Advanced process measurements and controls at a modern concentrator

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Modern mineral processing plants typically have a good level of process instrumentation, on-line analyzers and centralized process control system that is able to provide robust basic level control for a concentrator plant. In addition, increasing number of operations benefit from advanced process control and information management systems. When designing, implementing or improving any concentrator automation it is essential to follow the traditonal automation pyramid hierarchy and make sure that the layer underneath supports and provides all the options for the applications on the next level. This extended abstact is a general summary of the advanced instrumentation level at a modern concentrator, with special emphasis on grinding and flotation processes.

Grinding process

In grinding, on-line particle size analyzers from cyclone or other classifier overflow is the industry practice today. The information about the particle size is essential in order to be able to control and optimize the grinding process throughput, energy efficiency and availability at the current operation point and restrictions active, and also to guarantee optimal particle size distribution for the flotation recovery and grade.

Other essential advanced instrumentation for grinding optimization is on-line mill charge volume measurement and machine vision based on-line mill feed size and feed distribution measurements. For mill charge estimation different methods are available. The measurement enables better optimization of the grinding mill performance and throughput. Often mill load cells are used for volume estimation but these are known to be prone to continuous changes in the properties of the ore fed to grinding mills and liner wear. Information on the feed distribution provides information on the disturbances resulting from the feed ore changes and therefore enables various feedforward control strategies in the grinding circuit. Figure 1 summarizes the state of the instrumentation and control structure at the grinding section.

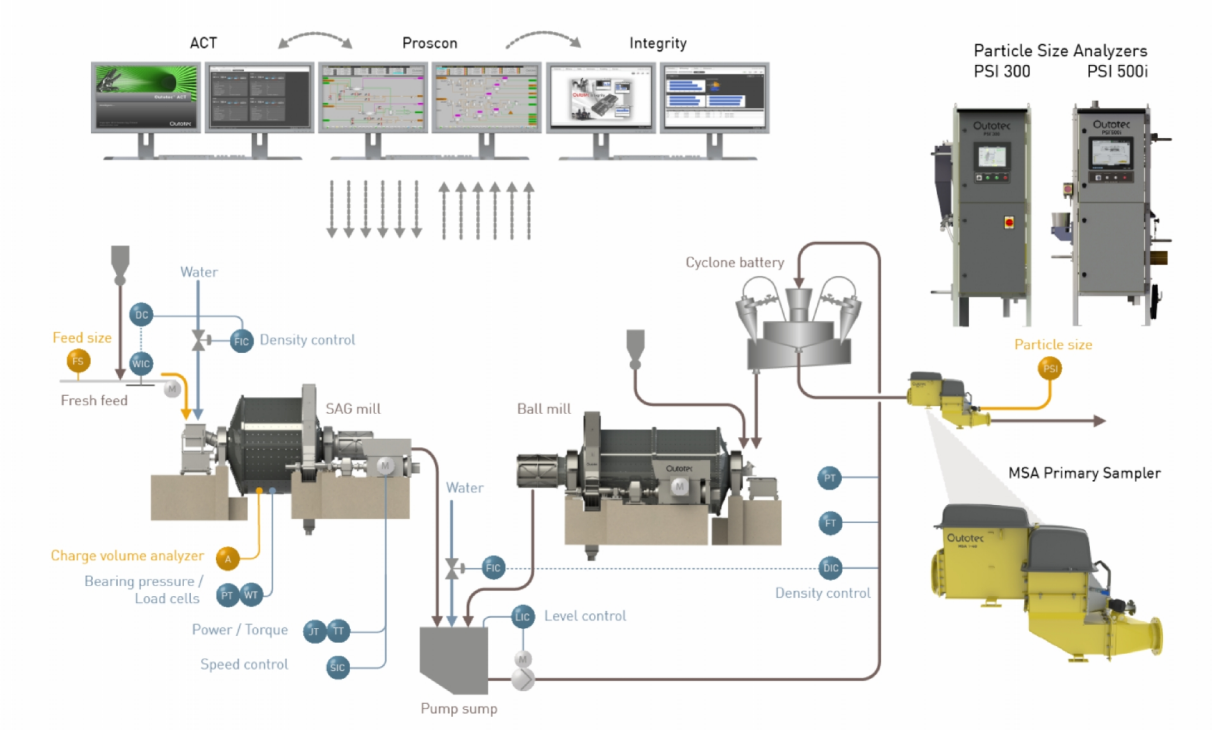

Figure 1: Advanced instrumentation and control of Grinding Circuit

In flotation, an online slurry analyser provides key feedback information of the process performance, grades and recovery. Due to long analysis time delay, process control and particularly optimization either by the operator or advanced process control system are difficult if only laboratory samples are available. State of the art on-stream X-ray analyzers provide accurate and representative assays for the process control and are crucial for immediate reactions for changes in the metallurgical behaviour and disturbances of the flotation circuit. Recently introduced new analyzers that enable the measurement of light element concentrations, such as Silica, Aluminium and Magnesium, out of X-ray reach directly in slurries or electro-chemical potentials (eH) with mineral electrodes from the slurry stream offer novel valuable input for the optimization of the flotation for many minerals.

