

EuroBrake 2019

Dresden, Germany
21 - 23 May 2019

ISBN: 978-1-5108-8883-8

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2019) by FISITA
All rights reserved.

Printed by Curran Associates, Inc. (2019)

For permission requests, please contact FISITA
at the address below.

FISITA
29, M11 Business Link
Stansted
CM24 8GF
United Kingdom

Phone: +44 (0) 1279 883 470

info@fisita.com

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

DISC BRAKE PADS REGENERATION: PRELIMINARY INVESTIGATION OF THE RE-USE OF WORN FRICTION MATERIALS	1
<i>M. Leonardi</i>	
EXPERIMENTAL STUDY ON STEERING BRAKE SQUEAL BASED ON VEHICLE ROAD TEST	11
<i>M. Song, X. Yu, D. Meng, B. Kuang, W. Li, J. Huang</i>	
EXPERIMENTAL STUDY OF STEERING BRAKE SQUEAL ON INERTIA DYNAMOMETER	21
<i>S. Wu, X. Yu, K. Fei, L. Xi, D. Meng</i>	
ESTABLISHMENT OF BRAKE WEAR EMISSION ANALYSIS TECHNIQUES	25
<i>S. Suzuki, R. Yamashima, H. Nakagawa</i>	
THE BRAKE DUST PARTICLE FILTER FOR FINE DUST REDUCTION	35
<i>L. Bock, E. Thebault</i>	
ECO DESIGN OF BRAKE PADS WITH RECYCLED FRICTION MATERIALS	44
<i>J. Ma, A.H. Astrom, U. Olofsson, Y. Lyu, M. Leonardi, J. Wahlstrom</i>	
IMPACT OF GEOMETRY, TYPE OF MATERIAL AND QUALITY OF PUNCHING OF THE METALLIC SUPPORT OF A BRAKE PAD ON ESSENTIAL PROPERTIES OF A HYDRAULIC FRICTION BRAKE ASSEMBLY	50
<i>M. Mlodzikowski, D. Banach, T. Orłowski</i>	
DEVELOPMENT AND ADVANTAGES OF A NEW LIGHTWEIGHT FLOATING CALIPER DESIGN	64
<i>F. Wagner, R. Mayer, L. Pander, G. Sprandel, C.P. Weidner</i>	
INVESTIGATION OF THE POTENTIALS OF REGENERATIVE BRAKE SYSTEMS TOWARDS THE REDUCTION OF BRAKE PARTICLE EMISSIONS	72
