

8th International Ferroalloys Congress Proceedings

**June 7-10, 1998
Beijing, China**

**Organized by
The Chinese Society for Metals**

China Science & Technology Press

CONTENTS

PLENARY SESSIONS AND KEYNOTE REPORTS

Developments in Technology for Ferrochromium Production	1
<i>Aidan M Edwards</i>	
Strategic Issues in the Ferroalloy Industries	5
<i>Christopher Stobart</i>	
Environmental Aspects of the Ferro Alloy Industry	13
<i>Halvard Tveit</i>	
Optimization of Structure of Steel-Making in China and Its Demand on the Optimization of Ferroalloy Production	20
<i>Zhang Baiseng, Yang Dong and Su Tiansen</i>	
The Outlook for Ferro-Manganese, Silico-Manganese and Ferro-Chrome	23
<i>Amy Bennett</i>	
The Present Situation and Future Prospects of Ferroalloy Industry in China	29
<i>Wu Jianmin</i>	
The North American Ferroalloys Industry at the Crossroads into the New Millennium-Challenges or Stumbling Blocks on the Road?	33
<i>Dr. Dieter W. Ksinsik</i>	
The Current Situation and the Future Development of the Ferroalloy Industry in Asia	39
<i>Teiken Akizuki</i>	
Recent and Anticipated Developments of Ferroalloys in South Africa	43
<i>Zacharias Van Der Walt</i>	
TECHNICAL SESSIONS	
Environmental	
Environmental Solutions to Waste Products from Ferrochrome Production	51
<i>Willem A. Gericke</i>	
Environmental Aspects of Ferro-Silicon Furnace Operations-An Investigation of Waste Gas Dynamics	59
<i>Stein Tore Johansen, Halvard Tveit, Svend Gradahl, Aasgeir Valderhaug and Jon Age Byberg</i>	
Comprehensive Treatment Technology of Chromium Leached Residues	64
<i>Zhang Zinong, Tong Jin, Lan Tiegang, Ren Zhiguo, Liu Yingjie and Zhang Huitang</i>	
Treatment of Waste Water Containing Vanadium and Chromium by a Two-Fractional Precipitation Process	68
<i>Liu Mingyang, Yang Jianmu, Deng Xiaodong, Li Ming, Luo Faying and Li Longyin</i>	
Company Profile Including Development in Stack Emission Filtration Technology	75
<i>Dagfinn Wintersto</i>	
Practice on the Application of Electrostatic Dust Filter for the Fumes of FeMn Furnaces	82
<i>Sun Zhenku</i>	
CO ₂ -Emissions and the Ferroalloys Industry	87
<i>Tor Lindstad</i>	
Silicon Metal and Ferrosilicon	
On the Control of Silicon Content in Ferrosilicon	95
<i>Gudmundur R. Jonsson and Helgi Thor Ingason</i>	

