

Top Gas Recycling Revisited to Reduce Blast Furnace CO₂ Emissions

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ABSTRACT

Blast furnace (BF) top gas recycling (O2BF) was tested by the ULCOS program to reduce CO₂ emissions using the LKAB experimental blast furnace. During tests, the carbon rate was reduced by about 25%. Hatch and BHP re-visited the O2BF concept to assess if additional technologies could be implemented to further reduce CO₂ emissions beyond what was achieved. Using a two-stage heat and mass balance model, viable operating conditions were established for a low-carbon-rate operation, significantly less than what was achieved in the ULCOS trials. Details of the enabling technologies to reach such low CO₂ emission rates will be presented.

Keywords: Blast Furnace, Ironmaking, Top Gas Recycling, Low CO₂ Emissions Technologies

INTRODUCTION

Global steel production represents about 7% of the world's greenhouse gas emissions (International Energy Agency, 2020). The sector is dominated by blast furnace produced steel, representing about 70% of global steel output. Many new technologies are being considered to replace the traditional blast furnace to reach net zero carbon emissions. These technologies face implementation challenges be it the need for large amounts of green electrical power to produce hydrogen or increased use of recycled obsolete scrap.

To meet the Paris Climate Change Agreement objectives, steel sector greenhouse gas emissions must decrease by more than 50% by 2050 compared to 2019. The steel Sustainable Development Scenario (SDS), which meets the United Nations Sustainable Development Agenda, advocates steel-related greenhouse gas emissions decrease by 90% by 2070. Further details are available in the IEA's Iron and Steel Technology Roadmap, Towards More Sustainable Steelmaking (International Energy Agency, 2020).

From 2007 to 2010, blast furnace top gas recycling was tested as part of the European Community's Ultra Low Carbon Dioxide Steelmaking (ULCOS) program. During these tests, the blast furnace carbon rate was reduced by 25% on a relative basis. BHP and Hatch have re-visited the top gas recycling concept to assess if additional technologies could be implemented to further