<i>D. Hesse, K. Augsburg, A. Stueken, T. Frenzel</i>	
POTENTIAL OF REGENERATIVE BRAKE SYSTEMS REGARDING REDUCTION OF BRAKE PARTICLE EMISSION	76
<i>T. Frenzel</i>	
THERMAL AND BRAKING REGIMES DURING PROVING GROUND MEASUREMENTS USING THE WLTP-BRAKE CYCLE FOR BRAKE EMISSIONS MEASUREMENTS	80
<i>C. Agudelo, R. Vedula, J. Bautell, A. Stanard, T.H. DeFries</i>	
MAGNETIC DIFFERENTIATION OF BRAKE WEAR FROM OTHER ROADSIDE POLLUTION PARTICLES	92
<i>T. Gonet, B.A. Maher</i>	
INFLUENCE OF FRICTION MATERIAL ON CORROSION-INDUCED BRAKE JUDDER DURING THE REMOVAL OF RUST	105
<i>N. Molina, L. Ortiz, F. Squadrani, J. O'Leary</i>	
JSAE STANDARDIZATION ACTIVITIES UPDATE	117
<i>T. Miyazaki, S. Sakamoto, M. Yamaguchi</i>	
DISC THICKNESS VARIATION MEASUREMENT UNDER OPERATIONAL COLD AND HOT BRAKE JUDDER CONDITIONS	125
<i>B. Ferrer, J.J. Garcia-Bonito, A. Claverias, L. Ortiz, F. Squadrani, D.H. Jeon</i>	
A STUDY OF BRAKE CONTACT PAIRS UNDER DIFFERENT BRAKE CONDITIONS WITH RESPECT TO AIRBORNE WEAR PARTICLE EMISSIONS	136
<i>L. Wei, Y.S. Choy, C.S. Cheung</i>	
PERCENTAGE BRAKING SYSTEM (PBS)	144
<i>S. Seyyedfatemi</i>	
DEVELOPMENT METHODS USING AI TO COPE WITH TODAY'S AND FUTURE NVH CHALLENGES	147
<i>H.M. Unger, M. Djurovic, T. Noack, A. Romer</i>	
HIGH-FREQUENCY VIBRATIONS IN THE FRICTION BOUNDARY LAYER OF BRAKE SYSTEMS	156
<i>J. Otto, J.M. Sandgaard, G.P. Ostermeyer</i>	
REAL DRIVING EMISSIONS MEASUREMENT OF BRAKE DUST PARTICLES	170
<i>D. Hesse, K. Augsburg, T. Feibel, J. Sommer</i>	
A STUDY ON PISTON RETRACT MECHANISM BY USING PHENOLIC PISTON	179
<i>N. Yoshizawa</i>	
MEASUREMENT OF TIRE WEAR PARTICLES	187
<i>F. Wenzel, K. Augsburg</i>	

