



Book of Abstracts

Universidad Politécnica de Madrid / Technical University Madrid

**Second International Conference on
Concrete Sustainability - ICCS16**

**13 – 15 June 2016
Madrid, Spain**

ICCS16

Book of Abstracts of the II International Conference on Concrete Sustainability, held in Madrid, Spain on 13 - 15 June 2016

Edited by:

Jaime C. Gálvez

Technical University of Madrid

Antonio Aguado de Cea

Technical University of Catalonia

David Fernández-Ordóñez

International Federation for Structural Concrete (fib)

Koji Sakai

ICCS

Encarnación Reyes

Technical University of Madrid

María J. Casati

Technical University of Madrid

Alejandro Enfedaque,

Technical University of Madrid

Marcos G. Alberti,

Technical University of Madrid

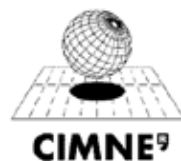
Albert de la Fuente

Technical University of Catalonia

A publication of:

**International Center for Numerical
Methods in Engineering (CIMNE)**

Barcelona, Spain



**International Center for Numerical Methods in Engineering
(CIMNE)**

Gran Capitán s/n, 08034 Barcelona, Spain
www.cimne.com

ICCS16 – Concrete Sustainability

J. C. Galvez, A. Aguado de Cea, D. Fernández-Ordóñez, K. Sakai, E. Reyes, M. J. Casati, A. Enfedaque, M. G. Alberti and A. de la Fuente
(Eds.)

First edition, June 2016

© The authors

Printed by: Artes Gráficas Torres S.A., Huelva 9, 08940 Cornellà de Llobregat, Spain

ISBN: 978-84-945077-8-6

CONTENTS

| | |
|--------------------------|-----|
| Preface | 9 |
| SUMMARY | 11 |
| | |
| CONTENTS | 13 |
| Plenary Lectures | 29 |
| Technical Sessions | 81 |
| Authors Index | 261 |

PREFACE

This volume collects the abstracts of all contributions to the Second International Conference on Concrete Sustainability (ICCS 16), held at *Escuela de Ingenieros de Caminos, Canales y Puertos of Universidad Politécnica de Madrid (Civil Engineering School of the Technical University of Madrid)*. Madrid, Spain, 13-15 June 2016.

The conference program includes four plenary lectures and 168 contributions articulated in 34 sessions.

Abstracts are presented in the following order:

Plenary lectures (4):

Environmental impact, performance and service lifetime - pillars of sustainable concrete construction

Harald S. Müller

President of fib

Institute of Concrete Structures and Building Materials, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany

Expanding knowledge and resources for modern concrete professionals: innovation, sustainability, and resilience

Mike Schneider

President (2016-2017), American Concrete Institute

Senior Vice President, Baker Concrete Construction, Monroe, OH, USA

Recycling of construction and demolition waste an overview of RILEM achievements and state of the art in the EU

Johan Vyncke

President of RILEM

Director Research & Innovation Belgian Building Research Institute – BBRI, Brussels, Belgium

Sustainability evaluation of the concrete structures

Antonio Aguado¹, Jaime C. Gálvez², David, Fernández-Ordóñez³, Albert de la Fuente¹

¹Technical University Catalonia, Barcelona, Spain

²Technical University Madrid, Madrid, Spain

³Secretary of fib, Lausanne, Switzerland

Parallel sessions:

- Case Studies (2)
- Construction aspects (4)
- Durability (11)
- Environmental design (6)
- Materials (11)

Full papers are enclosed in the E-book available at the Conference website:
www.iccs16.org

ICCS16 is the second international conference on this topic, which is organised by the Technical University of Madrid and co-organised by the Spanish Association for Structural Concrete (ACHE), the American Concrete Institute (ACI), the Latin American Association for Pathology of Constructions (ALCONPAT), the International Federation for Structural Concrete (fib), the Japan Concrete Institute (JCI), and the International Union of Laboratories and Experts in Construction Materials (RILEM).

Madrid, 20 May 2016

The Editors,

Jaime C. Gálvez
Technical University of Madrid

Antonio Aguado
Technical University of Catalonia

David Fernández-Ordóñez
International Federation for Structural Concrete (fib)

Koji Sakai
ICCS Chairman

Encarnación Reyes
Technical University of Madrid

María J. Casati
Technical University of Madrid

Alejandro Enfedaque,
Technical University of Madrid

Marcos G. Alberti,
Technical University of Madrid

Albert de la Fuente
Technical University of Catalonia

SUMMARY

PLENARY LECTURES

| | |
|---|----|
| Environmental impact, performance and service lifetime - pillars of sustainable concrete construction..... | 31 |
| <i>H. S. Müller, M. Haist, J. S. Moffatt and M. Vogel</i> | |
| Expanding knowledge and resources for modern concrete professionals: innovation, sustainability, and resilience | 42 |
| <i>M.J. Schneider</i> | |
| Recycling of construction and demolition waste an overview of RILEM achievements and state of the art in the EU | 55 |
| <i>J. Vyncke and J. Vrijders</i> | |
| Sustainability evaluation of the concrete structures | 66 |
| <i>A. Aguado de Cea, J.C. Gálvez, D. Fernández-Ordóñez and A. de la Fuente</i> | |

TECHNICAL SESSIONS

| | |
|-----------------------------------|-----|
| Case Studies | 83 |
| Construction Aspects | 98 |
| Durability | 119 |
| Environmental Design | 173 |
| Materials | 201 |

CONTENTS

PLENARY LECTURES

| | |
|---|----|
| Environmental impact, performance and service lifetime - pillars of sustainable concrete construction..... | 31 |
| <i>H. S. Müller, M. Haist, J. S. Moffatt and M. Vogel</i> | |
| Expanding knowledge and resources for modern concrete professionals: innovation, sustainability, and resilience | 42 |
| <i>M.J. Schneider</i> | |
| Recycling of construction and demolition waste an overview of RILEM achievements and state of the art in the EU | 55 |
| <i>J. Vyncke and J. Vrijders</i> | |
| Sustainability evaluation of the concrete structures | 66 |
| <i>A. Aguado de Cea, J.C. Gálvez, D. Fernández-Ordóñez and A. de la Fuente</i> | |

