LIST OF TABLES

Table-1: Grade-wise share of Indian iron ore reserves
Table-2: Hematite iron ore availability in India
Table-3: Magnetite iron ore availability in India
Table-4: Comparison between pellets and sinter
Table-5: Major pellet producing countries in the world
Table-6: Share of various technologies in world’s pellet production
Table-7: Status of commissioned pellet plants in India
Table-8: Chemical analysis of the as-received iron ore fines from Noamundi mines
Table-9: Chemical analysis of fluxes and additives used in pelletizing
Table-10: Size analysis of fluxes and additives used in pelletizing
Table-11: Chemical assay & mineral mass % in the as-received sample
Table-12: Mineral mass and grain size of as-received sample
Table-13: Liberation pattern of goethite & hematite for as-received sample
Table-14: Responsible minerals and their concentration (Deportment) for Fe & Al in the as-received sample
Table-15: Mineral mass and mean grain size of different size fractions of ground sample
Table-16: Liberation pattern of goethite & hematite for ground sample
Table-17: Deportment of Al and Fe in the ground sample
Table-18: Ingredients of green pellets with varying amount of fluxes and their quality
Table-19  Chemical analysis of pellets with varying basicity and MgO content
Table-20  Details of burden sample and slag chemistry from softening melting test
Table-21  Ingredients of green pellets with varying amount of magnesite
Table-22  Chemical analysis of magnesite pellets with varying MgO content
Table-23  Chemical formula and theoretical MgO content of magnesium silicate minerals
Table-24  Ingredients of green pellets with varying pyroxenite dosage & their quality
Table-25  Chemical analysis of pellets with varying amounts of pyroxenite
Table-26  Chemical analysis of varying MgO pellets using pyroxenite as flux
Table-27  Advanced swelling and softening test results for varying MgO pellets
Table-28  Summary of the results of effect of different fluxes on pellet quality
Table-29  Summary of the results of advanced metallurgical tests of pyroxenite pellets
LIST OF FIGURES

Fig.1 Schematic diagram of pelletizing process
Fig.2 Schematic diagram of SG induration process for iron ore pelletizing
Fig.3 Structure of porous agglomerate with reference to the relative distribution of air-water-solid phases
Fig.4 Formal representation of green pellet growth mechanisms
Fig.5 The average green pellet diameters as a function of the number of drum revolutions
Fig.6 The differential growth rate curve for taconite concentrate
Fig.7 Contact angle versus ore hematite content
Fig.8 Effect of pelletizing feed fineness on the drop number and compression strength
Fig.9 Effect of feed fineness on the size distribution of manganese concentrate
Fig.10 Effect of feed fineness on the mean pellet diameter of manganese concentrate
Fig.11 Effect of moisture content on the size distribution and mean pellet diameter of manganese concentrate
Fig.12 Effect of bentonite dosage on the drop number
Fig.13 Effect of bentonite dosage on the compression strength
Fig.14 Effect of bentonite on growth of green pellets during batch balling
Fig.15 Self-preserving behaviour of manganese concentrate during pelletizing
Fig. 16  CaO-Fe₂O₃-SiO₂ system in air

Fig. 17  Effect of limestone addition on the strength of (a) preheated and (b) fired pellets

Fig. 18  Effect of pellet basicity on their swelling behaviour

Fig. 19  Effect of pellet basicity on their reducibility

Fig. 20  Effect of pellet MgO on its reducibility at 1.3 basicity

Fig. 21  Effect of MgO/SiO₂ ratio on reducibility of pellets

Fig. 22  Effect of MgO/SiO₂ ratio on swelling of pellets

Fig. 23  Effect of MgO/SiO₂ and CaO/SiO₂ on high temperature reducibility of pellets