LAYOUT OF ELECTRICAL PARKING BRAKE SYSTEMS BASED ON FIELD USE-CASES	194
<i>M. Schumann, G. Seipel, W. Wienands</i>	
ODS OF FIXED CALLIPER BRAKE AND DOUBLE WISHBONE AXLE DURING CREEP GROAN AT CORNER TEST RIG	200
<i>M. Purscher, P. Fischer</i>	
SURFACE RESERVOIR DYNAMICS IN FRICTION INTERFACES	215
<i>G.P. Ostermeyer, J. Kijanski</i>	
ANALYSIS OF THE INFLUENCE OF THE SANDING OUTPUT RATE ON THE COEFFICIENT OF FRICTION	226
<i>A. Reich, M. Kolker, C. Schindler</i>	
ANALYSIS OF THE THERMAL EFFECT ON MECHANICAL AND CHEMICAL PROPERTIES OF A FRICTION MATERIAL	236
<i>D.S. Antunes</i>	
A PIN-ON-DISC STUDY ON THE FRICTION, WEAR AND AIRBORNE PARTICLE EMISSION FROM RECYCLED BRAKE PAD MATERIAL	245
<i>Y. Lyu, M. Leonardi, J. Ma, J. Wahlstrom, S. Gialanella, U. Olofsson</i>	
THE REDUCTION TECHNOLOGY OF AUTOMOBILE BRAKE NOISE BY PIEZOELECTRIC-BASED DITHER CONTROL	253
<i>J.K. Hwang, J. Kim, G.H. Park</i>	
DEVELOPMENT OF INERTIA SIMULATION RANGE CALCULATION SOFTWARE FOR BRAKE DYNAMOMETER	263
<i>Z. Shuai, F. Gao, R. Fu, W. Qi</i>	
DYNAMIC BRAKING WITH AN ELECTRIC PARKING BRAKE SYSTEM	270
<i>C. Maron, K. Klein, S. Schubert</i>	
ANALYSIS OF BIG DATA STREAMS TO OBTAIN BRAKING RELIABILITY INFORMATION FOR TRAIN PROTECTION SYSTEMS	283
<i>R. Pfaff, I. Elsen, B. Schmidt</i>	
ADAPTIVE WHEEL SLIDE PROTECTION ALGORITHMS	293
<i>M. Frea, R. Tione</i>	
ELECTRONIC EMULATION OF PNEUMATIC BRAKING FUNCTIONS FOR RAILWAYS APPLICATIONS	304
<i>F. Ferrara, R. Tione, A. Grasso, M. Fasolini</i>	
IMPACT OF SLIP AT LOW ADHESION CONDITIONS CAUSED BY VARIOUS CONTAMINANTS	310
<i>M. Fischer, F. Szekely, M. Frea, S. Jennek</i>	
BRAKES 2025 – DESIGN OF AN ELECTROMECHANICAL DRUM BRAKE	321
<i>C. Vey, J. Hoffmann, M. Semsch, S. Pla</i>	
BRAKING SYSTEMS FUNCTIONAL SAFETY	329
<i>J.R. Muller</i>	
NON-ASBESTOS ORGANIC (NAO) DISC PAD WEAR BEHAVIOR: DIVERGENCE OF THICKNESS LOSS AND WEIGHT LOSS	343
<i>M. Sriwiboon, N. Tiempan, K. Kaewlob, S.K. Rhee</i>	
A COMPARISON BETWEEN TIN AND ANTIMONY SULPHIDES TRIBOLAYERS	354
<i>R.C. Dante, E. Cotilli, M. Conforti, M. Cotilli, F. Squadrani, J. O'Leary</i>	
THE INFLUENCE OF THE THERMAL MODULE OF A BRAKE DISC ON ITS NATURAL FREQUENCIES	367
<i>R. Becker</i>	
DESIGN AND ASSESSMENT OF A TEST RIG FOR AIRBORNE BRAKE WEAR DEBRIS MEASUREMENTS	377
<i>A. Sanuddin, S. Kosarieh, C. Gilkeson, P. Brooks, D. Barton</i>	
METAL SULFIDE COATED FIBERS - BRINGING SOLID LUBRICATION TO THE CONTACT PLATEAU	386
<i>C. Schmied</i>	
SCALABLE LIGHTWEIGHT CONCEPT FOR COMPOSITE BRAKE DISCS WITH STEEL HUB MADE OF STAMPED SHEET METAL	397
<i>W. Straub, T. Muller, R. Becker, M.G. Muller, K. Zawalich, U. Lorenz</i>	
ANALYSIS OF METAL PICK-UP GROWTH MECHANISM WITHIN AUTOMOTIVE BRAKE PADS	409
<i>H. Noda, T. Takei</i>	
EFFECT OF SUB-FRAME BOUNDARY CONDITIONS ON VEHICLE JUDDER PERFORMANCE	417
<i>B. Ferrer, J.J. Garcia-Bonito, O. Calvo, F. Squadrani, A. Claverias, D.H. Jeon</i>	