TECHNICAL SESSIONS

Case studies

| | |
|--|----|
| LEAD PAPER - Sustainability of bridge structures. Indicator system .. | 83 |
| <i>R. Valdivieso, J.R Sánchez Lavin and D. Fernández-Ordóñez</i> | |
| Bond-Slip behaviours between deformed steel bar and 100% Recycled Coarse Aggregate (RCA) concrete using pull-out and beam tests..... | 84 |
| <i>H.D. Yun, S.J Jang, S.W. Kim and W.S. Park</i> | |
| Carbonation and recycling potential of novel MgO cements..... | 85 |
| <i>C. Unluer</i> | |
| Case study for combination of architectural and structural design for a sustainable and aesthetic façade for a multilevel car park | 86 |
| <i>A. Bhate</i> | |
| Contributing to sustainability of concrete by using steel fibres from recycled tyres in water retaining structures | 87 |
| <i>A. Pérez Caldentey, J. Giménez Vila, J.M. Ortolano González, F. Rodríguez García and G. Grolí</i> | |

Feasibility study on the utilization of alkali-treated ground municipal solid waste incineration bottom ash as cement replacement88
Y. Liu and E.H. Yang

Ladle furnace slags of low and high alumina in masonry mortars.....89
I. Vegas, T. Herrero, D. García, A. Santamaría, J.T. San-José and J.J. González

Large infrastructure economic, social and environmental sustainability assessment. An approach to the Canal de Navarra irrigation area case90
J. E. Arizón Fanlo, D. Fernández-Ordóñez and J. A. Alfaro Tanco

Self-healing performance of magnesia-based pellets in concrete91
R. Alghamri and A. Al-Tabbaa

Study of concrete modification effect with recycled aggregate treated by carbonation92
T. Iyoda and N. Matsuda

Sustainability dimension of an elevated corridor over a greenfield93
S. Bansal, S K Singh, P K Sharma and M. Bansal

Sustainability evaluation of a new type concrete bridge structure94
K.I. Kata, T. Shibata, A. Kasuga and K. Sakai

The optimization of railway concrete sleepers for increasing the durability and sustainability95
Sz.A. Köllő, G. Köllő and A. Puskás

Thermal mass improvement of lightweight concrete with modified aggregates96
A. Gálvez, J. Cubillo and S Valcke

Wood-Concrete composite floor system in rehabilitation.....97
B. Martínez Juan and R. Irlés Más

Construction aspects

LEAD PAPER - Automatic design of building construction processes by simulated annealing. A measure to improve sustainability, time, financial and computational costs98
M. Buitrago, J.M. Adam, P.A. Calderón and J.J. Moragues

LEAD PAPER - Fabrication, performance and environmental safety of fired bricks from lake silt and sewage sludge.....99
Y.M. Zhang, L.T. Jia, H. Mei, P. Zhang, Q. Cui, P.G. Zhang and Z.M. Sun

| | |
|---|------------|
| LEAD PAPER - Shotcrete reinforced with recycled fibers from secondary waste of end of life tires | 100 |
| <i>S. Serna, P. Serna, M.J. Pelufo, V. Orero and A. Llano</i> | |
| A case of study for embedding RFID tags in precast concrete | 101 |
| <i>R. Alonso-Calvo, M. García-Remesal and D. Fernández-Ordóñez</i> | |
| An experimental study on precast concrete beam-to-column connection using interlocking bars. | 102 |
| <i>V. A. Noorhidana and J. P. Forth</i> | |
| Cement based façades for mid-rise commercial sustainable and resilient buildings | 103 |
| <i>G. Barluenga, O. Ladipo, G. Reichard and R.T. Leon</i> | |
| Development of environment-friendly blended cement and application of the cement to a building construction project | 104 |
| <i>M. Yamada, N. Urushizaki and Y. Kawabata</i> | |
| Durability of concrete exposed to sea water at early age: floating dock method for construction of caissons | 105 |
| <i>J. Vera-Agulló, R. Lample, N. Silva, U. Müller and K. Malaga</i> | |
| Eco-mechanical analysis of two lightweight fiber-reinforced cement-based composites | 106 |
| <i>A.P. Fantilli, A. Gorino and B. Chiaia</i> | |
| Innovative precast concrete structural floor as a part of a HVAC System. The real application experience in a building..... | 107 |
| <i>F. Pich-Aguilera, P. Casaldaliga and U. Muencheberg</i> | |
| Lessons learned from a life-cycle assessment of north american precast concrete | 109 |
| <i>D. Frank and E. Lorenz</i> | |
| Reducing energy needs in residential buildings in the Spanish climate through an innovative daily storage based solution..... | 110 |
| <i>S. Álvarez, J. A. Tenorio and R. Salmerón</i> | |
| Refuse cork as lightweight aggregate for more sustainable masonry units..... | 111 |
| <i>M. C. Pacheco, M. J. Arévalo, A. Macías and P. Serna</i> | |
| Retrofitting with an IAB concept: a sustainable solution | 112 |
| <i>M. Muñoz, F. Ariñez Fernández, R. Yadav, M. Iuliano and B. Briseghella</i> | |

Study of the use of different chemical admixtures in mortars manufactured with recycled sand from CDW..... 113
A.I. Torres-Gómez, C. Cingolani, E.F. Ledesma, V. Corinaldesi, J.R. Jiménez and J.M. Fernández

Sustainability features of an elevated road corridor under construction in an urban environment..... 114
S. Bansal and S K Singh

Sustainable TBM tunnels for tomorrow 115
S. Pompeu-Santos

Sustainable technology for PC Grout Infill 116
T. Matsuka, K. Sakai, S. Tanabe, R. Kudo, F. Seki and T. Urano

The effectiveness of thermal mass in insulated walls in moderate climates..... 117
M. VanGeem

TRC multilayer precast façade panel: structural behaviour in freezing-thawing condition 118
I.G. Colombo, M. Colombo and M. di Prisco

Durability

LEAD PAPER - Alkali-silica resistance of coal bottom ash mortars 119
C. Argiz, E. Menéndez and A. Moragues

LEAD PAPER - Concrete cracking in marine micro-climates 120
P. Castro-Borges, A. A. Torres-Acosta, M. G. Balancán-Zapata and J. A. Cabrera-Madrid

