosion and offers virtually maintenance-free operation, along with simple installation for upgrade projects, and highest flexibility when conditions in the mine change.

FIGURE 6.1

The Rosemount™ 5408 Level Transmitter - Non-Contacting Radar is a valuable tool in increasing production and leaching efficiency while lowering costs. It can detect plugged lines, prevent flooding and pad instabilities, and provide a better understanding of leaching processes for improved efficiency.

Leach Solution pH — Precious metals, such as gold and silver, are typically processed via tank leaching using sodium cyanide. This is a delicate process and must operate with a pH between 11 and 12 for maximum efficiency. If the pH value moves out of that window, chemical activity with the ore decreases, and the process can emit highly toxic hydrogen cyanide gas. Sodium cyanide is also expensive, so given the volumes involved, adding make-up volume is costly. During operation pH tends to go down, so lime must be added.

The **Rosemount 396P pH/ORP Sensors** (Figure 6.2) are well suited for pH control in tank leaching applications. The sensor includes a large area reference junction that resists coating from solution solids, plus a rugged polypropylene body construction for maximum chemical resistance and minimal maintenance. It is compatible with all Rosemount transmitters, including the **Rosemount 5081 Explosion-Proof Transmitter**, and the **Rosemount 1056 Intelligent Four-Wire Transmitter**.