Fig. 24  Effect of MgO/SiO₂ and CaO/SiO₂ on softening temperature of pellets

Fig. 25  Effect of MgO on the Fe²⁺ content of pellets

Fig. 26  Effect of MgO/SiO₂ ratio on the cold strength of pellets

Fig. 27  Effect of MgO in the form of serpentine on the swelling of pellets

Fig. 28  Iron ore sample preparation using coning and quartering of bulk sample

Fig. 29  Rotary hearth furnace used for firing the pellets

Fig. 30  Photographs of pellets before and after firing in RHF

Fig. 31  Schematic diagram of RDI apparatus for pellet testing

Fig. 32  Schematic diagram of Softening-Melting testing apparatus

Fig. 33  Mounted and polished pellet samples for microstructural study
Fig.34 (a)  Size analysis of the as-received Noamundi iron ore fines
Fig.34 (b)  Size distribution of as-received Noamundi iron ore fines
Fig.35  (a) Goethite inclusion in Hematite (b) Gibbsite and Hematite inclusion in Goethite
Fig.36  Particle analysis of some size fractions of as-received sample (a=+3mm, b=+0.5mm, c=+0.045mm)
Fig.37  Particle analysis of some size fractions of ground sample (a=+1.4mm, b=+0.25mm, c=+0.15mm)
Fig.38 (a)  XRD analysis of the iron ore fines and different fluxes
Fig.38 (b)  TGA analysis of the iron ore, different fluxes and coal
Fig.39  Effect of grinding time on $P_{80}$ and mean particle size during ball mill grinding
Fig.40  Mean particle size distribution of iron ore fines ground for different duration
Fig.41  Effect of pelletizing feed fineness on the $D_{50}$ of green pellets
Fig.42 (a)  Self-preserving behaviour of the Noamundi iron ore fines
Fig.42 (b)  Aggregated self-preserving curve of the Noamundi iron ore fines
Fig.43  Green pellet properties as a function of Mean particle size
Fig.44  Effect of the firing temperature on the cold crushing strength (CCS) of pellets at varying fineness
Fig.45  Microstructure of fired pellets made from different fineness pellet feed
Fig. 46  Optical microstructures of the fired basic pellets with varying basicity

Fig. 47  Image analysis of the MgO-free pellets (a) Distribution of different phases and (b) silicate melt density

Fig. 48  Optical microstructures of the fired MgO pellets with varying basicity

Fig. 49  Image analysis of the fired MgO pellets with varying basicity (a) Distribution of different phases and (b) pore density

Fig. 50  SEM image of Pellet A C & E with EDS analysis of all the pellets (A,B,C,D &E)

Fig. 51  Distribution of Fe, Si, Ca and Mg in the fired MgO-free pellet with 0.8 basicity (Pellet E)

Fig. 52  SEM image of Pellet A1 C1 & E1 with EDS analysis of all the pellets (A1,B1,C1,D1 &E1)

Fig. 53  Distribution of Fe, Si, Ca and Mg in the fired MgO pellet with 0.4 basicity (Pellet D1)

Fig. 54  Effect of pellet basicity on the cold strength of fired pellets

Fig. 55  Effect of pellet basicity on the swelling of fired pellets

Fig. 56  Effect of pellet basicity on the RDI of fired pellets

Fig. 57  Effect of pellet basicity on the reducibility of fired pellets

Fig. 58  Effect of pellet basicity on the softening melting characteristics of mixed burden

Fig. 59  Effect of pellet basicity at 1.5% MgO on the softening melting characteristics of mixed burden
Fig.60  Composite quality index of varying basicity pellets with and without MgO

Fig.61  Optical microstructures of magnesite fluxed pellets with varying MgO

Fig.62  Image analysis of magnesite fluxed fired pellets with varying MgO

Fig.63  SEM image of Pellet A, C, E & G with EDS analysis of all the pellets (A, B, C, D, E, F & G)

Fig.64  Distribution of Fe, Si, Al, Ca and Mg in the fired magnesite fluxed pellets with 3% MgO (Pellet G)

Fig.65  Effect of pellet MgO on the cold compression strength of fired pellets

Fig.66  Effect of pellet MgO on the swelling of the fired pellets

Fig.67  Effect of pellet MgO on the RDI of the fired pellets

Fig.68  Effect of pellet MgO on the reducibility of the fired pellets

Fig.69  Optical microstructures of the fired pellets with varying MgO

Fig.70  Amount of different phases formed in the fired pellets with varying MgO content

Fig.71  SEM image of Pellet A & D with EDS analysis of all the pellets (A, B, C, D, E, F & G)

Fig.72  Effect of MgO on the amount of relict Mg-silicate and FeO content of slag phase in the fired pellets

Fig.73  Distribution of Fe, Si and Mg in the fired pellets (a) Acid pellet (pellet A) and (b) Pyroxenite pellet with 1.5% MgO (pellet D)

Fig.74  FeO-MgO phase diagram

Fig.75  Effect of MgO content on cold strength of the fired pellets
Fig. 76: Effect of MgO on the density of hematite phase in the fired pellets

Fig. 77: Effect of MgO content on swelling index of the fired pellets

Fig. 78: FeO-SiO$_2$ phase diagram

Fig. 79: Effect of MgO content on reduction degradation of the fired pellets

Fig. 80: Effect of MgO content on reducibility of the fired pellets

Fig. 81: Effect of MgO content on the softening-melting characteristics of the fired pellets

Fig. 82: Free swelling index of varying MgO pyroxenite pellets

Fig. 83: Disintegration and reduction time of pellets as a function of MgO content

Fig. 84: Reduction time as a function of pellet MgO content

Fig. 85: Reduced pellet samples with varying MgO before and after tumbling

Fig. 86: Effect of MgO content on reduction time, delta P and softening temperature

Fig. 87: Effect of pellet MgO content on their softening temperature

Fig. 88: Pellet samples after completion of swelling and softening test

Fig. 89: Microstructure of pyroxenite pellet sample from 6 MTPA pellet plant of Tata Steel

Fig. 90: Microstructure of pyroxenite pellet with relict pyroxenite particle