LEAD PAPER - Corrosion crack pattern at early ages due to pressure rust layer in reinforced concrete..... 121
D. Galé, A.M. Bazán, J.C. Gálvez and E. Reyes

LEAD PAPER - Durability of sustainable ternary blended concrete containing blast furnace slag and limestone filler 122
Á. Fernández, M.C. Alonso, J.L. García Calvo and M. Sánchez

LEAD PAPER - Effect of phase change material on temperature shifting in concrete panels 123
P. Sukontasukkul, P. Chindapasirt, D. Choi and K. Sakai

LEAD PAPER - Replacement of steel with GFRP as internal reinforcement for corrosion-free reinforced concrete structures..... 124
S. Sheikh, Z. Kharal and A. Tavassoli

| | |
|--|-----|
| LEAD PAPER - Seeking a more sustainable structural concrete by using a combination of polyolefin-based fibres and steel fibres | 125 |
| <i>M.G. Alberti, A. Enfedaque and J.C. Gálvez</i> | |
| LEAD PAPER - The damage of calcium sulfoaluminate (CSA) cement paste partially immersed in Na ₂ CO ₃ solution | 126 |
| <i>Z. Liu, L. Hou, D. Deng and G. De Schutter</i> | |
| LEAD PAPER - The paradox of high performance concrete used for reducing environmental impact and sustainability increase | 127 |
| <i>J. Pacheco, L. Doniak, M. Carvalho and P. Helene</i> | |
| A study on the crack distribution and characteristics of a continuously reinforced concrete pavement | 128 |
| <i>HJ Jansen Van Rensburg and KJ Jenkins</i> | |
| Assessment of four electrical measurement methods for assessing the chloride resistance of concretes | 130 |
| <i>A. Pilvar, A.A. Ramezani-pour, H. Rajaie and S.M. Motahari Karein</i> | |
| Calcium hydroxide curing for accelerated carbonation testing of high volume fly ash cementitious blends | 131 |
| <i>R. Reis, A. Camões, M. Ribeiro and R. Malheiro</i> | |
| Carbonation-resistant evaluation of the fly-ash concrete in consideration of the pozzolanic reaction | 132 |
| <i>K. Imagawa and A. Koyama</i> | |
| Changes in chloride penetration properties caused by reaction between sulfate ions and cement hydrates | 133 |
| <i>Y. Kato, S. Naomachi and E. Kato</i> | |
| Changes in microstructure and pore structure of low-clinker cementitious materials during early stages of carbonation | 134 |
| <i>M. Bertin, O. Omikrine-Metalssi, V. Baroghel-Bouny and M. Saillio</i> | |
| Chloride diffusion in alkali activated concrete | 135 |
| <i>O.O. Ojedokun and P.S. Mangat</i> | |
| Coal bottom ash research program focused to evaluate a potential Portland cement constituent | 136 |
| <i>M. A. Sanjuán, C. Argiz, E. Menéndez and A. Moragues</i> | |
| Concrete as a radon barrier and its characterization | 137 |
| <i>P. Linares, C. Andrade and D. Baza</i> | |

| | |
|---|-----|
| Corrosion protection evaluation of galvanized steel reinforced concrete for service life extension in chloride aggressive environments..... | 138 |
| <i>F.J. Luna Molina, M.C. Alonso Alonso, R. Jarabo Centenero, M. Sánchez Moreno and E. Hernández Montes</i> | |
| Eco-mechanical analysis of tyres-fiber-reinforced cement-based composites | 139 |
| <i>A.P. Fantilli, R. Furnari, M. Guadagnini, B. Chiaia, K. Pilakoutas and P. Papastergiou</i> | |
| Effectiveness of various shrinkage prediction models for concrete made of crushed clay bricks as coarse aggregate | 140 |
| <i>Syed I. Ahmad and S. Roy</i> | |
| Effect of incorporating Sugarcane Bagasse Ash (SCBA) in mortar to examine durability of sulfate attack..... | 141 |
| <i>A. Joshaghani, A.A. Ramezani pour and H. Rostami</i> | |
| Efficiency of chloride extraction from reinforced concrete with intermittent applications..... | 142 |
| <i>H. Nguyen Thi, H. Yokota and K. Hashimoto</i> | |
| Evaluation of mechanical properties and accelerated Chloride Ion Penetration (RCMT) in alkali activated slag concrete | 143 |
| <i>A.A. Ramezani pour, F. Bahman Zadeh, A. Zolfagharnasab, M. R. Pourebrahimi and A. M. Ramezani pour</i> | |
| Experimental study of concrete deterioration due to frost action | 144 |
| <i>A. Marciniak and M. Koniorczyk</i> | |
| First approach to thermochromic mortars: compatibility between thermochromic pigments and cement..... | 145 |
| <i>G. Perez, A. Guerrero and A. Pons</i> | |
| Formation of air pores in concrete due to the addition of tire crumb rubber | 146 |
| <i>A. Zimmermann, F. Röser and E. A. B. Koenders</i> | |
| Fundamental study on sorption characteristic of radionuclide ion in cement and blast furnace slag based samples..... | 147 |
| <i>K. Hashimoto, N. Taguchi and H. Yokota</i> | |
| Geopolymerisation activity of Eifel Tuff | 148 |
| <i>O. Vogt, N. Ukrainczyk, F. Roeser, E. Steindlberger and E. A. B. Koenders</i> | |

