Analysis & Sampling System and Process Instrumentation for Mineral Flotation Plants

- On-Line Analysis
  - Light & Heavy Elements

- Particle Size Monitors
  - 5 Size Fractions & %Solids

- Slurry Sampling
  - Process Control & Metallurgical Accounting

- Cross Belt Analysers
  - Light & Heavy Elements

- Process Instruments
  - Density, Level, Thickener Interface, Conveyor, Weighscales, Tramp Metal Detectors

Thermo ELECTRON CORPORATION
Thermo – Products
Thermo Electron supplies a complete range of analysis and sampling systems.

Weighing Systems
Tramp Metal Detector
Proline Conveyor Safety & Control Equipment
Tank & Bin Level Measurement
Microwave Flow Measurement
CBX Cross Belt Analyser
BLG Bin Level Gauge
NBC Nuclear Ball Counter
HPDG High Performance Density Gauge
MSA Multi-Stream Analyser
AnStat Analysis & Sampling Station
PSM Particle Size Monitor
SamStat Sampling Station
LESA Light Element Slurry Analyser
TIG Thickener Interface Gauge
Complete analysis and sampling systems

Thermo Electron can instrument an entire flotation plant with critical analysis and sampling equipment:

**Crushing and Grinding**

**Blending Control**

*CBA*

The Cross Belt Analyser provides on-line analysis of material on the conveyor feeding the stockpile for critical light and heavy elements.

**Belt Scale**

Conveyor Belt Scales and Integrators from general use systems to certified for trade accuracy.

**Grinding Process Control**

*CBX*

The Cross Belt Analyser provides on-line analysis of the conveyor feeding the Grinding circuit to characterise grindability of the ore and for critical light and heavy elements to optimise reagent dosing.

*NBC*

The Nuclear Ball Counter measures grinding media addition to SAG and Ball mills.

*HPDG*

The High Performance Density Gauge provides on-line density of slurry or solution in pipes or tanks, and coupled with a flow-meter provides mass flow measurement for control purposes.

**PSM**

The Multipoint Particle Size Monitor provides on-line analysis of up to 5 particle size fractions and %solids for grinding optimisation.

**AnStat**

The Analysis and Sampling Station provides reliable metallurgical accounting sampling and elemental analysis. It can also be designed to provide distribution to the flotation plant.

**Flotation**

**AnStat**

Provides continuous elemental analysis of critical streams and metallurgical sampling for inventory accounting.

**SamStat**

The Sampling Station provides process or metallurgical quality samples for metallurgical accounting or process samples for Multi Stream Analysers.

**PMS**

Provides on-line analysis of up to 5 particle size fractions and %solids for regrind circuit optimisation.

**MSA**

The Multi Stream Analyser provides intermittent elemental analysis of intermediate non-critical process streams.

**LESA**

The Light Element Slurry Analyser is particularly suited to analyse critical light contaminant elements especially on final product streams.

**Dewatering**

**TIG**

The Thickener Interface Gauge provides on-line determination of the density profile and bed depth in thickeners.

**HPDG**

Provides on-line density measurement of thickener underflows.
**Dedicated Analysers and AnStats**

**Analysis and Sampling Station (AnStat)**
- A dedicated Analyser used in conjunction with the statistically correct Sampling Station (SamStat) constitutes an Analysis and Sampling Station (AnStat) to provide full metallurgical accounting sampling and continuous in-stream analysis.
- A cross cut metallurgical sampler is located at the outlet of each analysis tank for calibration and process control sampling.
- Each AnStat is designed to be one complete system arranged linearly or with parallel sections. AnStats can be designed for new plants or retrofitted to existing operations. With no pumps and no sample transport lines they provide the lowest cost of ownership.
- Can be dimensioned to handle any flow-rate.
- Lowest slurry head loss of any available metallurgical sampling system with compact footprint and flange-to-flange supply means large savings in engineering design and construction costs for new plants.
- Can be offered with automated filtering systems.

**Sampling Station (SamStat)**
- These are statistically correct metallurgical Sampling Stations that are an AnStat without the analysis probe and associated equipment.
- SamStats can be easily and economically upgraded to an AnStat.

**Multi Element and Single Element Probes (MEP and SEP)**
- Elemental analysis from Ca in the periodic table using X-Ray Fluorescence.
- Multi Element Probes for simultaneous analysis of up to 8 elements plus %solids.
- Single Element Probes for the analysis of a single element. Used in conjunction with a separate density probe for %solids.
- Continuous analysis of each stream providing assay updates every minute for optimum process control of critical streams.
- Accepts sampled flow from any of the samplers listed on the following page.
- Extremely stable operation, minimal recalibration.
- Window change out typically every 3 months.

**Skid Mounted Probes**
- Either the Multi Element or Single Element probes can be mounted in an integrated tank and sampling system to receive a flow rate up to 80 m3/hr.
- Ideal for testing different streams, easily moved from one stream to another.
Other Sampling Solutions
The correct presentation of sampled slurry to both dedicated analysers and Multi Stream analysers is fundamental to the success of any on-line analysis system.

Continuous Sampling Systems (SamStat(c))
- Applications for closed or open pipes.
- Provides highest quality samples for both metallurgical balance samples and process samples to feed on-line analysers.
- Compact multistage sampling system (available in 1, 2 or 3 stages as a function of flow-rate).
- No flush water or flushing valves required.
- Low velocity through the system which means low wear and maintenance requirements.
- Open visible system that can be easily monitored for performance.
- Cutters are replaceable on-line.
- Flexible screens for rejection of oversized particles with automatic dump valves are available as options.

