Table of Contents

Foreword, from the editors, Committees, Reviewers and Sponsors

Chapter 1: Overview

Development of Stainless Steels in Nuclear Industry: With Emphasis on Sodium Cooled Fast Spectrum Reactors History, Technology and Foresight R. Baldev, U. Kamachi Mudali, M. Vijayalakshmi, M.D. Mathew, A.K. Bhaduri, P. Chellapandi, S. Venugopal, C.S. Sundar, B.P.C. Rao and B. Venkatraman	3
Present Status of Stainless Steel Industry in India & it's Future Prospects N.C. Mathur and R. Kumar	26
Chapter 2: Melting and Refining	
SS Manufacture - Indian Practice and Electrical Perspective C.N. Muralinath	37
Stainless Steel - A Versatile Engineering Material for Critical Applications S. Narahari Prasad and M. Narayana Rao	44
Dynamic On-Line Control of Stainless Steel Making in AOD B. Deo and S. Kumar	50
Influence of Intrinsic Solidification Behaviour on Quality of Stainless Steel Cast and Rolled Products	
S.K. Ray Evolution of Mould Fluxes	63
A. Hariharan and S.K. Mozumdar	75
Manufacture of Specialty Stainless Steels through Triplex Route at Mukand S. Nair, D. Savio, Y.M. Srinivas and K.R. Srinivasan	90
Characteristics, Distinctive Advantages & Wide Ranging Applications of Chrome- Manganese Stainless Steels L.K. Singhal	103
Influence of Composition and Processing on Properties of Stainless Steels S. Narahari Prasad, K. Rajasekhar and M. Chatterjee	117
Energy Conservation Potential in Stainless Steel Making by use of Molten Pig Iron and Liquid Ferro-Chrome	
L.K. Singhal and S. Patra	124
Chapter 3: Forming and Fabrication	
Stainless Steel Processing to Meet Advanced Applications G. Balachandran and V. Balasubramanian	135
Calandria - A Manufacturing Challenge K. Shukla	159
Manufacturing and Critical Applications of Stainless Steel – An Overview M. Venkatraman, K. Pavitra, V. Jana and T. Kachwala	163
Comparison of Hot Extrusion and Hot Piercing Processes for Manufacturing Stainless Steel Hot Finished Pipes/Tubes	
M.S. Randhawa and C. Shah	174
Technological Challenges in Manufacturing of over Dimensional Stainless Steel Components of PFBR B. Azhagarason, N. Mahendran, T.K. Mitra and P. Kumar	186
Experiences in Manufacturing and Qualifying of Stainless Steel AISI 403 Grade Materials	100
for PHWR Reactors of NPCIL J.K. Jain, S. Singh, M.K. Mathur, N.P. Srivastava and K.P. Dwivedi	194