MINERAL PROCESSING TECHNOLOGIES AND THEIR IMPACT ON PROPERTIES OF FUNCTIONAL FILLERS	430
<i>V. Mayer</i>	
BEST OF BOTH WORLDS: OPTIMIZED FIBRE REINFORCEMENT FOR FRICTION MATERIALS	444
<i>J. Rothe</i>	
INTERPLAY BETWEEN COMPOSITION AND ELECTROCHEMICAL PERFORMANCE AT THE PAD-DISC INTERFACE	453
<i>F. Bertasi, A. Mancini, M. Bandiera, S. Pin, A. Casini, A. Bonfanti</i>	
HARD-METAL COATED BRAKE DISCS – INVESTIGATIONS OF TRIBOLOGY, MECHANICAL ROBUSTNESS AND WEAR PRODUCTS	463
<i>S. Gramstat, R. Waninger, B. Reinhold, H. Sieber, P.D. Eggenschwiler</i>	
COMPARISON OF MEASUREMENT METHODS FOR FIBER PARTICLE CONTENT IN TITANATE	475
<i>D. Taki, H. Sakai, H. Fujii</i>	
DEVELOPMENT OF A WHEEL HUB INTEGRATED BRAKE DISC	481
<i>M. de la Cruz, R. Leibl, H.W. Raedt, W. Straub</i>	
THE EFFECT OF BINDER VARIATIONS ON THE FRICTION MATERIALS PROPERTIES AND PRESSING PROCESS	488
<i>P. Monreal-Perez, M. Zugasti, E. Perez, L. Ciervide, A. Madariaga, J. Yaben, M. Idareta, R. Orzanco, J. Gonzalez, U. Wienstroth, T. Rouzaut</i>	
TRIBO PERFORMANCE OF SINGLE AND MULTIWALL CARBON NANOTUBE IN THE DISC BRAKE PAD FORMULATION	499
<i>B.S. Rajan, K. Sathickbasha, M.A.S. Balaji, A.S. Selvakumar, S.R. Mohideen, D.P. Arockia, A.B.M.A. Noorani, K.U. Hammad</i>	
DRY SLIDING WEAR AND FE CONTAMINATION OF INVESTMENT-CAST SIC FOAM REINFORCED ALUMINUM MATRIX COMPOSITES.....	508
<i>G. Volpato, M. Fredel, U. Tetzlaff</i>	
COMPARISON BETWEEN TWO DIFFERENT ROUTES FOR THE FABRICATION OF SINTERED CLUTCH PLATES	518
<i>B. Perez, J. Echeberria</i>	
COATING OF BRAKE DISCS THROUGH EXTREME HIGH-SPEED LASER MATERIAL DEPOSITION	527
<i>T. Schopphoven</i>	
EXPLORATION OF THERMOPLASTIC POLYMERS AS A POSSIBLE REPLACEMENT OF PHENOLIC RESIN IN FRICTION MATERIALS.....	536
<i>S. Goehring, U. Marathe, V. Mahale, N. Modler, A. Langkamp, J. Bijwe</i>	
STANDARD LOAD SPECTRA FOR COMMERCIAL VEHICLE BRAKES.....	546
<i>K. Lucan</i>	
ADDITIVE MANUFACTURING - 3D PRINTING OF FRICTION MATERIAL (PART 2): WATER-BASED LIQUID FRICTION COMPOUNDS.....	553
<i>R. Milczarek, C. Schmied</i>	
METHOD FOR EXTRACTING THE MAIN SPECTRUM OF FRICTION-MATERIALS BEHAVIOUR (BATCH TO BATCH CONTROL) USING A NEW SCALE - DYNAMOMETER SPECIFICATION	559
<i>K. Li, J. Zhang, O. Schmitt</i>	
REGULATORY FRAMEWORK STATE OF THE ART REGARDING BRAKING SYSTEMS FOR HIGHLY AUTOMATED VEHICLES IN EUROPE AND USA	570
<i>I. Lafuente, C. Lujan, J. Llop, M. Tobar, E. Martinez</i>	
NEW ISO PROJECT PROPOSAL FRICTION-RELEVANT BRAKE DISC SPECIFICATION	577
<i>S. Gramstat, C. Agudelo</i>	
SAE STANDARDS UPDATE AND LIAISON ACTIVITIES	583
<i>C. Agudelo</i>	
INVESTIGATIONS ON CREEP GROAN CONCERNING STATIC AND DYNAMIC AXLE BUSHING PROPERTIES	589
<i>M. Purscher, S. Huemer-Kals, P. Fischer</i>	
STATISTICAL ANALYSIS OF SQUEAL REDUCTION EFFECT BY SHAPE OPTIMIZATION METHODS.....	603
<i>D.J. Min, S.C. Park, K.H. Park</i>	
AUTOMATED BRAKING TESTS USING INDIVIDUALLY ADJUSTABLE DRIVING ROBOTS	611
<i>T. Rinnert, G. Prokop</i>	