| | |
|--|-----|
| Improvement of freezing and thawing durability on scaling of eco-cement extremely dry concrete under deicing agent condition..... | 149 |
| <i>A. Ueno, M. Ishida, K. Uji and K. Ohno</i> | |
| Influence of C ₃ A content on chloride transport in concrete..... | 150 |
| <i>K. Y. Ann, M. J. Kim and H. S. Jung</i> | |
| Influence of carbonation on the chloride Ion diffusion coefficient in fly ash concrete | 151 |
| <i>R. Malheiro, A. Camões, G. Meira, R. Ferreira, M. Amorim and R. Reis</i> | |
| Influence of electric conduction of steel bars on electrochemical measurement of reinforced concrete structure..... | 152 |
| <i>N. Someya, Y. Kato and E. Kato</i> | |
| Influence of high temperature history on chloride penetration of concrete using waste-derived aggregate..... | 153 |
| <i>Y. Ogawa, A. Fujiyama, R. Sato, K. Kawai and H. Ooishi</i> | |
| Long-term effects of the hardening temperature and relative humidity on the microstructure and properties of mortars with active additions | 154 |
| <i>J.M. Ortega, R.M. Tremiño, I. Sánchez and M.A. Climent</i> | |
| Mechanical properties and chloride ions penetration of concretes containing nanosilica and rice husk ash | 155 |
| <i>A.A. Ramezaniapur, M. Zahedi and A. M. Ramezaniapur</i> | |
| Mechanical properties of concrete reinforced with recycled steel fibers: a case study..... | 156 |
| <i>G. Centonze, M. Leone, F. Micelli and M.A. Aiello</i> | |
| Modified expanded clay lightweight concretes for thin-walled floating structures | 157 |
| <i>A. Mishutin, S. Kroviakov, N. Mishutin and V. Bogutsky</i> | |
| Permeability of hybrid concrete for sustainable bridge deck pavement | 158 |
| <i>K. K. Yun, S. W. Lee and Y. H. Cho</i> | |
| Plastic moment capacity evaluation for reinforced concrete frame elements by adopting the proper material constitutive laws..... | 159 |
| <i>A. Faur and A. Puskás</i> | |
| Porosity and resistivity measurement of accelerated cured geopolymers and conventional concrete | 160 |
| <i>A. Noushini and A. Castel</i> | |

| | |
|---|-----|
| Pozzolanic materials obtained through a treatment methodology of landfills. Characterization of new cements and durability of concretes | 161 |
| <i>F. Puertas, C. Varga, M.M. Alonso, A. Díaz-Bautista and S. Lizarraga</i> | |
| Preliminary assessment of durability of a low carbon concrete made with limestone calcined clay Portland cement..... | 162 |
| <i>F. Martirena, E. Díaz, A. Jose, R. Dayran, A. Adrian and K. Scrivener</i> | |
| Preventing reinforcement corrosion in cracked concrete by self-repair | 164 |
| <i>K. Van Tittelboom, B. Van Belleghem, J. Dhaene, L. Van Hoorebeke and N. De Belie</i> | |
| Pumpability of sustainable SCC mixtures | 165 |
| <i>A. Rodríguez, G. Barluenga, O. Río, I. Palomar, K. Nguyen, A. Sepulcre and M. Giménez</i> | |
| Punching shear strength of concrete slabs reinforced with recycled steel fibres from waste tyres from Waste Tyres..... | 166 |
| <i>M. Bartolac, D. Damjanović, J. Krolo and A. Baričević</i> | |
| Robust design and durability of CO ₂ -reduced concrete with high amount of supplementary cementitious materials..... | 167 |
| <i>C. Begemann and L. Lohaus</i> | |
| Steel corrosion in recycled aggregate concrete containing amino acid..... | 168 |
| <i>T. Ueda, K. Aihara and T. Iiboshi</i> | |
| Study of the behavior of concrete with recycled polypropylene fibers | 169 |
| <i>I. Carné and P. Serna</i> | |
| Sustainability analysis of steel fibre reinforced concrete flat slabs..... | 170 |
| <i>A. Blanco, A. de la Fuente and A. Aguado de Cea</i> | |
| The influence of metakaolin and natural zeolite on the rheology, engineering and durability properties of high strength self-compacting concrete at the early age | 171 |
| <i>K. Samimi, S. Kamali Bernard, A.A Maghsoudi and M. Maghsoudi</i> | |
| Various durability aspects of cement pastes and concretes with supplementary cementitious materials..... | 172 |
| <i>M. Saillio, V. Baroghel-Bouny and S. Pradelle</i> | |

Environmental design

| | |
|---|-----|
| LEAD PAPER - A study on an indicator for environmental impacts of cement industry | 173 |
| <i>K. Kawai, S. Hoshino, H. Hirao and S. Tanaka</i> | |
| LEAD PAPER - Can a general structural code for both new and existing concrete structures enhance the way we approach sustainability for existing structures? | 174 |
| <i>S. L. Matthews and G. Mancini</i> | |
| LEAD PAPER - Engeneering the way for sustainability | 175 |
| <i>G. L. Balázs, S. G. Nehme, R. Nemes, A. Ceh and K. Kopecko</i> | |
| LEAD PAPER - Green concrete specification and environmental declarations of concrete..... | 176 |
| <i>D. Choi, C.-U. Chae and M.-K. Lim</i> | |
| LEAD PAPER - New route to synthesize biobased PCE superplasticizer | 177 |
| <i>J. Zimmermann and C. Fiuza</i> | |
| LEAD PAPER - Overview of resource conservation and closed-loop recycling in concrete toward sustainability | 178 |
| <i>T. Noguchi</i> | |
| LEAD PAPER - Resiliency: The key to a sustainable future | 179 |
| <i>J.K. Buffenbarger</i> | |
| LEAD PAPER - Sustainability of concrete structures in changing world..... | 180 |
| <i>P. Hajek</i> | |
| LEAD PAPER - Swedish view of concrete and sustainability | 181 |
| <i>J. Silfwerbrand</i> | |
| A sustainability assessment approach based on life cycle assessment for structural retrofit of RC members..... | 182 |
| <i>C. Menna, L. Napolano, D. Asprone and A. Prota</i> | |
| Carbon emissions capturing in cement | 183 |
| <i>V. Rheinheimer and P. J.M. Monteiro</i> | |
| Design for safety in construction work | 184 |
| <i>M. Casanovas-Rubio, J. Armengou and G. Ramos</i> | |