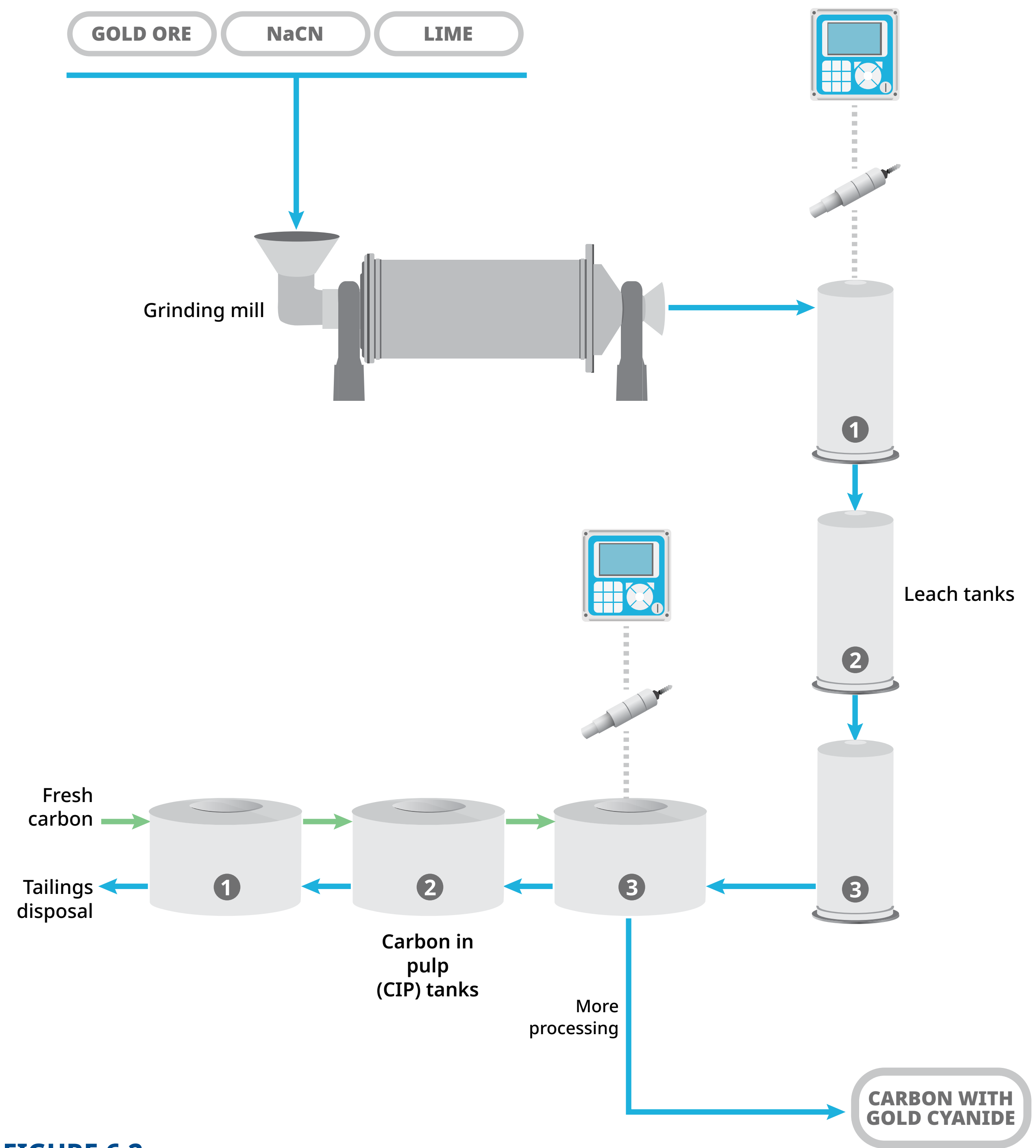


FIGURE 6.2

Maintaining effective cyanide leaching depends on controlling pH, and the Rosemount 396P pH/ORP sensor is ideal for this difficult task.

7 Electro-winning

ELECTROWINNING

Leach solution taken from a heap or tank process goes through a chemical process where the pregnant leach transfers its metal to a second solution, often a hydrocarbon, thereby replenishing the original leach solutions. The pure metal is extracted from the second solution via electrowinning (also called electroextraction), where it is plated onto a cathode surface in very pure form. Once this is done, the second solution is also renewed and can be used again, allowing both streams to be used continuously. Emerson has solutions to keep this process running effectively and efficiently.

Solvent extraction — Measuring the flow of solvents during metal extraction poses various challenges. Depending on the stage of extraction, challenges may include corrosiveness of the solvent, solid content and its resulting abrasiveness, or the lack of conductivity in the organic solvents. All these fluid conditions, and more, can be handled by the Flexim **FLUXUS® 721** flow meter. Its clamp-on installation means it has no direct contact with the fluids in the pipe, and it is thus unaffected by the process media conditions. Furthermore, the ultrasonic measurement principle is ideally suited for non-conductive fluids.

Electrolyte temperature monitoring — For maximum efficiency, the electrolyte must be kept in an optimized temperature range to minimize electric current consumption, while maintaining metal quality. An increasing temperature indicates problems such as short circuits, dirty cells, and poor contacts. This wastes energy, slows depositing, and reduces metal quality. On the other hand, if the electrolyte is too cold, electrical resistance increases, slowing deposition.

The **Rosemount 3144P Temperature Transmitter** provides accuracy and stability with sophisticated diagnostics. It can work with conventional thermowells, or it can be combined with **Rosemount X-well™ Technology** for measurements without a process penetration.

Electrolyte level monitoring — To ensure high efficiency, each cell must have the optimal liquid level to cover each cathode fully so it can deposit on the entire surface. Moreover, if the level drops, hydrogen generation increases, creating a potentially hazardous situation. Emerson has created a variation of its **Rosemount 2120 Level Switch – Vibrating Fork**, (Figure 7.1), with the probe as a remote assembly connected to a *Wireless*HART transmitter. The probe can be inserted in the cell's filling well, with the transmitter outside the well. If the level drops below the setpoint, operators will be notified immediately.

FIGURE 7.1

If electrolyte level is low, overall surface area for plating is lost, reducing production. The Rosemount 2120 Level Switch – Vibrating Fork sends an alarm if level falls below the setpoint.

8 Tailings Dam

TAILINGS DAM

The tailings pond is both a place to store unusable fines and provide a source of recycled process water. It is also a potential disaster affecting the safety and environment if the dam fails. New construction methods are more reliable, but the amount of water added, and the condition of the dike, must be monitored since tailings and rain add to the volume. Additionally, the level of solids beneath the surface must be monitored to ensure even distribution and avoid drawing solids into the return pump. Emerson offers a range of products using wireless technologies to monitor and measure a range of critical variables to maximize water reuse, and to ensure structural stability of the containment system.

Tailing stability — When tailings are added to the pond, moisture content is high, so the solids remain entrained in the fluid and unstable for some time. To monitor this condition, Emerson offers the **Rosemount 3051S Wireless Submersible Level Transmitter**, with a sensor that is embedded in the tailings embankment to monitor pore water pressure of the dam. These can be placed at strategic points near the dam to monitor water content continuously, and therefore dam wall stability. These instruments also help determine if water is seeping through the dam.

