

Table of Contents

Committees

Organizers

Preface

I. Plenary Session

Semi-Solid Metal Processing – A Process Looking for a Market P. Kapranos	1
Theory and Technology of Semisolid Metal Molding F. Czerwinski	9
On the Modeling of Semisolid Suspensions A.N. Alexandrou	17
Thixoforming of Steel: A State of the Art from an Industrial Point of View P. Cezard and T. Sourmail	25

II. Process Development and Industrial Application

Investigations on Thermal Influences for Thixoforging and Thixojoining of Steel Components R. Baadjou, F. Knauf and G. Hirt	37
Influence of Processing Route on the Properties of Magnesium Alloys F. Hagen, N. Hort, H. Dieringa and K.U. Kainer	43
A Comparison of Deep Drawing and Ironing of Metal Alloy Strip Produced Conventionally and Non-Conventionally via Semi Solid Material Processing A. de Pádua Lima Filho, M.I. Yamasaki, L.A. Ono, L. Nampo and A. Padilha	49
Forming of Biocompatible Materials in the Semi-Solid State L. Kertész and M. Liewald	55
Process Window Determination for Thixoextrusion Processes Using a Steel Alloy F. Knauf, R. Baadjou and G. Hirt	61
Investigation of Thin Wall Casting Made of Semi-Solid A356 Using Back Extrusion and Die Cast M. Moradi, M. Nili-Ahmadabadi, B. Heidarian and S. Ashouri	67
Basic Study on Thixo-Co-Extrusion of Multi-Layer Tube with Al/Mg Alloys K.K. Wang, P. Zhang, Y.M. Du, Z. Pan and H.G. Li	73
Feasibility of Recycling Aluminum Alloy Scrap by Semisolid Extrusion S. Sugiyama and J. Yanagimoto	79
Fabrication of C_{sf}/Mg Composites Using Extrusion Directly Following Vacuum Infiltration - Part 1: Monitoring and Acquiring of Process Parameters J.M. Zhou, L.H. Qi and J.T. Guan	85
Fabrication of C_{sf}/Mg Composites Using Extrusion Directly Following Vacuum Infiltration - Part 2: Forming Process Study L.H. Qi, J.M. Zhou, L.Z. Su, H.B. Ouyang and H. Li	91
Development of the Gas Induced Semi-Solid Metal Process for Aluminum Die Casting Applications J. Wannasin, S. Junudom, T. Rattanochaikul and M.C. Flemings	97
One-Step SSM Process by MSC & HPDC for Metallic Components H.V. Martínez, M.F. Valencia, A. Morales, A.F. Duque, M. Arroyave and J. Cruz	103
Recent Developments within Semi-Solid Forming at the Institute for Metal Forming Technology M. Liewald and P. Unseld	109
Thixo-Extrusion of 5182 Aluminium Alloy P. Kapranos, R. Nakamura, E. Bertoli, A. Pola, Z. Azpilgain and I. Hurtado	115
Strategies for Re-Heating Steel Billets for Thixoforming B.A. Behrens, D. Fischer and A. Rassili	121