| | |
|---|-----|
| Development of cementitious-woodchip compound products for resilience measures in disaster situation toward sustainability | 185 |
| <i>M. Tamura and K. Arakawa</i> | |
| Doing more with less: topology optimization as a means for the design of sustainable concrete forms | 186 |
| <i>M. Donofrio</i> | |
| Durability behaviour of sustainable cements exposed under real environmental conditions of the Mediterranean area | 187 |
| <i>I. Sánchez, M.P. López, J.M. Ortega and M.A. Climent</i> | |
| Lessons learned from implementing the North American precast concrete sustainable plant program..... | 188 |
| <i>E. Lorenz and D. Frank</i> | |
| Life cycle assessment of protective coatings for concrete | 189 |
| <i>M. Donadio, A. Carmona, A. Tebar and C. Fiuza</i> | |
| Life cycle assessment of reinforced concrete beams designed according to the MC 2010 and the Spanish EHE – 08 standard..... | 190 |
| <i>P. Pujadas, A. de la Fuente and C. Almirall</i> | |
| Life cycle assessment of waterproofing solution for concrete basement..... | 191 |
| <i>A. Carmona, C. Fiuza and C. López</i> | |
| NO _x adsorption, fire resistance and CO ₂ sequestration of high performance, high durability concrete containing activated carbon ... | 192 |
| <i>M. Di Tommaso and I. Bordonzotti</i> | |
| Parametric analyses on sustainability indicators for design, execution and maintenance of conference structure | 193 |
| <i>H. Yokota, S. Goto and K. Sakai</i> | |
| Self – compacting concrete CO ₂ uptake..... | 194 |
| <i>H. Witkowski and M. Koniorczyk</i> | |
| Strength development of concrete: balancing production requirements and ecological impact | 195 |
| <i>S. Onghena, S. Grunewald and G. de Schutter</i> | |
| Sustainability and human habitat..... | 196 |
| <i>M. Bastons and J. Armengou</i> | |
| Sustainability assessment of Indian blended cements in terms of energy and resource consumption..... | 198 |
| <i>A. Patel, K. Nagrath, S. Prakasan, R. Gettu, S. Palaniappan and S. Maity</i> | |

The French National Project RECYBETON, to recycle concrete into concrete..... 199
H. Colina and F. De Larrard

Use of recycled aggregates and sea water for sustainable concrete in marine environments..... 200
M. Etxeberria and P. Pardo

Materials

LEAD PAPER - Can artificial recycled fine aggregate truly represent fine aggregated from C&DW 201
A. Katz and D. Kulisch

LEAD PAPER - Future cements: research needs for sustainability and potential of LC3 technology 202
K. Scrivener

LEAD PAPER - Influence of temperature on the rheology of pastes and selfcompacting mortars with sustainable binders..... 203
A. Pacios, A. Köening and F. Dehn

LEAD PAPER - Sustainability applied to prefabrication..... 204
D. Fernández-Ordóñez and A. de la Fuente

LEAD PAPER - Sustainability assessment of concrete with recycled concrete aggregates 205
D. García, A. Lisbona, J.S. Dolado, I. Vegas, J. San Jose, J. Sánchez and V. García

A first approach: towards sustainable civil engineering works using precast concrete solutions 206
A. López and V. Yepes

A study into the relationships between the mechanical properties of recycled aggregate concrete 207
N. Khalil, A. Touma, T. Touma and R. Daher

A study of the sustainability potential of cement reduced concrete 210
J. S. Moffatt, M. Haist and H. S. Müller

Applicability of biomass plant waste to the design of new cement based materials..... 211
J.M. Medina Martínez, I. F. Sáez del Bosque, M. Frías Rojas, M. I. Sánchez de Rojas and C. Medina Martínez

| | |
|---|-----|
| Assessing the sustainability of precast concrete towers for wind turbines | 212 |
| <i>A. de la Fuente, C. Gómez del Pulgar, F. Pardo and A. Aguado de Cea</i> | |
| Biomass and coal fly ash as cement replacement on mortar properties | 213 |
| <i>E. Teixeira, A. Camões, F. Branco and L. Tarelho</i> | |
| CO ₂ and H ₂ O diffusion of water- and clinker-reduced concretes | 215 |
| <i>S. Steiner, A.L. Müller and T. Proske</i> | |
| Design and modeling of nanostructured sol-gel titania cement system for environmental applications..... | 216 |
| <i>E. Cerro-Prada, S. García-Salgado, F. Escolano and M.A. Quijano</i> | |
| Dosage of economic self-compacting concrete with low and medium compressive strength..... | 217 |
| <i>G. Rodríguez de Sensale, I. Rodríguez Viacava, R. Rolfi and A. Aguado de Cea</i> | |
| Durability of high volume fly ash concrete used in channel revetment..... | 218 |
| <i>Q. Bing, G. Jianming, S. Yejong, Z. Ping and W. Fang</i> | |
| Economical effect on ultra-high performance concrete by using of coarse aggregates | 219 |
| <i>M. Schneider, S. Ofner, T. Steiner and P. Druml</i> | |
| Effect of internal alkali activation on long-term pozzolanic reaction of fly ash in cement paste..... | 220 |
| <i>T. P. Bui, K. Ootaishi, Y. Ogawa, K. Nakarai and K. Kawai</i> | |
| Effects of phase change material on hydration heat of fly ash and blast-furnace slag concrete | 221 |
| <i>S.J Jang, G.Y Jeong and H.D. Yun</i> | |
| Effects of pozzolanic addition and fibre treatment on mechanical performance of cement based composites reinforced with cellulose fibre nonwovens | 222 |
| <i>J. Claramunt, L.J. Fernández-Carrasco and M. Ardanuy</i> | |
| Efficiency factors of fly ash - a powerful tool for mix proportioning | 224 |
| <i>S. Bhanja</i> | |
| Experimental study on maintenance and conservation for traditional architecture from the standpoint of plaster finishing material..... | 225 |
| <i>K. Oka and M. Tamura</i> | |