It is crucial to measure the level of tailings to prevent them from overflowing. The **Rosemount™ 5408 Level Transmitter - Non-Contacting Radar** replaces manual monitoring with automated systems to manage risk and enhance safety, particularly in preventing dam failures that can impact mine value. Also, this reduces operational costs and increases productivity.

Leak detection in slurry piping systems — Fresh tailings are pumped to the pond via large pipelines that deposit them in the desired location. Given the volume of solids involved, these are prone to clogging, causing backups and other problems. Flow meters and pressure transmitters at strategic points on the pipeline can determine where restrictions and clogs have formed, or where a break is allowing leakage (Figure 8.1). The **Rosemount MS Magnetic Sensor** and **Rosemount 8782 Transmitter for Slurry Applications** is excellent for this service, and this instrument can be outfitted with the **Emerson Wireless 775 THUM Adapter** to avoid the need for signal cabling. The **Rosemount 3051S Wireless In-Line Pressure Transmitter** also sends its data via *Wireless*HART.

Valve positioners — Valves are typically installed throughout the piping system to control flow and distribution. Adding a **Rosemount 702 Wireless Discrete Input or Output Transmitter** in conjunction with Emerson **TopWorx® GO switches** can help verify the correct positions along the full pipeline, reducing the need for potentially dangerous manual inspections.

Pump monitoring — Water from the pond must be returned to the process so it can be recycled. The pump responsible for this service, and the overall application, should be monitored on several fronts, and wireless sensing devices are available for all of them. Pump mechanical health can be monitored using bearing temperature and vibration sensors that send their data wirelessly to a **Plantweb Insight™** dashboard (Figure 2.3).

Solids level detection using a **Rosemount 2160 Wireless Level Detector-Vibrating Fork** can extend into the water from the pump barge to make sure solids on the bottom are not too close to the inlet.

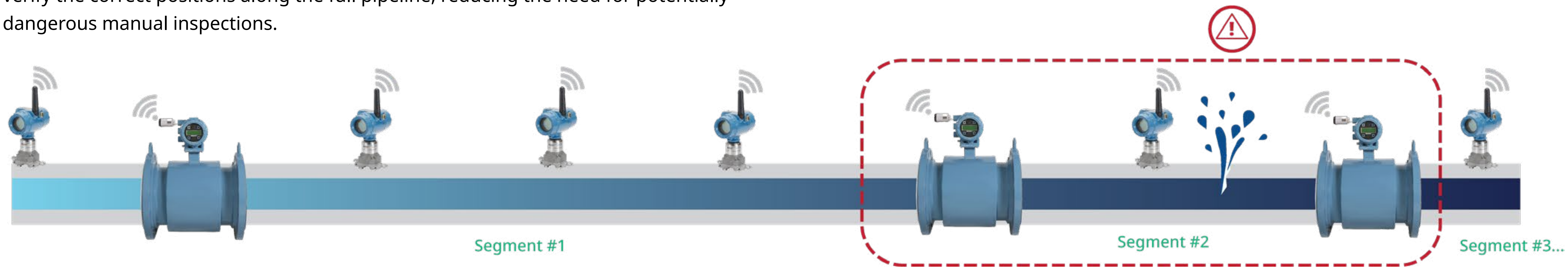


FIGURE 8.1
By monitoring pressure and flow at strategic points on the pipeline, it is possible to determine where clogs and leaks have formed.

9 Water Management

WATER MANAGEMENT

Water consumption at mine sites is under increasing scrutiny as water scarcity problems become more common worldwide. Therefore, all sustainability programs must include water management as a key element.

Pit and tailings water recycling — Most mining operations have some monitoring of water flows through a facility, but not always with sufficient granularity, often due to the cost of installing additional flow meters. The Flexim **FLUXUS® 721 Series** clamp-on ultrasonic flow meters (Figure 9.1) provide a cost-effective solution, and can be mounted without a pipe penetration or shutdown, providing a temporary or permanent solution.

FIGURE 9.1
Flexim FLUXUS® 721 clamp-on ultrasonic flow meters can be used on a permanent or temporary basis to analyze water flow.

As an alternative to Flexim **FLUXUS® 721**, flow meters equipped with Smart Meter Verification can be used to provide reporting of water usage to federal and state agencies.