Flatness Based Control of Inductive Heating of X210CrW12 into the Semi Solid State R. Gasper, A. Schönbohm, M. Enning and D. Abel	127
Numerical Simulation of Induction Heating of Aluminum Alloy Billets N. Barman, J. Mukherjee and P. Dutta	133
The Microstructure Evolvment and Simulation Analysis during Semi-Solid Processing of Aluminum Alloy Y.T. Yang, J.F. Wang, H.H. Zhang and G.J. Shao	139
Semi-Solid Casting of High-Reactive Wrought Alloys by Means of the Alloy AlLi2.1Mg5.5ScZr (AA1420*) M. Bünck, F. Kütke, A. Bührig-Polaczek, A. Arnold, B. Friedrich and R. Sauermann	145
Rheocasting of Al-Cu Alloy A201 with Different Silver Contents E.P. Masuku, G. Govender, L. Ivanchev and H. Möller	151
Study on Microstructure-Processing Relationship of a Semisolid Rheocasting A357 Aluminum Alloy Y.L. Kang, L.Q. Yang, R.B. Song, F. Zhang and T. Tao	157
Microstructure Evolution and Mechanical Properties of Rheoformed YL112 Aluminum Alloy X.J. Yang and H.M. Guo	163
The Influence of Heat Treatments for Laser Welded Semi Solid Metal Cast A356 Alloy on the Fracture Mode of Tensile Specimens G. Kunene, G. Govender, L. Ivanchev, R.D. Knutsen and H.P. Burger	169
Compocasting of an Al-Si-SiC_p Composite Using Powder Injection Method M. Ghahremanian and B. NIROUMAND	175
Development of In-Mold Rheocasting Process S.K. Kim and Y.C. Lee	181
Development of Rheo-Diecasting of Al-Si Alloys Based on a Modified DSCP Process Z.F. Zhang, J. Xu, Y.L. Bai and L.K. Shi	185
Development of Novel Hot Chamber Rheo-Diecasting Process J.K. Lee, S.K. Kim and Y.C. Lee	191
Twin Roll Casting and Melt Conditioned Twin-Roll Casting of Magnesium Z. Bian, I. Bayandorian, H.W. Zhang and Z. Fan	195
Thixoforming of Hypereutectic Al/Si Automotive Pistons H.V. Atkinson and P.J. Ward	201
Robustness of a Thixoforming Production Line J.C. Pierret, A. Rassili, G. Vaneetveld, J. Lecomte-Beckers and R. Bigot	207
Thixoforming of Steel: Parameters and Means for Industrialization A. Rassili, M. Robelet and R. Bigot	213
Sub Liquidus Casting Technology for the Production of High Integrity Component A. Forn, S. Menargues, E. Martín and J.A. Picas	219
Semisolid Joining of Zinc AG40A Alloy by Partial Remelting and Mechanical Stirring A. Narimannezhad, H. Aashuri, A.H. Kokabi, A. Khosravani, M. Kiani and A. Foroughi	225
Mold Filling Simulation of Semi-Solid Magnesium Alloys F. Ilinca, J.F. Héту, F. Ajersch and J.F. Moisan	231
Effects of T5 and T6 Heat Treatments Applied to Rheocast A356 Parts for Automotive Applications M. Rosso, I. Peter and R. Villa	237
Semi-Solid Extrusion of Complex-Shaped Steel Rods Using Ceramic Dies S. Muenstermann, R. Telle, F. Knauf and G. Hirt	243
Deposition of Oxides as Tool Protection for Large Thixoforming Dies by Using the Pulsed MSIP-PVD Process K. Bobzin, N. Bagecivan and P. Immich	249
Laser Surface Modification of Tool Steel for Semi-Solid Steel Forming D. Brabazon, S. Naher and P. Biggs	255
Servomechanical Press: A New Press Concept for Semisolid Forging Z. Azpilgain, R. Ortubay, A. Blanco and I. Hurtado	261
Thixoextrusion for 7075 Al Wrought Alloy Tube D.I. Jang, Y.O. Yoon and S.K. Kim	267

Rheoforging of Wrought Aluminum Alloys H.M. Guo and X.J. Yang	271
Forging Process of Wrought Aluminum Alloy with Controlled Solid Fraction by Electromagnetic Stirring J.W. Bae, S.M. Lee and C.G. Kang	277
EN AC-46500 Injected by Semi-Solid Rheocasting M. Campillo, M.T. Baile, S. Menargues and A. Forn	283
The Use of CrNiCo-Based Superalloy as Die Material in Semi-Solid Processing of Steels Y. Birol	289
Casting of Aluminum Alloy Bar by Semisolid Roll Casting R. Nakamura, T. Asai, H. Watari and S. Kumai	295