| | |
|---|-----|
| Fundamental study on the properties of mortar using Gehlenite clinker as fine aggregate | 226 |
| <i>H. Fujiwara, M. Maruoka, M. Nemoto, K. Yoshikawa and M. Kobayakawa</i> | |
| High performance sustainable mortars | 227 |
| <i>D. Hesselbarth, C. Fiuza and T. Moser</i> | |
| Impact of aluminates on silicates hydration | 228 |
| <i>E. Pustovgar, J. B. d’Espinoze de Lacaille, M. Palacios, A. Andreev, R. K. Mishra and R. J. Flatt</i> | |
| Influence of physicochemical and microstructural properties of TiO ₂ cementitious materials on hydroxyl radicals production and photocatalytic pollution degradation | 229 |
| <i>E. Jiménez-Relinque and M. Castellote</i> | |
| Material properties and application to structure of low carbon high performance concrete using fly ash and blast furnace slag | 230 |
| <i>H. Saito, A. Saito and K. Sakai</i> | |
| Material properties of mineralized foam and its density dependency – a meta-study | 231 |
| <i>A. Gilka-Bötzow, M. Zimmer and E. A. B. Koenders</i> | |
| Mechanical behaviour of concrete using recycled granulated steel | 232 |
| <i>U. M. T. Qadir, K. Islam, A. H. M. M Billah and M. S. Alam</i> | |
| Mechanical properties of fiber reinforced cementitious composites with high amounts of fly ash as cement replacement | 233 |
| <i>A. V. Georgiou and S. J. Pantazopoulou</i> | |
| New permeability reducing admixture for sustainable concrete | 234 |
| <i>G. Ferrari, G. Bianchin, V. Russo, D. Passalacqua, G. Artioli and L. Valentini</i> | |
| Paper as additive in concrete mixtures for low resistance blocks..... | 235 |
| <i>M. Soares, E. Aguiar and G. Gomes</i> | |
| Possible reusing of household ceramic wastes as mineral admixtures in ecological cement/concrete | 236 |
| <i>I. Ding, H. Dong, Y. Zhang and C. Azevedo</i> | |
| Properties of alkali-activated fly ash mortars made with multiple activators | 237 |
| <i>N. Ghafoori, K. Sierra, M. Najimi and M. Sharbaf</i> | |

| | |
|--|-----|
| Properties of high fluidity concrete using fine powder of melt-solidified slag from municipal waste as an admixture | 238 |
| <i>T. Kimura, T. Numao and K. Fukuzawa</i> | |
| Properties of self consolidating concrete containing Natural Pozzolan..... | 239 |
| <i>N. Ghafoori, M. Sharbaf and M. Najimi</i> | |
| Recycled aggregate: compliance with legal requirements | 240 |
| <i>C. Medina Martínez, I. F. Saéz del Bosque, A. Matías Sánchez, B. Cantero Chaparro, E. Asensio de Lucas, M. Frías Rojas and M. I. Sánchez de Rojas</i> | |
| Research on spray type high ductility PVA fiber concrete used for the deep roadway supporting key technology | 241 |
| <i>B. Yuanzhi and G. Shumei</i> | |
| Reuse of waste discarded by the ceramic industry as high quality components of concrete | 242 |
| <i>M.J. Pelufo, N. Salomon, M. Muñoz and P. Serna</i> | |
| Seismic retrofitting of concrete structures in Switzerland: repair instead of demolish. Government's approach to school buildings | 243 |
| <i>F. Ortiz Quintana</i> | |
| Self-compacting concrete made with recovery filler from hot-mix asphalt plants: mechanical properties..... | 244 |
| <i>A. Romero-Esquinas, J.M. Fernández and J.R. Jiménez</i> | |
| Simplifications for considering the contribution of the reinforcement in the compression zone for designing more efficient RC frame elements | 245 |
| <i>A. Faur and A. Puskás</i> | |
| Strength properties and eco-efficiency of low carbon strain-hardening cement composite (SHCC) | 246 |
| <i>S.W. Kim, H.D. Yun, W.S. Park, Y.I. Jang, S.W. Kim, J.W. Lee and Y.I. Nam</i> | |
| Structural behaviour of recycled concrete: mechanical strength, shrinkage and bond strength..... | 247 |
| <i>S. Seara Paz, V. Corinaldesi, B. González Fonteboa and F. Martínez-Abella</i> | |
| Study of buckling of SMA reinforcements in concrete elements | 248 |
| <i>J. Pereiro , J.L. Bonet and A. Navarro</i> | |

Ladle furnace slags of low and high alumina in masonry mortars

I. Vegas^{*†}, T. Herrero[†], D. García[†], A. Santamaría^{††}, J.T. San-José^{††}, J.J. González^{††}

[†]TECNALIA Research & Innovation

c/Geldo, Edificio 700 - Parque Tecnológico de Bizkaia, 48160 Derio (Vizcaya), Spain
Edificio C1, Campus Norte UPC

Email: inigo.vegas@tecnalia.com Web page: <http://www.tecnalia.com>

^{††}University of the Basque Country. Dep. of Mining, Metallurgical and Materials Science
Alameda Urquijo, s/n. 48013 Bilbao (Vizcaya), Spain
web page: <http://www.ehu.es/es/>

ABSTRACT

An important by-product from steelmaking industry is the ladle furnace (white or basic) slag, produced in the secondary or basic refining of steel. This manufacturing process yields two types of basic slag that are either low or high in alumina, depending on the saturation method.

Among other properties, in previous works, have been analyzed their instabilities, mineralogy, hydraulic reactivity and their application in construction sector by their addition in Portland cement matrixes (pastes and masonry mortars). Present research will be focused on the characterization of pastes and masonry mortars (non-structural) containing such by-product as a partial substitution of binders (cement) and fine aggregates.

This investigation will be emphasized on the reactivity of certain compounds at outdoor temperatures such as calcium aluminates, free calcium oxide and free magnesium oxide. In line with this experimental work, different techniques will be used: DRX, TGA, chemical analyses, volumetric stability and a series of controlled hydration reactions. Hence, this research work focuses on the study of such slag in itself and its performance in cement matrixes.

In order to do this, different properties will be studied: mechanical behaviour under compression and flexural loads and durability issues, under weathering ageing, mainly referred to efflorescence and wetting-drying ageing cycles.

Interesting results were achieved by the replacement of 10% and 20% in cement by weight. The white slags with a high content of alumina showed a better physical-chemical performance than mortar designs incorporating high content of silica slag.

Present research concludes that the ladle furnace basic slag can induce slight hydraulic reactivity and that a partial cement replacement, by it lower than 20% by weight, does not negatively affect the mechanical performance and durability in cement masonry mortars.

