Implementing SampleManager LIMS Software to Support Metal Accounting Processes

Accurate and precise metal accounting processes are critical to the success of every mining operation. With operations increasingly spread across multiple companies, there are more points in the process where materials change hands and are bought and sold according to the values determined by laboratory analysis. The value is determined by the expected recovery of the materials, which requires the companies involved to have an accurate knowledge of this figure. Problems arise when there are issues with the sampling process, sample handling and storage or with the lab instruments and equipment being used to analyse the material and calculate the expected recovery. All of these could contribute to inaccurate results. If the calculated recovery is not achievable this could result in a financial loss for the company purchasing the material.

Aside from this clear financial impact, there is another consideration. The processes used to extract the valuable material can increase or decrease in efficiency, depending on multiple factors including the state of the materials being processed (whether it is damp, coarse, etc.), whether the machines involved have been properly serviced and calibrated, how much material is passing through, and other factors. By constantly and accurately monitoring the composition of the materials throughout the process and employing statistical analysis, any adverse changes to product can be identified and could potentially indicate an issue at some point in the recovery process. Adjustments or interventions could then be made to ensure optimum recovery is achieved.

Metallurgical accounting is under increasing scrutiny with stakeholders being more concerned about the origin and accuracy of reported results. As well as considering whether best practices have been employed to ensure the sampling process is correct, labs must also consider the processes that they follow to analyse the samples, process the data and report results. The AMIRA P754 code of practise outlines a list of metal accounting guidelines which address the importance of rigorous accounting systems and is a key focus of senior management in mining plants. Introducing data redundancy and the use of secure and auditable relational database systems enables the estimation of errors and drives data integrity, traceability and accurate reporting throughout all processes. A Laboratory Information Management System (LIMS) such as Thermo Scientific™ SampleManager™ LIMS, SDMS and LES software can be used to adhere to the AMIRA code - managing associated lab processes, driving best practices and ensuring unquestionable data management throughout testing processes.

The sampling process can be critical to ensuring real values are returned from physicochemical analyses without biased results. Once a fit for purpose method has been devised, a Laboratory Execution System (LES) can be used to take analysts step by step through the sampling process. Videos, images and detailed descriptions are used to show the user exactly how to undertake the tasks involved.

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SampleManager software's LES links directly into the LIMS and can be accessed on a tablet, enabling the user to access the system during the sampling process and make any comments about the sample immediately while they work. This approach can eliminate bad sampling practices such as storage in inadequate containers which could be considered a cost saving, whereas the inaccurate results returned could lead to erroneous results with a more significant financial impact. Accessing the LIMS remotely also makes it possible to record results contemporaneously, enabling the lab to demonstrate data integrity.

The LIMS can be used to schedule the sampling plan and its locations, ensuring regular and accurate sampling and time stamping the exact moment at which samples are taken. Connections into external systems enable other data which may affect the sampling to be recorded at the same time, such as the temperature or humidity of the sample location.

Calibrations and maintenance of instruments and equipment used during the sampling and testing process are key to its integrity, just as the performance of any machinery involved in the recovery process is inherently linked to the final quantity of recovered material. SampleManager LIMS software includes a complete Instrument/Equipment Calibration and Maintenance System designed to help plan and execute a solid instrument management plan, ensuring that all the equipment used is working correctly, checked at regular intervals and any maintenance can be properly planned and prepared for. When instruments and equipment can be shown to be working to a high standard, the potential for errors in both the recovery process and the analyses to determine the amount of material recovered is significantly reduced. Calibration and maintenance plans may be applied to numerous items such as rotary sample splitters, sludge drying ovens, truck scale calibration and granulometry analysis equipment.

Statistical analysis such as Shewhart control charts are commonly used in laboratories to monitor processes and identify any issues as soon as possible. CUSUM charts are used less frequently but are an excellent tool for detecting bias or variance in an analytical procedure. SampleManager LIMS software's Statistical Quality Control package enables the creation and monitoring of Shewhart, CUSUM and other charts designed to highlight any process issues.

The statistical analysis of raw data also assists in the determination of metal recovery accuracy, which is a reporting requirement of any company's audit committee.

Data security is of great importance to the transparency and integrity of the data. Any system storing or processing data must have clear protocols in place to ensure that only authorized people can access the system. It should not be possible for data to be altered in any way, and there must be a full auditing service which records any changes as and when they happen, along with who made them. SampleManager LIMS software enables secure system access and can also be configured to request comments if details are changed, providing full data traceability based on ALCOA+ principles.