Improvement in Properties of 301LN Austenitic Stainless Steel for Metro Coach Manufacture	
S. Srikanth, P. Saravanan, D. Saravanan, S. Sisodia, K. Ravi and A. Bandyopadhyay	201
Development of Heat Treatment Parameters to Enhance HAZ Impact Toughness of SS 430 Material	
R. Raj Kumar and S. Patle	214
Trans- Granular Stress Corrosion in Partially Fabricated Austenitic Stainless Steel Items and their Re-Conditioning to make them Suitable for Balance Fabrication G.K. Saxena, M.M. Master, N.P. Srivastava, K.P. Dwivedi, G.R. Iyer and A. Mistry	222
AFM Characterization of Structural Evolution and Roughness of AISI 304 Austenitic Stainless Steel under Severe Deformation by Wavy Rolling K.C. Sekhar, B.P. Kashyap and S. Sangal	230
Surface Engineering of Stainless Steels: Role of Surface Mechanical Attrition Treatment	
(SMAT) A.M. Gatey, S.S. Hosmani, R. Singh and S. Suwas	238
Performance of Multilayered PVD Coated Cemented Carbide Inserts during Dry Turning of AISI 304 Austenitic Stainless Steel	
A.P. Kulkarni and V.G. Sargade	248
Chapter 4: Welding and Joining	
Landmark Events in the Welding of Stainless Steels D.J. Kotecki	257
Metallurgy of Welding Stainless Steels S. Sundaresan	274
Microstructure and Mechanical Properties of 16Cr-2Ni Stainless Steel Fusion and Solid State Welds-Influence of Post Weld Treatments G. Madhusudhan Reddy and A. Rajasekhar	289
Welding and Fabrication of Stainless Steel Equipment for 500MWe Prototype Fast Breeder Reactor	205
P. Kumar Challenging Experiences in the Usage of Stainless Steels in a Heavy Fabrication Industry	305
T. Gurunathan	316
Power Beam Processing of Stainless Steels B. Shanmugarajan and G. Buvanashekaran	332
Stainless Steel Welding in Railways R. Ravichandran	340
Friction Welding of Type 304 Stainless Steel to CP Titanium Using Nickel Interlayer M. Cheepu and V. Muthupandi	351
Distortion and its Control in Welding of Stainless Steel Structures - Case Studies N. Raju, G. Ravichandran, V. Sudharsanam and R. Easwaran	358
Nondestructive Evaluation of Austenitic Stainless Steel Welds A. Kumar, B. Sasi, G.K. Sharma, B.P. Rao and T. Jayakumar	366
Case Studies on Field Repairs of Stainless Steel Components in Refinery B.S. Negi	375
Welding of Stainless Steel - A Heavy Engineering Perspective K. Sivaraman and D. Kulkarni	380
Effect of Welding Processes on Fatigue Behaviour of AISI 409M Grade Ferritic Stainless Steel Joints	
V. Balasubramanian, A.K. Lakshminarayanan and S. Malarvizhi	391
Chapter 5: Physical Metallurgy	
Deformation Fatigue and Fracture vis-a-vis Deformation Induced Martensite in AISI 304LN Stainless Steel	
K.K. Ray, H. Roy, A. Ray, K. Dutta and S. Tarafder	415

Production of High Nitrogen Stainless Steel X8CrMnN18-18 through EAF-AOD-LRF-CC-Steckel Mill Route and its Hot Deformation Study by Gleeble Thermomechanical Simulator S. Patra and L.K. Singhal	429
The Effect of Nitrogen Alloying on the Low Cycle Fatigue and Creep-Fatigue Interaction Behavior of 316LN Stainless Steel G.V. Prasad Reddy, R. Sandhya, M.D. Mathew and S. Sankaran	441
Characterisation of Fatigue Crack Growth and Fracture Behaviour of SS 316L(N) Base and Weld Materials	771
G. Sasikala, M. Nani Babu, B. Shashank Dutt and S. Venugopal	449
Deformation and Fracture Behavior of AISI 403 Stainless Steel for Nuclear Structural Applications C. Gupta, J.K. Chakravartty and R.N. Singh	460
Thermodynamic Stability of Fe-Cr Binary System: The Crucial Role of Magnetic Contribution as Elucidated by Calorimetric Measurements R.N. Hajra, S. Raju, A.K. Rai, H. Tripathi, S. Saroja and T. Jayakumar	468
Study of Creep Damage in a 10.86% Cr Heat Resistant Steel using Synchrotron X-Ray Microtomography	
C. Gupta, H. Toda, C. Schlacher, P. Mayr, C. Sommitsch, K. Uesugi, Y. Suzuki, A. Takeuchi and M. Kobayashi	476
Improvement in Welding of Austenitic Stainless Steel Thick Pipe: Metallurgical, Mechanical & Full Scale Pipe Weld Tests P.K. Singh, V. Bhasin, R.K. Singh and K.K. Vaze	484
Role of Modelling in the Development of High Performance Steels for Important	-
Engineering Applications P.V. Sivaprasad, N. Girase, S. Sarkar and O. Wijk	493
Influence of Copper on Redistribution Behaviour of Boron in Titanium Stabilized and Low Carbon Steel as Observed by Neutron Induced Alpha Autoradiography B.B. Shriwastwa and A. Kumar	502
Quality Management during Manufacturing of High Tempertaure Thin Walled Austenitic Stainless Steel Sodium Tanks of Prototype Fast Breeder Reactor	
R.G. Rangasamy and P. Kumar	507
Chapter 6: Corrosion	
Corrosion of Non-Sensitized Austenitic Stainless Steels in Nitric Acid Environment: An Electrochemical Approach	
V. Kain, S. Khan, A.V.R. Reddy and P.K. Wattal	517
Austenitic Stainless Steels for Back End of Nuclear Fuel Cycle U. Kamachi Mudali	530
Biofouling and Microbially Influenced Corrosion of Stainless Steels K.A. Natarajan	539
Stress Corrosion Cracking of Duplex Stainless Steels I. Chattoraj	552
Studying the Mechanism behind Stress Corrosion Cracking of Non Sensitized 304L Austenitic Stainless Steel S. Ghosh Acharyya, M.K. Kumar and V. Kain	564
Corrosion Resistance of 9 - 15% Cr ODS Steels and its Comparison with Austenitic Stainless Steel	301
S. Ningshen, M. Sakairi, K. Sukuki and S. Ukai	575
Macro and Micro Electrochemical Techniques to Study Influence of Sigma Phase Formation in a Duplex Stainless Steel B. Sunil Kumar and V. Kain	583
Influence of pH on Hydrogen Absorption in Duplex Stainless Steel V. Viswanathan and N. Deepashri	592
Effect of Oxidation on Corrosion Behavior of Austenitic Stainless Steel 304L Welds B. Sunil Kumar, V. Kain, K. Benerjee, P.D. Maniyar, S. Sridhar, K. Jitendra and K. Jatin	598
Microbial Effects on Heat Treated 316L Weldments in Marine Water K. Suvarna, K.R. Udupa and A.O. Surendranathan	