Keywords: Cement; Durability; Ladle Furnace Slag; Masonry Mortar; Pastes; Shrinkage;

REFERENCES

- [1] J.M. Manso, A. Rodríguez, A. Aragón, J.J. González, “The durability of masonry mortars made with ladle furnace slag”, *Construction and Building Materials*, vol. 25, pp. 3508–3519, (2011).
- [2] J. Papayianni, E. Anastasiou, “Effect of granulometry on cementitious properties of ladle furnace slag”, *Cement and Concrete Composites* vol. 34, pp. 400–407 (2012).
- [3] T. Herrero, “Estudio del efecto de la hidratación de la escoria blanca de acería de HEA: aplicación en pastas y morteros de cemento”. Ph.D. Thesis, University of the Basque Country (UPV/EHU), 2015.

| | | | |
|----------------------------|---------------------------------|----------------------------|---------------|
| Álvarez, S..... | 110 | Bhate, A..... | 86 |
| Adam, J.M. | 98 | Bianchin, G..... | 234 |
| Adrian, A..... | 162 | Billah, A. H. M..... | 232, 251 |
| Aguado de Cea, A..... | 66, 170, 212, 217, 252 | Bing, Q. | 218 |
| Aguiar, E. | 235 | Blanco, A..... | 170, 252 |
| Ahmad, Syed I. | 140 | Bogutsky, V..... | 157 |
| Aiello, M.A. | 156 | Bonet, J.L..... | 248 |
| Aihara, K..... | 168 | Bordonzotti, I..... | 192 |
| Al-Tabbaa, A. | 91 | Branco, F. | 213 |
| Alam, M. S. | 232, 251 | Briseghella, B..... | 112 |
| Alberti, M.G. | 125 | Buffenbarger, J.K..... | 179 |
| Alfaro Tanco, J. A..... | 90 | Bui, T. P..... | 220 |
| Alghamri, R. | 91 | Buitrago, M..... | 98 |
| Almirall, C. | 190 | Cabrera-Madrid, J. A. | 120 |
| Alonso, M.C. | 122 | Calderón, P.A. | 98 |
| Alonso, M.M..... | 161 | Calixto, J. | 250 |
| Alonso-Alonso, M.C. | 138 | Camões, A..... | 131, 151, 213 |
| Alonso-Calvo, R..... | 101 | Cantero Chaparro, B. | 240 |
| Amorim, M. | 151 | Carmona, A. | 189, 191 |
| Andrade, C. | 137 | Carné, I. | 169 |
| Andreev, A..... | 228 | Carvalho, M. | 127 |
| Ann, K. Y..... | 150 | Casaldaliga, P..... | 107 |
| Arakawa, K..... | 185 | Casanovas-Rubio, M..... | 184 |
| Ardanuy, M. | 222 | Castel, A. | 160 |
| Arévalo, M. J..... | 111 | Castellote, M..... | 229, 259 |
| Argiz, C..... | 119, 136 | Castillo, A..... | 259 |
| Ariñez Fernández, F..... | 112 | Castro-Borges, P..... | 120 |
| Arizón Fanlo, J. E..... | 90 | Cavalaro, S..... | 252 |
| Armengou, J. | 184, 196 | Ceh, A. | 175 |
| Artioli, G. | 234 | Centonze, G..... | 156 |
| Asensio de Lucas, E. | 240 | Cerro-Prada, E. | 216 |
| Asprone, D. | 182 | Chae, C.-U..... | 176 |
| Azevedo, C. | 236 | Chiaia, B. | 106, 139 |
| Bahman Zadeh, F..... | 143 | Chindaprasirt, P..... | 123 |
| Balancán-Zapata, M. G..... | 120 | Cho, Y. H. | 158 |
| Balázs, G. L. | 175 | Choi, D. | 123, 176 |
| Bansal, M. | 93 | Cingolani, C..... | 113 |
| Bansal, S..... | 93, 114 | Claramunt, J. | 222 |
| Baričević, A. | 166, 256 | Climent, M.A..... | 154, 187 |
| Barluenga, G. | 103, 165 | Colina, H. | 199 |
| Baroghel-Bouny, V. | 134, 172 | Colombo, I.G. | 118 |
| Bartolac, M..... | 166 | Colombo, M. | 118 |
| Bastons, M. | 196 | Corinaldesi, V..... | 113, 247, 249 |
| Baza, D..... | 137 | Crespo, R. | 257 |
| Bazán, A.M..... | 121 | Cubillo, J. | 96 |
| Begemann, C..... | 167 | Cui, Q..... | 99 |
| Bertin, M. | 134 | Daher, R..... | 207 |
| Bhanja, S. | 224 | Damjanović, D. | 166 |
| | | Dayran, R..... | 162 |