Buffer and water storage tanks — Water is needed to perform essential operations such as mineral processing, dust suppression, cooling, slurry transport and meeting needs of personnel. On-site buffer and storage tanks provide water and storage capacity for waste. Without a means of effective measurement and control, continuity of supply may be interrupted and sites may struggle to comply with environmental regulations.

The **Rosemount 1208 Level and Flow Transmitter** is a cost-effective and reliable solution, offering full inventory and process control to ensure water availability. It provides continuous access to detailed data for reporting to authorities, whilst eliminating manual rounds.

When combined as a system with the **Rosemount 3490 Controller**, measured values can be visualized on the display and up to 6 pumps may be controlled at chosen levels.

Liquid analysis — The question of how suitable a recycled water stream is for a given application can often be determined by measuring its conductivity. This is a simple process, but it provides a wealth of information that can frequently be used to reduce the need for fresh water. The **Rosemount 228 Toroidal Conductivity Sensor**, coupled with a **Rosemount 1056 Intelligent Four-Wire Transmitter** (Figure 9.3), provides spot or continuous readings, each with temperature compensation.

FIGURE 9.2
The Rosemount 1208 Level and Flow Transmitter combined with the Rosemount 3490 Controller provide a complete solution for efficient, sustainable and compliant water and wastewater management.

FIGURE 9.3
Monitoring conductivity using the Rosemount 228 Toroidal Conductivity Sensor, coupled with a Rosemount 1056 Transmitter, can determine if water treatment is necessary.

10 | Auxiliary Processes

AUXILIARY PROCESSES

Some ores are still processed using smelting and roasting operations, although many have been phased out for environmental reasons in favor of chemical processes.

Storage — Feedstocks for blast furnace operations (iron ore, limestone, coke) are held in silos prior to transfer to the blast furnace via conveyors. The **Rosemount 5408 Non-Contacting Radar Level Transmitter** provides a very accurate picture of the level of material in the silo, despite the very dusty, and often humid conditions, common to these environments. This instrument supports automated storage control and reliable feedstock flow for efficient operation.

Compressed air — Proper management and control of compressed air flow is crucial for continuous operations and cost-saving. The Flexim **FLUXUS® CA532** provides this and other functions with its non-invasive installation, bi-directional flow measurement, and high turndown ratio for leak detection. Additionally, the device provides robust measurement even with contaminated air, making it a versatile option for a variety of mining conditions.

Backfilling stopes — Once underground stopes have had all recoverable ore removed, they are backfilled for safety reasons. Solids can be added to these spaces as a slurry to fill all the voids. To ensure the correct amount has been added, the flow must be monitored, but this is a very difficult application due to the slurry's highly abrasive nature. Magnetic flow meters are a natural choice since they have no internal restrictions. The **Rosemount MS Magnetic Sensor** and **Rosemount 8782 Transmitter for Slurry Applications** (Figure 3.1) are designed to withstand the abrasiveness, plus the excessive process noise characteristic of slurries. They deliver a stable and responsive flow measurement in pipe sizes of 4 to 36 inches.

Solid additives storage — The **Rosemount™ 5300 Level Transmitter - Guided Wave Radar** (Figure 10.1), a global leader in guided wave radar with over 200,000 installations, is known for its durability against dust and condensation. Its reliability can enhance plant productivity, decrease unexpected downtime, and offer accurate level measurements for improved inventory management