40 Year History of Metal Silicon Production in China	99
<i>He Yunping and Yu Zhichun</i>	
Effect of Thermal History and Internal Stresses on Disintegration of Ferrosilicon	104
<i>B. Johannesson and Th.I.Sigfusson</i>	
Phase Stability in Silicon Rich Ferrosilicon	110
<i>Th. Magnusson, Th. Sigfusson and O. Helgason</i>	
Statistical Analysis of Properties for Coals Used in the Production of Silicon Rich Alloys	116
<i>Ola Raaness, Leiv Kolbeinsen and Jon Age Byberg</i>	
Experience of Carbonaceous Reducer Utilization in FeSi Production at Joint-Stock Company KUZNETSKIE FERROSPLAVY	121
<i>S. S. Zhylyakov, G. A. Chashin, Y. P. Snitko, I. M. Kashlev, Y. P. Kanaev, N. E. Molchanov, V. M. Strakhov and V. V. Tregub</i>	
Microstructural Study of Granulated Ferrosilicon with 75wt% Silicon	126
<i>Q. C. Horn, C. L. Nassaralla and R. W. Heckel</i>	
Chromium Metal and Ferrochromium	
Kinetic Modelling on Solid State Reduction of Chromite Pellet with CO	135
<i>Yanping XIAO and Lauri HOLAPPA</i>	
Kinetic Study on Solid State Reduction of Chromite Pellets and Lumpy Ores	141
<i>Marko KEKKONEN, Ari SYYNIMAA, Lauri HOLAPPA, and Pekka NIEMELA</i>	
The Effect of Chromite Ore Mineralogy on Reduction Mechanism and Reducibility	147
<i>Eli Ringdalen and Sverre E. Olsen</i>	
South African Chrome Ore for the Production of Charge Chrome	153
<i>M. Sciarone</i>	
The Selective Carbothermic Reduction of Chromite	158
<i>T. R. Curr, L. R. Nelson and L. B. McRae</i>	
The Production of Ferroalloys by the Toll Treatment of Slag Dumps	171
<i>B. J. Olivier, R. N. Guest and J. A. L. Parker</i>	
Development of High Quality Ferrochromium Alloy (NKK Super-Chrome)	176
<i>Masanori KATO, Sotoaki KAWAGUCHI and Takeharu TOYODA</i>	
Chromium Recovery from Ferro-Chromium Slags	180
<i>KUCUKKARAGOZ C Serdar, AKDOGAN Guven and ERIC R Hurman</i>	
A Preliminary Study on Pellet-Sintering of Chromite Fines	184
<i>Qiu Fangming and Zhong Lin</i>	
Studies on Factors Affecting Carbon Content in Ferrochrome and Chromium Content in Slag	189
<i>Chen Yonggao</i>	
Carbon Solubility and Mass Action Concentrations of Fe-Cr-C Melts	195
<i>Zhang Jian</i>	
Phase Equilibria and Oxygen Potential in SiO ₂ -CrO-MgO-Al ₂ O ₃ Slags (MgO/Al ₂ O ₃ =2.0)	201
<i>K. L. Kossyrev, A. V. Pavlov and S.E. Olsen</i>	
Technical Methods for Reducing Power Consumption in Smelting Extra-Low Carbon Ferrochromium	206
<i>Sun Yihua, Bo Hongyuan and Zhao Wenbiao</i>	

Ferromanganese

Solidification of MC SiMn Segregation, Structures and Strength	215
<i>Eivind G.Hoel and Johan Kr.Tuset</i>	
Optimization of Medium-and Low-Carbon Ferromanganese Process by Silicothermic Reduction	221
<i>Ding Weizhong, Xu Weiwei, Tang Kai and Jiang Guochang</i>	
Studies on Production of High Carbon Ferromanganese in Blast Furnace with High Proportion of Sinter and Improvement in Manganese Recovery	226
<i>Xiong Xiaoxing and Liu Daolin</i>	
Industrial Trials on Basic Fluxes in SiMn Smelting	232
<i>Shu Li and Dai Wei</i>	
Production of HCFeMn Using High Proportions of Sinter in the Charge	237
<i>Joao Pais, William Brown and Magid Wahib Saab</i>	
Refining of High-carbon Ferromanganese	243
<i>Prakash J.Bhonde and Ramchandra D.Angal</i>	
Technical Progress of Blast Furnace Ferromanganese Production in China	247
<i>Zhang Tangke</i>	
Control of Oxygen Potential and Its Effect on Dephosphorization in Ferromanganese	255
<i>Dong Yuanchi, Guo Shangxing and Chen Erbao</i>	
Improvement of Production Process for Medium/Low Carbon Ferromanganese	259
<i>Fu Weixian</i>	
Carbothermic Reduction of Manganese from Manganese Ore and Ferromanganese Slag	263
<i>M. Yastreboff, O. Ostrovski and S. Ganguly</i>	
The Application of Steel Belt Technology for the Sintering of Manganese Ore Fines	271
<i>KROGERUS Helge, DAAVITILA Jorma, VEHVILAINEN Jouni and HONKANIEMI Matti</i>	
Reduction Kinetics of MnO-Saturated Slags	279
<i>Vegard Olsø, Merete Tangstad and Sverre E.Olsen</i>	
Thermodynamics of C-Mn-Si-Fe Quaternary Alloy	284
<i>Tang Kai, Xu Jianlun, Ding Weizhong, Zhang Xiaobing, Jiang Guochang and Xu Kuangdi</i>	
A Discussion on Thermodynamics of Pyrometallurgy for Ferroalloys	290
<i>Jiang Guochang and Xu Kuangdi</i>	
Thermodynamics of Carbon and Sulphur Solutions in Manganese Based Melts	294
<i>V.Ya.Dashevskii, V.I.Kashin and N.P.Lyakishev</i>	
Thermodynamics of Phosphorus and Silicon Solutions in Manganese Based Melts	297
<i>V.Ya.Dashevskii, V.I.Kashin and N.P.Lyakishev</i>	
Dephosphorization of Manganese Ferroalloys with CaO & MnO Based Slag-Forming Mixtures	300
<i>V.Ya.Dashevskii, V.I.Kashin, N.P.Lyakishev, B.F.Velichko and A.V.Koval</i>	
Production of Ferromanganese and Silicomanganese from Tavas Ore, Turkey	302
<i>Onuralp Yuçel and M. Emin Ari</i>	
Equilibria Between Refined Ferromanganese/Silicomanganese Alloys and Silicate Slags at 1500°C	306
<i>KUCUKKARAGOZ C Serdar and ERIC Rauf Hurman</i>	