III. Material Development and Characterisation

Rheological Characterization of a New Alloy for Thixoforming A. Pola, R. Roberti, M. Modigell and L. Pape	301
A Comparison of Measuring Devices Used to Prevent Wall Slip in Viscosity Measurements of Metallic Suspensions M. Modigell and L. Pape	307
Predictions of Structure Breakdown, Buildup and Shear Banding in Semisolid Suspensions A.N. Alexandrou, N. Constantinou and G. Georgiou	313
Thixotropic Strength and Thixotropic Criteria in Semi-Solid Processing W.C. Keung, Y.F. Lee, W.W. Shan and S.J. Luo	319
Analysis of Rheological Properties of Steel near Solidus Point Using Gleeble® Simulator K.P. Solek, Z. Mitura, M. Karbowniczek, P. Kapranos, R. Kuziak and J. Dutkiewicz	325
Couette Rheometry: Direct Analysis vs. Inverse Parameter Determination M. Modigell, L. Pape and K. Vasilic	331
Reynolds' Dilatancy and Shear Bands in Semi-Solid Alloys C.M. Gourlay, S. Otarawanna, B. Meylan and A.K. Dahle	337
The Determination of Semi-Solid Processing Ability Using a Novel Rheo-Characterizer Apparatus M. da Silva, A. Lemieux, H. Blanchette and X.-. Chen	343
Functionally Gradient Materials via a Casting Process Involving Partial Solidification D.J. Browne, M. Scanlan and A. Bates	349
Controlling the Semisolid Grain Size during Solidification D.H. StJohn, M. Easton and M. Qian	355
Preparation of Large-Diameter Semi-Solid 7075 Aluminum Alloy Billets W.W. Wang, J.L. Song and S.J. Luo	361
Study of Microstructural Evolution and Phase's Morphology after Partial Remelting in A356 Alloy A. Mahdavi, M. Bigdeli, M. Hajian Heidary and F. Khomamizadeh	367
Fabrication of Metal Matrix Composites under Intensive Shearing N. Hari Babu, S. Tzamtzis, N. Barekar, J.B. Patel and Z. Fan	373
Viscosity Estimation of Semi-Solid Alloys by Drop Weight Backward Extrusion Test under High Speed Deformation S. Ghadiani, H. Aashuri, A. Khosravani and A. Foroughi	379
Heat Treatment Processes of A2024 Rheoforging Alloy and Morphology Investigation by Nanoindentation and Atomic Force Microscopy D.S. Kim, C.G. Kang and S.M. Lee	385
Comparison of Microstructural Changes in a SIMA Processed A356 Aluminum Alloy after Unidirectional Compression and Rolling: Effect of Pressure Depth M. Hajian Heidary, M. Bigdeli, A. Mahdavi and F. Khomamizadeh	391
Study of ECAP Processing Routes on Semi-Solid Microstructure Evolution of A356 Alloy M. Moradi, M. Nili-Ahmadabadi, B. Heidarian and M.H. Parsa	397
Melt Conditioned Direct Chill Casting (MC-DC) of Wrought Al-Alloys R. Haghayeghi, Y. Liu and Z.Y. Fan	403
Rheological Behavior of Semi-Solid Slurry of A356 Alloy at High Shear and Cooling Rates N. Barman and P. Dutta	409

A New Processing Route for As-Cast Thixotropic Steel G. Walmag, P. Naveau, A. Rassili and M. Sinnaeve	415
The MSMT Process for Semi-Solid Slurry Production Y.D. Zeng, Z.F. Zhang, J. Xu and L.K. Shi	421
Microstructural Evolution of AZ91 Alloy Containing 3%Ca Prepared by Cooling Slope A. Khosravani, H. Aashuri, P. Davami, A. Narimannezhad, A. Foroughi and M. Kiani	427
