The benefits of sampling and blending from pit to port

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Most sampling systems are implemented with a genuine desire to achieve a sample which can be used in a quality control process. However, having observed many interesting and inventive sampling systems around the world, it is obvious that sometimes the desire to achieve any sample far outweighs the regard to adherence to basic sampling rules. As a consequence, the sample produced offers little of the information the user expects and the end experience is disappointing.

When it comes to minerals sampling, many get it wrong – never is this more so than in the production and global trade of iron ore commodities.

Supplying quality ore is the imperative; but supplying it an optimum quality is the goal. There is little point supplying high grade ore if the buyer does not want that grade and will not pay for it, as was the case a decade or more ago.

The aim here is simple: mine so that stock piles have blended low and high grade ore to optimise the material sold. To achieve an optimum quality and to maximise financial benefits it is critical to representatively sample the critical process streams from mine to ship loading. For suppliers, even small differences in ore grade can have a significant effect on the value of a mine towards the latter part of its life.

Historically it has been difficult to justify to management the expenditure required to either upgrade existing sampling stations or to install new sampling stations to achieve representative sampling of a company's process streams. This has been due to the difficulty in quantifying the total value that the company can obtain by the installation of such sampling improvements.

Representative sampling installed at strategic locations can improve product quality and increase throughput. Unfortunately, many companies prefer to follow a policy that avoids capital expenditure and remain satisfied with numbers on a piece of paper regardless of whether they are representative of the process.

Iron ore unloading at China's Huangdao port.

Accuracy

The essential components of an effective quality control system must be based on accuracy of data (Jelenich). Realistic decision making cannot be performed without this. Therefore, the key component must be suitable and well maintained sample stations that satisfy the international standards for the products being sampled. These plants must undergo regular audits to maintain this status.

The number and location of the sample stations are dependent on many factors including:

- number of contributing ore sources
- mining equipment and crushing types
- product mix
- blending requirements
- train loading/unloading methods
- stacking/reclaiming methods and procedures
- ship loading methods.

Sound operating practices and procedures are also essential components of an effective quality control system. In any total ore process flow – that monitors ore quality from the mine to ship loading – the requirement is to track the chemical and physical properties of the ore throughout the system and to have the ability to reconcile that data back through all stages to the geological model.

These stages include:

- geological block model
- mining block model
- blast holes
- grade control model
- crushing
- train loading stockpiles
- train loading
- train unloading
- port shipping stockpiles
- ship loading.

Take a close look at your ore because your customers are now looking closer

Prepare to see a greater emphasis on minerals sampling and blending in the global ore trade.

Technically advanced sampling and testing systems are gaining acceptance in China's burgeoning network of iron ore receiving ports. Ensuring that the quality of this incoming iron ore is accurately controlled is a massive task.

End users at port are demanding more efficient, accurate and reliable ore sampling and testing systems that don't constrain trade activity.

Automating the port sampling and analysis processes has provided many benefits. These include greater consistency of results, better hazard management, improved quality and traceability, tighter cost control, more flexible capacity, and insulation from labour availability and cost fluctuations.

Ore sampling at key locations in the supply chain can improve product quality, increase throughput and enhance competitive market positioning.

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The outcome of the overall reconciliation process highlights the critical data required to enable a company to make informed and controlled decisions. These decisions could be to modify their production targets or operating practices, or to monitor ongoing trends to determine their future impact. This provides a powerful tool for a company to maintain control of not only its cost performance, but its desired position in a competitive market.

There are several instances globally where operational process changes were warranted to improve final product grade and increase throughput. These improvements would add significant benefit to the companies involved. This achievable performance has generally occurred due to a variety of reasons which include:

- poor or no sampling
- mining equipment mismatch with task
- tonnage throughput as prime objective
- port inefficiencies due to a lack of quality knowledge at car dumpers
- too many products resulting in many variable sized stockpiles
- inefficient stacking/reclaiming practices.

Other poor sampling practices include:

- complexity in the transport of ore from car dumper to stockyard to ship
- lack of infrastructure
- poor condition of operating equipment and infrastructure
- insufficient understanding of physical split characteristics of the ore.

Invariably, ineffective quality control through these operating activities can result in this outcome. It is therefore critical that a tonnage and grade reconciliation process be used to provide the performance measures for quality control that can be applied to the total project. This will clarify: optimum ore recovery practices; accuracy of mine plans; knowledge of resource base; marketability of life of mine (LOM) products; and validity of LOM project assumptions.

Some situations have been observed where inaccurate or insufficient sampling has directly resulted in poor optimisation of economic resources, loss of revenue and/or triggering of contractual penalty payments.

Sampling and testing at port

Prepare to see a greater emphasis on minerals sampling and blending in the global ore trade. Quality control of ore is commonplace today at critical points in the supply chain but commensurate with greater tonnages of supply is a higher risk of cargo rejection at port.

Port authorities in China and Japan are far more discerning about the ore they will accept. As such, suppliers can expect to face increasing scrutiny about their ore quality.

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Automating the port sampling and analysis processes has provided many benefits. Long gone are the high maintenance and labour intensive hydraulically driven sampling devices. A decade ago, most sampling systems at ports were several storeys in height to allow the primary sample to gravity feed and be processed for final result at ground level. Obviously there is great cost involved in not only building that structure but also maintaining the moving parts inside and driving the conveyor at such a height.

Several companies have pioneered automation in iron ore sampling where the primary and sometimes secondary sample is taken traditionally with a mechanical device but thereafter the robotic approach is taken on ground level. Automating the port sampling analysis processes provides numerous benefits such as greater consistency of results, better hazard management, improved quality and traceability, tighter cost control, more flexible capacity and insulation from labour availability and cost fluctuations.

This sampling and analysis facility at the Caofeidian iron ore port in China includes a robotic preparation and analysis cell.

References

Jelenich Lou, Financial Justification of Representative Sampling of Raw Materials; AusIMM Sampling 2012 Conference, Perth, Wester Australia, August 2012.