ADVANTAGES OF IMPROVED MATERIAL DAMPING HANDLING FOR BRAKE SYSTEM SIMULATION	619
<i>M. Klein</i>	
EFFICIENT LARGE MULTI-PARAMETRIC SQUEAL SIMULATION AND ANALYSIS USING ADVANCED MODEL REDUCTION TOOLS	629
<i>G.V.D. Roches, O. Stump, E. Balmes</i>	
A FURTHER UNDERSTANDING OF BRAKE DISC THERMAL SIMULATIONS UNDER EMERGENCY STOP	639
<i>H. Yu, Q. Yang</i>	
NUMERICAL EFFICIENT THERMAL NETWORK FOR CALCULATING THE BRAKE DISC TEMPERATURE	651
<i>M. Arnold, M. Bolay, O. Stump, M. Fister, A.G. Daimler</i>	
WHEEL-RAIL ADHESION LIMIT IN PRESENCE OF LOAD DYNAMICS AND INTER-AXLES CLEANING EFFECT	661
<i>S. Perna, M. Frea, R. Tione</i>	
DYNAMICS OF AIR BRAKE ACTUATION SYSTEM UNDER CREEP GROAN EXCITATION	669
<i>A. Sanchez, J.J. Garcia-Bonito, J. Lapresta, N. Molina, F. Squadrani</i>	
DAMPING SPECIFICATIONS OF VEHICLE BRAKE COMPONENTS BASED ON SIMULATIVE AND EXPERIMENTAL INVESTIGATIONS	678
<i>P. Diel, S. Horwath, C. Rausch, H.P. Klatt</i>	
DYNAMIC AIR CONSUMPTION SIMULATION AT THE TRAIN LEVEL	687
<i>E. Tassart, S. Bony, F. Fumarola, S. Penel</i>	
SIMULATION STUDY ON THE THERMOMECHANICAL BEHAVIOUR OF AL-MC AUTOMOTIVE BRAKE DISCS	695
<i>A. Thomas, N. Zervos, A. Eklund, S.A. Awe</i>	
ADVANTAGES OF COMPLEX RAILWAY BRAKE SYSTEMS VALIDATION USING EXTENSIVE HARDWARE IN THE LOOP APPROACH	707
<i>F. Astengo</i>	
INFLUENCE OF NONLINEAR EFFECTS ON THE EIGENVECTOR OF A MODE COUPLING SYSTEM	719
<i>B. Koll, J. Otto, G.P. Ostermeyer</i>	
A FIRST-PRINCIPLE SEMI-EMPIRICAL METHOD FOR BRAKE SQUEAL ASSESSMENT	734
<i>J.J. Garcia-Bonito, N. Molina, F. Squadrani, A. Sanchez, R. Urena, H. Cho</i>	
MDRE: AN EFFICIENT EXPANSION TOOL TO PERFORM MODEL UPDATING FROM SQUEAL MEASUREMENTS	750
<i>G. Martin, G.V.D. Roches, E. Balmes, T. Chancelier</i>	
A NEW APPROACH FOR TESTING OF BRAKE TUBES: CONSIDERATION OF ASSEMBLING BASED MISTAKES	760
<i>O. Tokul, O. Koyuncu</i>	
BRAKE COOLING MODELLING & CORRELATION	776
<i>Y.K. Hacisalihoglu, Y. Dalga, B. Akca, C. Dinc, O. Ford</i>	
DESIGNING FAULT-TOLERANT BRAKE CONTROL ALGORITHMS USING SIMULATION	787
<i>S. Miller</i>	
RUNWAY TESTS OF ANTI-LOCKING (ABS) SYSTEM FOR MID-SIZED AIRPLANE	799
<i>Z. Skorupka</i>	
DEVELOPMENT OF A REGENERATIVE FRICTION MODEL TO ENHANCE BRAKING SIMULATION WITH THE MULTIBODY SOFTWARE VOCO	807
<i>M. Toumi, M. Sebes, K. Laden, H. Chollet, M. Bouallaga</i>	
MODELLING OF REAL CONTACT SURFACES: APPLICATION TO BRAKE SQUEAL	821
<i>Y. El Attoui, J. Sadet, F. Massa, T. Tison, L. Coustenoble, M. Bigerelle, J. Kim</i>	
HIGH-FIDELITY MODELLING AND CHARACTERIZATION OF DYNAMOMETER ENCLOSURE INTERACTIONS USING A DOE APPROACH FOR BRAKE EMISSIONS MEASUREMENTS	831
<i>C. Agudelo, R. Vedula, J. Bautell, J. Capecelatro, Q. Wang</i>	
Author Index	