Evaluation of Surface Chemical Segregation of Semi-Solid Cast Aluminium Alloy A356 G. Govender and H. Möller	433
Mechanical Analysis of Semi-Solid Metals Shear Deformation during Compression S.J. Luo, Q. Chen and X.R. Gao	439
A Novel Process for Fabrication of Globular Structure by Equal Channel Angular Pressing and Isothermal Treatment of Semisolid Metal H. Meidani, S. Hossein Nedjad and M. Nili-Ahmadabadi	445
Development of Non-Dendritic Microstructure of Aluminum Alloy in Semi-Solid State under Ultrasonic Vibration S.S. Wu, J.W. Zhao, L.P. Zhang, P. An and Y.W. Mao	451
Fabrication of Semi-Solid Slurry for Steels and Their Rheo-Rolling Process R.B. Song, Y.L. Kang and A. Zhao	457
Quick Semi-Solid Slurry Making Method Using Metallic Cup F. Pahlevani, K. Anzai and E. Niyama	463
Study on Semi-Solid Continuous Roll-Casting Strips of AZ91D Magnesium Alloy S.S. Xie, Y.F. He, G.J. Huang, M.P. Geng and Y. Zhang	469
X-Ray Microtomography Investigation of the Effect of Ba Additions on the Microstructure of Partially Remelted Al-4%Cu Alloys S. Terzi, N. Limodin, E. Boller, L. Salvo and M. Suéry	475
Effect of Ultrasounds Treatment on Alloys for Semisolid Application A. Pola, A. Arrighini and R. Roberti	481
Production of Semi-Solid Slurry through Heterogeneous Nucleation in Metal Matrix Nanocomposites (MMNC) Using Nano-Scale Ultrasonically Dispersed Inoculants M. De Cicco, L.S. Turng, X.C. Li and J.H. Perepezko	487
Morphological Features of Silicon Rich Phase in Powder Thixoformed Spray Atomized Hyper-Eutectic Al-Si Alloy M. Kiani, H. Aashuri, S. Nategh, A. Foroughi, A. Narimannezhad and A. Khosravani	493
Effect of Reheating to the Semisolid State on the Microstructure of the A356 Aluminum Alloy Produced by Ultrasonic Melt-Treatment W. Khalifa, Y. Tsunekawa and M. Okumiya	499
Numerical Simulation of Semi-Solid AZ91D Magnesium Alloy in Thixoforming Process Z.S. Ji, H.H. Yan, M.L. Hu and X.P. Zheng	505
The Semi-Solid Forming of an Improved AA6061 Wrought Aluminum Alloy Composition J. Langlais, N. Andrade, A. Lemieux, X.-. Chen and L. Bucher	511
Thixoforming of Aluminium-Silicon Alloys in a Mechanical Eccentric Press E.J. Zoqui, L.A. Lourençato and D.M. Benati	517
Alloy Characterization to Adapt Steels to Thixoforming: Study of a High Chromium High Carbon Steel C. Fraipont and J. Lecomte-Beckers	523
Processing of Al-45Sn-10Cu Based Immiscible Alloy by a Rheomixing Process H.R. Kotadia, J.B. Patel, Z.Y. Fan, E. Doernberg and R. Schmid-Fetzer	529
Influence of Processing Parameters on Microstructure of Casting Rolling Semi-Solid AZ91D Magnesium Alloy Y. Zhang, M.P. Geng, L. Cheng and Y.C. Wang	535
Microstructure and Thermal Plasticity of Semi-Solid M2 Steel Casting Ingots Using Inclined Slope Pre-Crystallization Method Y.F. He, S.M. Xing, S.S. Xie, G.J. Huang and J.N. Gou	539
Microstructural Evolution of SiCp/AZ61 Composites during Partial Remelting H. Yan, F.Y. Zhang and W. Pan	545
Study of SiCp/AZ61 Composites H. Yan, S.B. Lingli and W. Pan	551