Investigation into the Incidence of Severe Rusting and Pitting Corrosion in Imported Hot-Rolled AISI 430 Ferritic Stainless Steel Coils P. Saravanan, S. Srikanth, S. Sisodia and K. Ravi	618
A Comparative Study of Semiconducting Behavior of Passive Film of High Nitrogen and Ni and Mn Free Stainless Steels in 3.5 wt. % NaCl S.B. Arya, V.S. Raja and A.N. Tiwari	626
Anodic Polarization Behavior of Cold Worked Austenitic Stainless Steel N. Srinivasan, A.K. Revelly, V. Kain, I. Samajdar, C.R. Hutchinson and P. Sivaprasad	632
Chapter 7: Experience from Industries and Newer Varieties	
Use of Advanced Austenitic and Duplex Stainless Steels for Applications in Oil & Gas and Process Industry	
P. Kangas and G.C. Chai	645
Nitrogen Enhanced 316LN Austenitic Stainless Steel for Sodium Cooled Fast Reactors T. Jayakumar, A.K. Bhaduri, M.D. Mathew, S.K. Albert and U. Kamachi Mudali	670
Degradation/Damage Modes and their Control Measures for Stainless Steel Components in Chemical Plants M. Nakahara	681
Potential for Application of Special Stainless Steels for Chemical Process Equipments K. Elaya Perumal	691
Comparative Evaluation of 316L and N-Bearing Ni-Free Austenitic Stainless Steel as a Potential Cost-Effective Replacement for Body Implants P. Poojary and L.K. Singhal	697
Experience with Material Combinations for Sliding Applications in PFBR In-Vessel Fuel	
Handling Machine S.C.S.P. Kumar Krovvidi, C.S. Surendran, N. Chakraborthy, B.K. Sreedhar, J. Varghese, G. Padmakumar, S. Raghupathy, K.K. Rajan and P. Chellapandi	705
Development of Lean Duplex Stainless Steels (LDSS) with Superior Mechanical and Corrosion Properties on Laboratory Scale S. Srikanth, P. Saravanan, P. Govindarajan, S. Sisodia and K. Ravi	714
Applications of Stainless Steel in Automobile Industry	/14
A. Saha Podder and A. Bhanja	731
Development of 216L for Conservation of Nickel & Molybdenum and its Application in Sugar Refinery Instead of 316L	741
L.K. Singhal and P. Poojary Development of IFAC-1 SS: An Advanced Austenitic Stainless Steel for Cladding and	741
Wrapper Tube Applications in Sodium-Cooled Fast Reactors M.D. Mathew, K.A. Gopal, S. Murugan, B.K. Panigrahi, A.K. Bhaduri and T. Jayakumar	749
Temper Embrittlement and Corrosion Behaviour of Martensitic Stainless Steel 420 K. Chandra, V. Kain, N. Srinivasan, I. Samajdar and A.K. Balasubrahmanian	757
Development of a Technique for the Calibration of HPGe Detector to Estimate	
Radionuclides Present in Steel Samples S. Singh and A. Mhatre	766