Hygroscopic Moisture Determination of Groote Eylandt Manganese Ores	310
<i>Peter Merritt</i>	
Simulation, Control and Modeling	
Modelling of AC Arcs in Three-Phase Submerged Arc Furnaces	317
<i>Gudrun Saevarsdottir, Hilde Løken Larsen and Jon Arne Bakken</i>	
Application of Artificial Intelligence Technology on the Submerged Arc Furnace	323
<i>Li Dada, Sun Yanguang and Shi Yang</i>	
An Advanced DCS Control System for Low-Carbon Ferrochromium Production Line	327
<i>Huo Naili, Sun Guohui and Chen Xiaojun</i>	
Advanced Furnace Control	332
<i>W. Braun, T. Nettleton and A. Jamieson</i>	
Automation and Reduction of Labor in the Operation of Electric Arc Furnace for HCFeMn Production	337
<i>F. Yoshida, T. Honma and T. Sasaki</i>	
Development of an Operator Guidance System for Intermediate Carbon Charge Chromium Production	343
<i>Louis M. Booysen, Lloyd R. Nelson, K. Narayana Swamy and Marius Visser</i>	
Advances in Furnace Control	350
<i>M. S. Rennie, I. J. Barker, A. L. Moolman, C. Pretorius, A. G. Fourie and M. A. Reuter</i>	
Intelligent Control System for Ferroalloy Plant Using Expert System and Neural Networks	353
<i>B. Z. Livneh and X. Pan</i>	
Practical Aspects of DC Furnace Design	364
<i>N. M. O'Brien and M. Ford</i>	
Model Study of Bath Mixing Intensity in Ferroalloy Refining Processes	369
<i>AKDOGAN Guven and ERIC Rauf Hurman</i>	
Raw Materials, Electrode, Refractory and Production Facilities	
A Method of Studying Soderberg Electrode Consumption	377
<i>Reidar Innvaer and Arvid Hempel</i>	
A Three Dimensional Simulation Model for a Soderberg Electrode	383
<i>Magnus Thor Jonsson, Dr.ing. and Helgi Thor Ingason, Dr.ing.</i>	
The New Compound Electrode: Current Situation and Thermoelectric Studies	389
<i>BULLON, Javier; LAGE, Miguel; BERMUDEZ, Alfredo and PENA, Francisco</i>	
Improved Methods for the Lump Casting of Ferroalloys	394
<i>M. B. Cortie, I. J. Barker, D. Knight and F. Levey</i>	
"Freeze" Lining Concepts for Improving Submerged Arc Furnace Lining Life and Performance	401
<i>Anthony M. Hearn, Albert J. Dzermejko and Pieter H. Lamont</i>	
The Technical Characteristics of the Chinese Submerged Arc Furnace	427
<i>Guo Hongfa and Ye Zheng</i>	
Developments of DC Submerged Arc Furnace Technology for Ferroalloys in China	433
<i>Zheng Tianhe, Yang Zhizhong, Jiang Boqun, Xie Shucai, Wu Wenbin, Liu Zhongwei, Yao Qun and Zong Pigong</i>	
Electro-Aluminothermic Process for Ferrovandium Production in Pangang	439
<i>Li Guisheng, Du Yong and Ma Jiayuan</i>	