Semisolid Microstructural Evolution of Equal Channel Angular Extruded Mg-Al Alloy During Partial Remelting	
S.M. Liang, R. Chen and E.H. Han	557
Solidification of A356 Alloy in a Linear Electromagnetic Stirrer	
P. Kumar, H. Lakshmi and P. Dutta	563
A Control of Microstructure of A356 Alloy by Sequential Semi-Solid Process	
S.C. Lim, H.J. Lee, J.W. Kang, S.K. Lee, K.H. Kim, H.S. Lee and H.C. Kwon	569
Microstructural Evolution of ETIAL 160 Aluminium Alloy Feedstock Produced by Cooling Slope Casting	
N. Saklakoğlu, Y. Birol and Ş. Kasman	575
Characterization of Mushy Zone of ZW_x2 (x=2, 4, 6) Magnesium Alloys	
Z.H. Huang, R. Chen and E.H. Han	581
Processing of Hypereutectic AlSiCuFe Alloys in the Semi-Solid State	
Y. Birol	587

IV. Numerical Modelling and Simulation

Study of the Precision Forging of an Impeller by Numerical Simulation and Test Forming	
W.W. Wang, F. Han and S.J. Luo	593
Numerical Simulation of Mould Filling in Rheocasting Process of Semisolid A356 Aluminum Alloy	
Y.L. Bai, J. Xu, W.M. Mao, Z.F. Zhang and H. Xu	599
Numerical Modeling of Die Filling of Semi-Solid A356 Aluminum Alloy	
A. Foroughi, H. Aashuri, A. Narimannezhad, A. Khosravani and M. Kiani	605
FSI-Analysis of the MMC-Thixoforging Process Regarding the Rheology of the Aluminiumcast-Alloy AlSi7Mg0,3	
P. Unseld and M. Liewald	611
Numerical Simulation of Semi-Solid Roll Strip-Casting Process for AZ91D Magnesium Alloy	
Z.M. Du, S.S. Xie, P. Wu and Y.Y. Zhang	617
Numerical Simulation of Thixoforging of an AZ91D Magnesium Alloy Magazine Plate and Experimental Validation	
J.F. Jiang, Y. Wang, Z.M. Du and S.J. Luo	623
A One Phase Thermomechanical Model for Semi-Solid Thixoforming	
R. Koeune and J.P. Ponthot	629
Investigation of the Primary Phase Segregation during the Filling of an Industrial Mold with Semi-Solid A357 Aluminum	
F. Pineau and G. Simard	635
Use of Calphad Thermodynamics to Simulate Phase Formation during Semi-Solid Processing	
B. Hallstedt	641
Deformation Behavior of Aluminum Alloy during Semi-Solid Compression	
Z.M. Du, X.H. Zhang, Q. Wang and S.J. Luo	647
On a Class of Thermo-Visco-Plastic Constitutive Equations for Semi-Solid Alloys	
S. Benke and G. Laschet	653
Study on Thixo-Extrusion of Semi-Solid Aluminium	
A. Neag, V. Favier, R. Bigot and D. Frunză	659
Study on Apparent Viscosity of Semi-Solid Alloys during Rheocasting	
W. Liu, S.M. Xing and M.L. Zhang	665
Simulation of Temperature Field during Semi-Solid Magnesium Alloy Produced by Casting-Rolling Technology	
S.Y. Zhang, M.P. Geng and S.S. Xie	671
Study on Thixo-Forging of AZ61 Wrought Magnesium Alloy	
H. Yan, B.F. Zhou and W. Pan	677
Numerical Simulation of Semi-Solid Billet Preparation by Equal Channel Angular Extrusion	
X.H. Zhang, Y.Y. Zhang, D.Z. Wu and S.J. Luo	683

V. Process and Parts Assessment

Influence of the Pre and Post Treatment Operations on the Properties of the Thixoformed Steel Parts	
A. Rassili, J.C. Pierret, G. Vaneetveld, P. Cezard, R. Bigot and M. Robelet	689
Development of Adapted Heat Treatments for Steels out of the Semi-Solid State after Thixoforming	
S. Dziallach, W. Püttgen and W. Bleck	695
Steel Thixoforging: Heat Exchange Impact on the Mechanical and Metallurgical Features of Thixoforged Samples	
E. Becker, P. Cezard, R. Bigot, L. Langlois, V. Favier and J.C. Pierret	701
Improvement in Thixoforging of 7075 Aluminium Alloys at High Solid Fraction	
G. Vaneetveld, A. Rassili, J.C. Pierret and J. Lecomte-Beckers	707
Microstructure and Mechanical Properties of Rheo-Extruded AZ31 Mg Alloy	
J. Xu, S.M. Zhang, B.C. Yang, L.K. Shi and Z. Fan	713
Influence of Parameters during Induction Heating Cycle of 7075 Aluminium Alloys with RAP Process	
G. Vaneetveld, A. Rassili and H.V. Atkinson	719
Fatigue Behavior of Semi-Solid Cast Aluminum: A Critical Review	
M. Brochu, Y. Verreman, F. Ajersch and L. Bucher	725
Fabrication of Rheological Material of A356 Aluminum Alloy by Electromagnetic Stirring through Vacuum Pump	
H.H. Kim, S.M. Lee and C.G. Kang	731
The Natural and Artificial Aging Response of Semi-Solid Metal Processed Alloy A356	
H. Möller, G. Govender and W. Stumpf	737
Effects of Thixoforming Defects on the Stress-Strain Curves of Aluminum Structural Parts for Automobile	
S.Y. Lee and B.H. Choi	743
Symmetry Behavior of Thixoextruded AZ31 Mg Alloy	
Y.O. Yoon and S.K. Kim	749
Anodizing of A356 T6 Alloys Obtained by Sub-Liquidus Casting	
A. Forn, I. Espinosa, M.T. Baile and E. Rupérez	755
Effect of Volume Fraction Solid and Injection Speed on Mechanical Properties in New Type Semi-Solid Injection Process	
N. Omura, Y. Murakami, M.J. Li, T. Tamura and K. Miwa	761
Preparation of Semi-Solid Slurry of Hypereutectic Al-Si Alloy by Ultrasonic Vibration	
J.W. Zhao, S.S. Wu, P. An and Y.W. Mao	767
Weldability of SSM Rheo Processed Aluminum Alloy A356	
G. Govender, L. Ivanchev, H.P. Burger, R.D. Knutsen and G. Kunene	773
The Effect of Si Content on the Mechanical Properties of Rheocast Al Components Using the RHEOMETAL™ Process	
H.P. Cao, O. Granath and M. Wessen	779
Modeling of Inclined Cooling Plate Semisolid Processing by Model Alloy	
H. Mehrara, M. Nili-Ahmadabadi, B. Heidarian, S. Ashouri and J. Ghiasinejad	785