Other advanced instrumentation that support flotation stabilization and optimization is online camera based systems that measure the essential properties of froth appearance, such as froth speed, bubble size, loading, froth stability and froth color. Robust slurry level control alone has a significant effect on the flotation process results and efficiency. Therefore improved level measurement is important in addition to adaptive feedforward level control strategies for a bank of flotation cells. A new solution that utilizes electrical impedance tomography (EIT) has also been lately introduced. The solution enables more reliable information about the slurry level, froth thickness and conductivity profile of the froth. Advanced froth conductivity analysis obtained with the help of EIT technology provides furthermore new valuable information for the grade and recovery optimization helping to minimize the reagent consumption.

Advanced process control applications are typically built on top of separate systems that interact with the main control system of the plant. Advanced control solutions provide a platform to build customized control applications that can be implemented to practically any modern process with an existing automation system and adequate instrumentation. Outotec's proprietary advanced control platform, ACT is an example of such a system and enables predefined stabilizing and optimizing applications from single-unit processes to plant-wide production. Figure 2 summarizes available advanced analyser systems and a general and control structure at the flotation section.

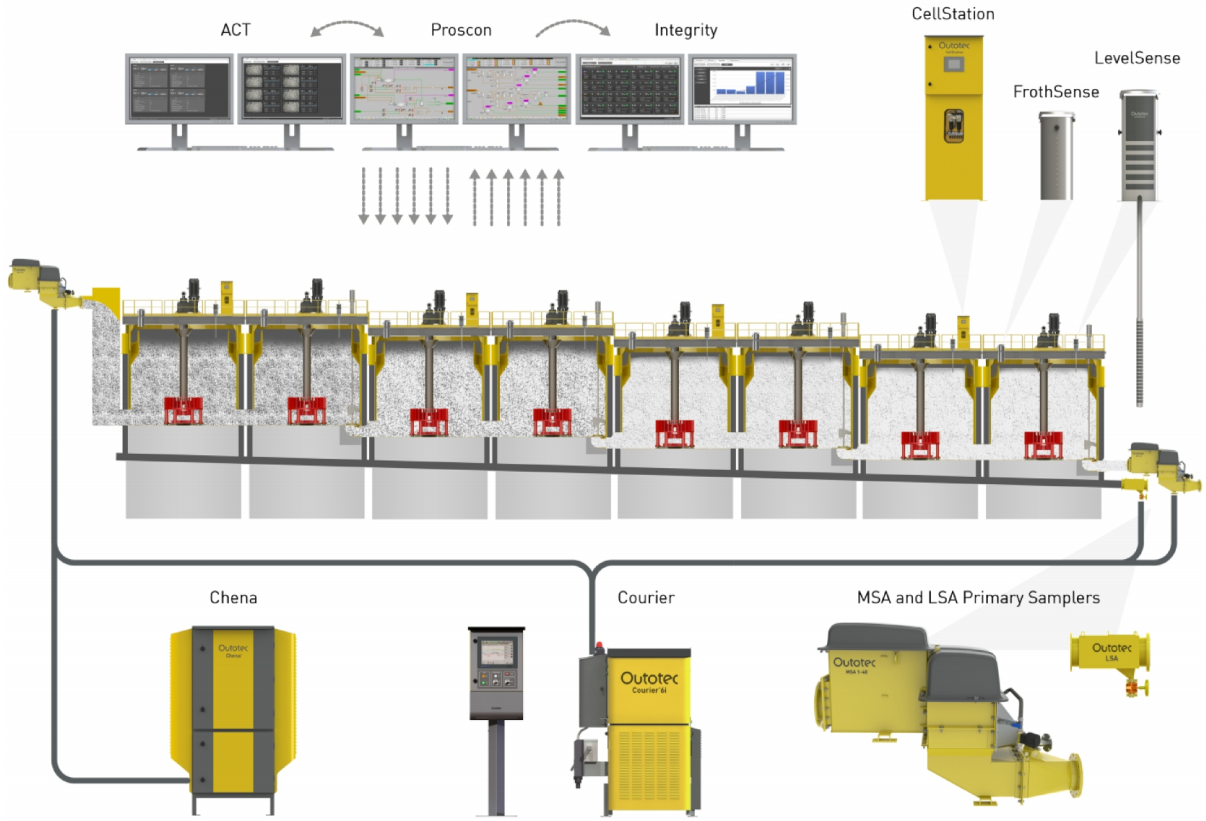

Figure 2: Advanced instrumentation and control of flotation

By comparing manual and APC operation, typically 1-3 per cent recovery improvement or 2-5 per cent throughput can be achieved. On the operational scale of a large concentrator, this equals significant increased annual production and income. In addition to the increased production perhaps even bigger advantage of an APC based control system is the increased process stability and equipment availability. When the process is running under more stable operating conditions, it is easier for plant operators to detect abnormal process disturbances and events and they can concentrate on developing their process understanding and solving unexpected problems.