Intelligent Control and Optimization: Need of the Time in Mineral Processing Industry

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Abstract

Mineral processing sits at the heart of metal extraction process for sectors such as ferrous and nonferrous metallurgy. Continuous endeavors towards fundamental process improvement and explosion of technological advancements has driven mineral processing plants to command high level of efficiency and consistency in output quality. However, the challenges are numerous and multifold, demanding significant effort towards crafting intelligent and learning systems for further improvements. Moreover, cutting edge technology is often coupled with a "cutting edge" cost of its acquisition and sustenance.

With the improvement driven by the fundamental research in mineral processing, improved understanding, advanced instrumentation, process modeling, simulation techniques, on-line optimization and control methods, the entire process of mineral processing has become more predictable and controllable. In line with the fact that the challenges grow in proportion to the knowledge the growth of knowledge in mineral processing poses us with grand challenges such as handling of uncertainty in ore quality, lack or insufficiency of advanced instrumentation (due to the cost angle), process changes, adaptation required owning to changing process and market conditions, and the business challenge of striking an optimal balance of plant sophistication and cost.

Although advanced process control (APC) and optimization is certainly an effective vehicle to drive successfully towards meeting these challenges, it needs to be supported by methods and techniques to facilitate continuous learning, adaptation, and intelligent decision-making. Methods to overcome lack or absence of sophisticated instrumentation can be countered by use of a thoughtful mix of soft-computing techniques such neural networks, genetic algorithms, fuzzy logic, statistical techniques, and data mining. The thrust of research and development needs to be on development of techniques that can potentially make the APC solutions complete in the sense of their ability to expand plant-wide, be adaptive, learn, and arrive at cost effective economic decisions.

The talk intends to cover a discussion on use of intelligent, learning, and optimization based techniques to drive cost effective solutions for overall enhancement in mineral processing plants. It is also intended to discuss the relevance of such development from Indian context. Need of the future is the solutions that are complete, self-enhancing, and cost-effective with a definite element of longevity. The talk also aims at articulation of this grand challenge facing the mineral-processing world.

Keywords: *Mineral Processing, APC, Learning and Intelligent Techniques, Soft-computing.*