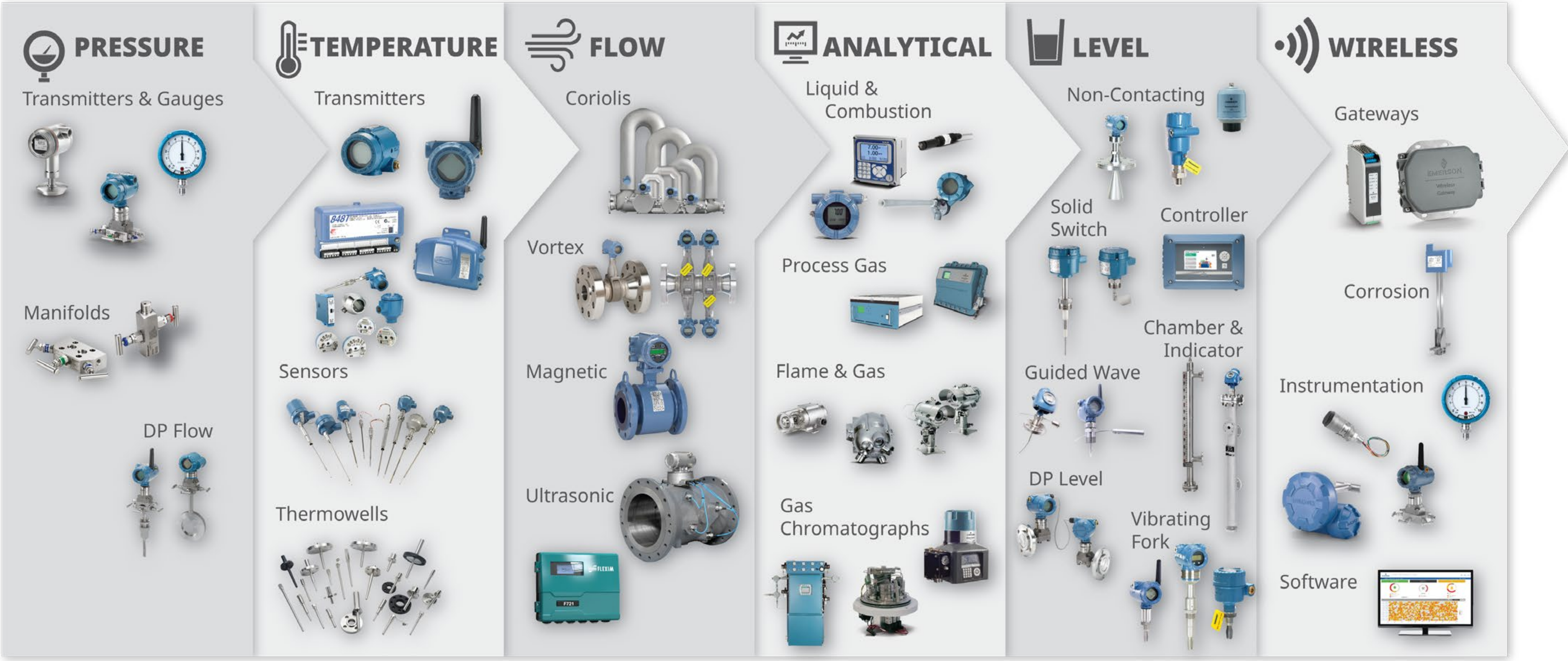
Additionally, the **Rosemount™ 1208 Level and Flow Transmitter - Non-Contacting Radar** is specifically designed to measure solids in applications such as limestone and fly ash storage tanks.

FIGURE 10.1
The Rosemount 5300 Level Transmitter - Guided Wave Radar and Rosemount 1208 Level and Flow Transmitter offer reliable measurements for auxiliary mining processes.

11 Conclusion

Global Service Capabilities — Many mining companies are global operations, so they require partners that have a worldwide footprint capable of servicing their operations in many remote parts of the world. This not only includes engineering, specification, and sales support, but also technicians on site when required, along with spare parts.

Emerson, with a global network of service capabilities, is the partner of choice for many global mining and metals companies, plus a wide range of other process industries. Our consultants employ innovative digital technologies to improve any facility's competitive edge. Project Services engineers support a new facility or upgrade from concept to start-up, including instrumentation. Once a facility is running, Emerson's Lifecycle Services personnel offer maintenance, reliability, and performance services—where and when needed. Emerson's Educational Services can be used to train operators, engineers, and technicians throughout the mine life cycle.



Greening with Emerson — Like our customers, Emerson is also a manufacturer, and we are experiencing the same challenges and pressures in our drive toward improved sustainability. Emerson utilizes a framework that groups our environmental sustainability efforts into three broad pillars: Greening Of Emerson, Greening By Emerson, and Greening With Emerson. This framework has resonated strongly with customers, employees, investors, governments, and communities as we partner with stakeholders.

Mike Train, Emerson's Chief Sustainability Officer, sums up the concept: "We are witnessing firsthand how our commitment to innovation and our strategic vision are advancing us toward our net zero goals. We will continue to take actions that tackle emissions across our global operations while supporting our customers in their decarbonization efforts and the broader communities we serve."

Make Emerson your partner for sustainability.

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