June 21, 2011 (Tuesday) 55th EOQ Congress

CONCURRENT SESSIONS **Tuesday 13:30 – 17:30**
KEMPINSKI HOTEL CORVINUS **Erzsébet tér 7-8, Budapest V.**

REGINA BALLROOM I.

10.2. INNOVATION AND QUALITY II.

Session Chair: ***Kostas N. Dervitsiotis****, University of Piraeus, Greece*

16.20 Quality Management of Iron Ore and Coal by Raw Material Division of Tata Steel
Rewati R. Srivastava and Rajesh Murkherjee, Tata Steel Ltd., India

Srivastava, Rewati R. (India)

He learned Mining Engineering from ISM (Indian School of Mines) Dhanbad, India (1993-97). He has key skills in the following areas: Six Sigma Black Belt; business planning related to mining operations; policies and strategies formulations, identification of improvement areas; financial analysis of mining projects; feasibility study and due diligence for new projects. He is an ISO 18001 Information Technology Lead Assessor. Joined Tata Steel on 1st July 1997 and have worked in various capacities starting from shop floor level to middle management level in business objectives and strategies, process and system mapping, gap identification as well as identification of improvement projects. He continuously analysed performance of all areas pointing the gaps. Recently he organised several national seminars on mining Industry.

Abstract Submission Form

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Title of the presentation:

Quality Management of Iron ore and coal by Raw Material Division of Tata Steel
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Preferred Format of Presentation (Select one):

(●) Oral Presentation
( ) Poster Presentation
( ) Both Oral and Poster Presentations

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Abstract (Not more than 200 words)

The role of Raw Material Division (RMD) in Tata Steel is to supply Iron ore and coal to its internal customer as per the required specifications. Any deterioration in the Iron ore and coal quality adversely affects hot metal quality and increases steel making cost downstream. Coal produced from captive sources, being cheaper, is treated as base coal by Customer and according to the quality of captive coal, proportion of costlier imported coal is decided for the blend used in coke making. Any deviation in coal quality forces change in proportion of imported coal usage and thereby has huge cost implication. Therefore, the division strives to continuously improve its offering to its Customer by improving Quality Management. Challenge for RMD is to do Quality Management and ensure that the Customer needs is fulfilled while ensuring that compliance to quality does not jeopardize the long term need of the Company. This is done by keeping in mind the finiteness of the deposit, and ensuring that any improvement in Quality is done while improving mine life and reduce wastages.

Extended Abstract

The integrated iron and steel plants are raw material intensive and the quality and cost of raw materials influence the techno-economic performance of the plants significantly. It has been well established that the cost of steel can be significantly brought down by improving physical and chemical characteristics of the raw materials. Under Indian Conditions, the role of raw material is more critical on account of their intrinsic quality considerations which are unique compared to global scenario. Indian iron ores are generally high in iron content and at the same time are characterized by aluminous gangue. Reduction in Alumina level by 0.16%, leads to reduction in fuel rate by 3 Kg /THM and Increase in productivity of Blast Furnaces by 0.5%. It has been established that a reduction of 0.10 unit iron ore fines alumina increases sinter plant productivity by 1%, reduces coke rate by 1.5kg/THM which ultimately lead to increase in blast furnace productivity by 0.375%. Similarly, ash content, volatile matter and coking properties of coal besides its fludity and crucibel swelling index (CSN) have improtant bearing in cost of hot metal produced

Primary objective of the Raw Material Division of Tata Steel is to supply right quality iron ore and coking coal from its captive mines to its Blast Furnaces at Jamshedpur, India. 75% of the cost of hot metal produced by the Blast Furnaces is contributed by iron ore and coal. Hence, having own iron ore and coal mines is a competitive advantage for Tata Steel. Therefore the division strives to continuously improve its offering to its customer, the Coke, Sinter and Iron making groups by improving QA processes.

