

Prediction of Trace Elements in Blast Furnace Hot Metal

Barun Kumar

Lead – Data Analytics

IT & Digital

Tata Metaliks Limited

Kharagpur, 721301, West Bengal, India

barun.kumar@tatametaliks.co.in

Hindol Bose

Assistant Manager

Quality Assurance

Tata Metaliks Limited

Kharagpur, 721301, West Bengal, India

hindol.bose@tatametaliks.co.in

Abstract

Molten metal from blast furnace is used as raw material for producing Ductile Iron, which provides better ductility properties than cast iron, due to its nodular graphite inclusions. Trace describes metallic or non-metallic elements that are not specified in the alloy grade, but an acceptable amount can be present without any detrimental effect on the alloy's performance. For Ductile Iron Pipe manufacturing, few critical trace elements are - Cr, As, etcetera. Raw Materials charged into Blast Furnace are analyzed to determine the chemical composition of the burden and then fed into a mass balance model to estimate the chemistry of output Hot Metal. However, it is not possible to measure amount of trace elements entering into the blast furnace as the measuring instrument does not have sensitive detection limits for most of the trace elements. An alternative approach to understand the impact of input raw materials charged on the output Hot Metal trace element chemistry is suggested. The effect of different raw materials charged in Blast Furnace was studied by analyzing the historical data and a Machine Learning Model was developed to predict the levels of trace elements in Hot Metal, allowing for corrective action in downstream processes.

Keywords

Trace Elements, Blast Furnace, Hot Metal, Ductile Iron Pipe, Machine Learning

Acknowledgements

This project and the research behind it would not have been possible without the exceptional help and support provided by General Manager of Quality Assurance Department at Tata Metaliks Limited, Mr. Santanu Banerjee. Extensive support during data gathering was also received from Mr. Sandipan Bagchi and Mr. Ayan Chakravarty of Iron Making Technology Group and Mr. Arka Dasmahapatra and Mr. S. Duraimurugan of Quality Assurance Lab at Ductile Iron Plant. We would also like to thank Dr. Bharat Bhushan (General Manager – Projects & Chief Technology Officer) for his guidance through-out the various project stages.

The generosity and expertise of one and all have improved this study in innumerable ways and saved us from many errors; those that inevitably remain are entirely our own responsibility.

Biographies

Barun Kumar is Lead – Data Analytics, at Tata Metaliks Limited, West Bengal, India. He has 11 years of experience spanning across Operations, Business Excellence & Digital Transformation domain. He earned B.E. in Mechanical Engineering from Visveswaraya Technological University, Belgaum, PGDBA in Operations Management from Symbiosis, Pune and PGP in Business Analytics & Business Intelligence, jointly delivered by Great Lakes Executive Learning and The University of Texas at Austin. His research interests include Manufacturing, IoT, Machine Learning, Optimization, Reliability, and Lean Six Sigma.

Hindol Bose is Assistant Manager, at Tata Metaliks Limited, West Bengal, India. He has 2 years of experience spanning across Quality Assurance, Business Excellence & Data Analytics domain. He earned B.Tech in Metallurgical and Materials Engineering from National Institute of Technology, Durgapur. His research interests include Data Analytics, Lean Six Sigma, Manufacturing, and Big Data.