SampleManager LIMS, LES and SDMS software has been implemented to support Metallurgical Balance or Metal Accounting processes at various organizations, including Codelco in Chile. LIMS is now a central part of the MA process, managing product quality data and product movement through integration with other information systems, weighing systems, external laboratories and truck tracking systems across the organization. The LIMS is the data repository integrating the sampling and control information of truck tonnages, enabling timely report generation of all KPIs and providing information for other management systems, facilitating corrective action or investigation where necessary.

At Codelco's Ministro Hales site, SampleManager LIMS software is integrated with the truck weighing and tracking systems to receive tonnage, origin, destination and sampled date data for the reconciliation of wet and dry product tonnage WMT/DMT. Product from each truck is sampled to calculate the total tonnage reports of the lot and fine product weight based on moisture content. Product quality, moisture and particle size results are received in the system and the results of external laboratories are processed with SampleManager software's LES (parsing and mapping of flat files). Turnaround calculations for physicochemical analysis, truck weighing and sampling can also be managed using SampleManager LIMS software. The system enables statistical analysis to assess the mass measurement and accuracy in each sampling, weighing and analysis process.

The metallurgy analyst can generate reports by customer, origin, destination and tonnage of each truck in its plant. It's also possible to see how much product is in stock in a given date range, enabling reports of daily, weekly and monthly metallurgical balance. Laboratory turnaround time is minimized due to the integration of the LIMS to external labs and site process optimization for result availability:

SampleManager LIMS software is configured to generate labels for each sample and product generated by the plant. The labels are scanned in external service laboratories and the results are sent back to LIMS. Raw data files are processed within the system, avoiding data/result manipulation or transcription errors.

In the screenshot below, two external laboratories, LQC and External Services Laboratory report results for the same sample. The metallurgy analyst can compare the results of different components and laboratories. This provides a double check of commodity purity and calculation of any accuracy/error/bias:

The system can also be configured to generate multiple reports for plant areas and high-level reports:

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ID OT: LOTE_0000003200

ID Producto: Calcina Venta

Posición	ID	N Ticket	Turno	Patente	Origen	Destino	Tonelaje	Fecha Muestreo	Peso Muestra
0	230170	448204	Turno A	DJWF-29	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26120	01-07-2019 17:37:40	
0	230209	448160	Turno A	LJCV-32	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26830	01-07-2019 12:22:31	
0	230212	448154	Turno A	GHLW-41	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	27660	01-07-2019 12:01:14	
0	230214	448148	Turno A	CFRG-10	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	27670	01-07-2019 11:41:36	
0	230217	448146	Turno A	DPTR-82	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	27340	01-07-2019 11:13:03	
0	230218	448145	Turno A	DBLS-83	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	27110	01-07-2019 11:08:34	
0	230219	448139	Turno A	FHRT-61	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26850	01-07-2019 11:02:41	
0	230227	448124	Turno A	HHPT-68	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	24790	01-07-2019 10:08:27	
0	230521	448217	Turno A	JZSK-36	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	24720	01-07-2019 18:48:50	
0	230523	448221	Turno B	KZPL-84	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	25650	01-07-2019 19:05:04	
0	233161		Turno A		DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	421550	01-07-2019 18:41:20	
1	230163	448208	Turno A	HTVY-98	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26380	01-07-2019 17:55:33	
1	230520	448215	Turno A	CTYZ-18	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	25980	01-07-2019 18:41:20	
2	230519	448214	Turno A	HXPZ-40	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26630	01-07-2019 18:42:34	
3	230522	448213	Turno A	DRCX-98	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26060	01-07-2019 18:56:19	
4	230524	448228	Turno B	HRTV-62	DMH-BODEGA 1	PUERTO MEJILLONES-PUERTO ANGAMOS	26070	01-07-2019 19:13:02	
5	230525	448229	Turno B	DRBW-13	DMH-GENERICO	PUERTO MEJILLONES-PUERTO ANGAMOS	25690	01-07-2019 19:35:20	

The AMIRA metal accounting model aims to support mining plant managers in making better and more informed decisions and ensure operations information is reliably available. SampleManager LIMS software provides a centralized relational database and automatically transfers information to eliminate redundancy and reconciliation errors, providing the best possible report of plant performance. The system helps organizations to meet the AMIRA requirements for easy setup, configuration and auditing, enabling them to achieve maximum profitability.

References

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