Depleting iron ore and coal reserves coupled with increasing demand for low-alumina iron ore fines and low ash coking coal to improve blast furnace performance in terms of productivity and reduced slag rate necessitate intensive beneficiatio and thereby call for capital investment of higher order. While Tata Steel has been improved its ore upgradation facilities apart from more scientific mine planning process, it has tremendously relied upon implementation on TQM principles to improve its product quality, not only improving mean but also in reducing variation for critical product quality paramters. And there comes the role of QA, not only sampling and inspection but also reducing defects through improvement in product quality to customer complaint handling. It is also important for RMD to keep in mind the finiteness of the deposit, and ensure that any improvement in quality is done while increasing mine life and reduce wastage.

The paper discusses the need for QA in RMD, its uniquesness, quality improvement of raw material with changing customer need arising out of changing business environment. It also presents the QA processes adopted in RMD apart from a brief on pre-production (exploration, deposit modelling & mine planning), production (mining & processing) and post-production QA in the division.

Uniqueness of QA in RMD lies in ensuring homogeneous output from a highly heterogenous input (iron ore and coal), which occur naturally and subsequently mined out. The task is even difficult and unique as the mines being captive to Tata Steel, do not enjoy the liberty to sale different products as per ore reserve and grade to the market unlike other mines in the vicinity. Therefore key success factor lies in effectiive utilization of all ore/ coal grade as occur naturally through beneficiation and blending. Since raw material resources are finite in nature, any improvement in quality has to be done keeping long term sustainability of resources in mind.

Process of QA in RMD starts from predicting deposit quality, mine planning (long term mine scheduling and short term), mining, processing and is followed rigorously till

dispatch of ore to its customer. Exploration result in the form of borehole data forms the basis of mine planning and scheduling of ore from the mines every year. The deposit model prepared based on drillhole information foirms the basis of excavation planning for long term and annual. Monthly breakup of this mine plan is then formed to ensure customer desired quality parameters are achieved. This planning process also takes into account the long term need of customer from the finiteness of resource point of view and ensures that mining is done in scientific and sustainable manner. This requires due diligence to safeguard future variability that might happen because of unscientific mining operation to meet selfish short term needs. At suitable frequencies the estimate of ore/ coal grade is analyzed with actual grade and tonnage achieved while mining. Deviation, if any, found during the reconciliation process is taken care of while planning for subsequent period.

The next important QA step involved is mine grade control which basically aims for delivering consistent run-off-mine to processing plants (coal and iron ore). In production stage QA mostly invloves sampling and inspection, feedback to operating departments, process validation in fixed intervals and finally assurance of product quality at the despatch end to customer. Quality improvement plans are made for each of the operating departments every year based on customer requirments taken during annual business planning process. The division also, during the last few years, stressed upon Statistical Process Control (SPC) in the form of daily management to bring about visible changes in quality assurance systems so as to offer direct benefits to the customers, particulalry in terms of reduction in variability. During the past few years, a course of action was agreed upon and a coordinated program to introduce SPC was formulated. Following the earlier educational and introductory events, a broader training program was organized where front-line managers, operators and laboratory technicians received training in the theory and use of control charts and statistical process control techniques. Subsequently roles and objectives of the Department was deliberated following Dr. Kano's questions, process flow, Process Failure Mode and Effect Analysis (PFMEA) and control plans were developed and the team started acting on. In case of diviations, potential and actionable reasons are delineated, countermeasures are identified. PDCA (Plan, Do, Check & Act) approach is followed as a continuous process of total quality management in implementation of each countermeasure. After each PDCA cycle is rotated, improvement in Process Performance Index (CpK) and Process Capability (Cp) is documented as a part of daily management deployment. In each stage and in between, development/modification of the standard operating procedures (SOPs) are carried out for standardized approach to the process control by the front-line supervisors/operators including visual management.

Oflate, efforts has been made to map all cusomer related paramters by translating the quality requirements into specific process indicators for each department. This has been done in accordance with the QA modules followed across the organization and customized based on specific need of RMD. This has helped improve understanding and appreciation of the process even to operator level ultimately to achieve business goals. Management System Chart for Quality Assurance has helped not only mapping the short term quality objectives but also processes for achieving long-term goals.

Complaint handling system also made robust to track compliance and esclate to higher management in case of undue delay in closing any complaint. As an effect of the continuous improvement in QA processes in RMD, non-conformance in quality parameters could be brought down, which ultimelty led to achievement of final business goal of improving blast furnace productivity and maintaining cost competitiveness.

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