Launer Samplers
- Applications for open launders (both metal above floor, and in-concrete at floor level).
- Same advantages and characteristics as for SamStat(c).

Gravity Feed Samplers
- Sizes 100 (4”) to 900 mm (36”)
- Flanged to suit application.
- Replaceable cutters - through inspection port.
- Rubber lined.
- Back flushing valves available.

Pressure Pipe Samplers
- Pressure samples have polyurethane turbulence bars, otherwise same specifications as Gravity Feed samplers.

Gravity Feed and Pressure Pipe Samplers
- Provide simple, cost effective samples to feed on-line analysers.
- Are best suited for lower flow rates (less than 250 m3/hr) and smaller pipe sizes (less than 300 mm).
**Multi Stream Analysers**

- Elemental analysis from Ca in the periodic table using X-Ray Fluorescence.
- Can measure 3 to 24 streams.
- Nominal flow rate of 2-12 m³/hr for standard 300mm wide tanks.
- Maximum flow rate of 60 m³/hr for 600mm wide tanks.
- Cost effective analysis of multiple sample streams.
- Fast assay update times.
- Each sampled stream is kept completely separate in its own analysis tank, meaning no multiplexer or demultiplexer is required.
- Low slurry head loss of less than 1000mm.
- Cross cut metallurgical samplers located at outlet of each analysis tank for calibration and process control samples.
- When used with statistically correct primary sampler (SamStat(c)) can collect shift composite samples for metallurgical accounting.
- Simultaneous analysis of up to 8 elements and %solids.

![Diagram of Lead and Zinc Circuits]

- continuous measurement of full stream with dedicated analysis probes
- intermittent analysis with Multi-Stream Analyser units
Light Element Slurry Analyser

For the simultaneous analysis of both light elements in slurries (ie elements below Ca in the periodic table), and the common heavier elements Thermo Gamma-Metrics offers the Light Element Slurry Analyser.

- Unaffected by changes in particle size, mineralogy and matrix.
- Available as single stream units or multi-stream units for up to 8 streams.
- Available with 2 different detector systems, NaI scintillator or solid state Ge.
- Suitable for applications such as Iron Ore plants to measure Fe, Si, S; and other light matrix applications; light element contaminants in final product streams (eg MgO in Ni final concentrate, SiO2 in Zn final concentrate, S in Cu final concentrates).

Multi stream unit uses the Slurry Handling System (SHS), which consists of:

- Primary samplers to collect a representative sample from the plant process. They can be any of the devices listed previously (ie gravity feed, pressure pipe or riffle samplers).
- Multiplexer, that collects up to 8 samples and prepares them for presentation to the Analyser Station. This unit also collects calibration and shift composite samples. It consists of 2 main slurry holding tanks, each fitted with 1 to 4 sample diverter units.
- A flow cell in the analyser presents the sample to the detector.
- Recirculation pump to recycle the sample (collected and prepared by the multiplexer) through the flow cell.

All of the above equipment is normally located on suitable platforms in the plant.
Particle Size Analysis

Multipoint PSM-400
- 5 particle sizes plus %solids every 5 seconds.
- Automatic calibration and shift composite sampler.
- Automatic, scheduled water standardisation.
- Advanced calibration models.
- Accurate over wide calibration ranges.
- Sophisticated software algorithms to optimise signal processing.
- New updated model for 2004

Integration with AnStat
- Can be combined with an AnStat to provide a 3-way Measurement Station for elemental analysis, metallurgical shift sampling and particle size analysis.
- Particularly suitable for cyclone overflow streams in flotation plants.
Cross Belt Analysers
The Cross Belt Analyser provides in-situ analysis of mineral material directly on the belt. The CBX uses the PGNAA principle of analysis of both light and heavy elements.
- No sampling or sample preparation required.
- Real-time elemental information for process control.

Typical Applications

Stockpile Management
Continuous measurements from the CBX can be used to determine the average grade of a stockpile of ore and the required reclaim methodology to optimise blend control.

Blending
On-line blending of different concentrates or materials (ore, flux, return dust, etc) to provide a more constant feed to a smelter, roaster or sintering plant.

Mine Grade Control
The CBX can monitor ore on the conveyor after crushing to provide timely feedback to mine management for mine grade control.

Sorting
The ore can be sorted onto different stockpiles based on analyses from the CBX measuring ore on the conveyor belt.

Comminution
Continuous elemental measurements from the CBX on the feed to an AG/SAG mill can be used to characterise the ore into different types to determine which AG/SAG mill control model is most appropriate for that ore type.
Process Instruments

A complete range of Process Instruments are offered:

- High Performance Density Gauges for density measurement of slurries in pipes. This gauge is also available as an Immersion Density gauge for specific applications.
- Continuous Level Measurement for measurement of levels (continuous or switch) in vessels and containers.
- Thickener Interface Gauge for measurement of the density profile and bed levels in thickeners.
- Radiometric Analysers for the measurement of naturally radioactive material on belts or in slurries (eg KCl).
- Nuclear Ball Counters to monitor grinding media consumption.
- Conveyor Belt Scales and Integrators from general use systems to certified for trade accuracy.
- Impact Weighers for low cost high accuracy measurement of mass flow rate and total mass of free flowing solids.
- Tramp Metal Detectors to protect crushers, conveyors and other process machinery from damage by tramp metal.
- Proline equipment to monitor belt misalignment under/over speed conditions as well as safety pull switches.
- A variety of level measurement systems to suit any industrial application. Measurement techniques available include strain gauge systems, ultrasonic, mechanical and capacitive.
- Microwave Flow/No Flow detectors to monitor solids flow in pipelines, ducts, airslides or transfer points of vibrating chutes, conveyors and bucket elevators.
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