| | | | |
|--------------------------------------|--------------------|------------------------------|----------|
| De Belie, N. | 164 | García-Remesal, M..... | 101 |
| de la Fuente, A..... | 66, 170, | García-Salgado, S..... | 216 |
| | 190, 204, 212, 252 | Gaviria, X. | 254 |
| De Larrard, F..... | 199 | Georgiou, A. V..... | 233 |
| de Schutter, G..... | 126, 195 | Gettu, R. | 198 |
| Dehn, F. | 203 | Ghafoori, N..... | 237, 239 |
| Deng, D. | 126 | Gilka-Bötzwow, A..... | 231 |
| Dhaene, J..... | 164 | Giménez, M. | 165 |
| di Prisco, M..... | 118 | Giménez Vila, J. | 87 |
| Di Tommaso, M. | 192 | Gomes, G. | 235 |
| Díaz, E..... | 162 | Gómez del Pulgar, C..... | 212 |
| Díaz-Bautista, A. | 161 | González, J.J..... | 89 |
| Ding, I. | 236 | González Fonteboa, B..... | 247 |
| Dolado, J.S. | 205 | Gorino, A..... | 106 |
| Donadio, M. | 189 | Goto, S. | 193 |
| Dong, H. | 236 | Groli, G. | 87 |
| Doniak, L. | 127 | Grunewald, S. | 195 |
| Donofrio, M..... | 186 | Guadagnini, M..... | 139 |
| Druml, P..... | 219 | Guerrero, A. | 145 |
| d'Espinose de Lacaillerie, J. B. ... | 228 | Guerrini, G.L..... | 257 |
| Enfedaque, A. | 125 | Gumieri, A..... | 250 |
| Escolano, F. | 216 | Haist, M. | 31, 210 |
| Etxeberria, M. | 200 | Hajek, P. | 180 |
| Fang, W..... | 218 | Hashimoto, K. | 142, 147 |
| Fantilli, A.P. | 106, 139 | Helene, P. | 127 |
| Faur, A. | 159, 245 | Hernández Montes, E. | 138 |
| Fernández, Á. | 122 | Herrero, T..... | 89 |
| Fernández, J.M..... | 113, 244 | Hesselbarth, D. | 227 |
| Fernández Ledesma, E. | 249 | Hirao, H. | 173 |
| Fernández-Carrasco, L.J. | 222 | Hoshino, S..... | 173 |
| Fernández-Ordóñez, D..... | 66, 83, | Hou, L..... | 126 |
| | 90, 101, 204 | Iiboshi, T. | 168 |
| Ferrari, G. | 234 | Imagawa, K..... | 132 |
| Ferreira, R. | 151 | Irles Más, R. | 97 |
| Fiuza, C. | 177, 189, 191, 227 | Ishida, M..... | 149 |
| Flatt, R. J. | 228 | Islam, K..... | 232, 251 |
| Forth, J. P. | 102 | Iuliano, M..... | 112 |
| Frank, D..... | 109, 188 | Iyoda, T. | 92 |
| Frías Rojas, M. | 211, 240, 258 | Jang, S.J..... | 84, 221 |
| Fujiwara, H..... | 226 | Jang, Y.I..... | 246 |
| Fujiyama, A. | 153 | Jansen Van Rensburg, HJ..... | 128 |
| Fukuzawa, K. | 238 | Jarabo Centenero, R. | 138 |
| Furnari, R..... | 139 | Jenkins, KJ | 128 |
| Galé, D. | 121 | Jeong, G.Y..... | 221 |
| Gálvez, A. | 96 | Jia, L.T. | 99 |
| Gálvez, J.C. | 66, 121, 125 | Jianming, G. | 218 |
| García, D..... | 89, 205 | Jiménez, J.R. | 113, 244 |
| García, V. | 205 | Jiménez-Relinque, E..... | 229 |
| García Calvo, J.L. | 122 | Jose, A..... | 162 |

| | | | |
|-------------------------|---------------|----------------------------|---------------|
| Joshaghani, A. | 141 | Maghsoudi, A.A | 171 |
| Jung, H. S. | 150 | Maghsoudi, M..... | 171 |
| Jurado, R..... | 257 | Maity, S..... | 198 |
| Kamali Bernard, S. | 171 | Malaga, K. | 105 |
| Kasuga, A..... | 94 | Malheiro, R. | 131, 151 |
| Kata, K.I. | 94 | Mancini, G. | 174 |
| Kato, E..... | 133, 152 | Mangat, P.S. | 135 |
| Kato, Y. | 133, 152 | Marciniak, A..... | 144 |
| Katz, A..... | 201 | Martínez, I | 259 |
| Kawabata, Y..... | 104 | Martínez Juan, B..... | 97 |
| Kawai, K..... | 153, 173, 220 | Martínez-Abella, F. | 247 |
| Khalil, N. | 207 | Martirena, F. | 162 |
| Kharal, Z. | 124 | Maruoka, M. | 226 |
| Kim, M. J..... | 150 | Matías Sánchez, A. | 240 |
| Kim, S.W. | 84, 246 | Matsuda, N. | 92 |
| Kimura, T. | 238 | Matsuka, T..... | 116 |
| Kobayakawa, M..... | 226 | Matthews, S. L. | 174 |
| Koenders, E. A. B.... | 146, 148, 231 | Medina Martínez, C. .. | 211, 240, 258 |
| Koniorczyk, M. | 144, 194 | Medina Martínez, G..... | 258 |
| Kopecsko, K..... | 175 | Medina Martínez, J.M. | 211 |
| Koyama, A..... | 132 | Mei, H..... | 99 |
| Krolo, J. | 166 | Meira, G..... | 151 |
| Kroviakov, S. | 157 | Menéndez, E. | 119, 136 |
| Kudo, R..... | 116 | Menna, C..... | 182 |
| Kulisch, D..... | 201 | Micelli, F. | 156 |
| Köening, A..... | 203 | Mishra, R. K. | 228 |
| Köllő, G..... | 95 | Mishutin, A. | 157 |
| Köllő, Sz.A..... | 95 | Mishutin, N. | 157 |
| Ladipo, O. | 103 | Moffatt, J. S. | 31, 210 |
| Lample, R..... | 105 | Monteiro, P. J.M..... | 183 |
| Ledesma, E.F. | 113 | Moragues, A. | 119, 136 |
| Lee, J.W. | 246 | Moragues, J.J..... | 98 |
| Lee, S. W..... | 158 | Moser, T. | 227 |
| Leon, R.T..... | 103 | Motahari Karein, S.M..... | 130 |
| Leone, M. | 156 | Muencheberg, U. | 107 |
| Lim, M.-K. | 176 | Muñoz, M. | 112, 242 |
| Linares, P. | 137 | Müller, A.L. | 215 |
| Lisbona, A. | 205 | Müller, H. S. | 31, 210 |
| Liu, Y. | 88 | Müller, U..... | 105 |
| Liu, Z..... | 126 | Nagrath, K..... | 198 |
| Lizarraga, S. | 161 | Najimi, M. | 237, 239 |
| Llano, A. | 100 | Nakarai, K. | 220 |
| Lohaus, L. | 167 | Nakic, D..... | 256 |
| López, A..... | 206 | Nam, Y.I..... | 246 |
| López, C..... | 191 | Naomachi, S. | 133 |
| López, M.P. | 187 | Napolano, L. | 182 |
| Lorenz, E..... | 109, 188 | Navarro, A..... | 248 |
| Luna Molina, F.J..... | 138 | Nehme, S. G..... | 175 |
| Macías, A. | 111 | Nemes, R. | 175 |

| | | | |
|------------------------------|----------|-------------------------------|------------------------|
| Nemoto, M. | 226 | Puertas, F. | 161 |
| Nguyen, K. | 165 | Pujadas, P. | 190 |
| Nguyen Thi, H. | 142 | Puskás, A. | 95, 159, 245 |
| Noguchi, T. | 178 | Pustovgar, E. | 228 |
| Nolli Filho, P. | 250 | Quadir, U. M. T. | 232, 251 |
| Noorhidana, V. A. | 102 | Quijano, M.A. | 216 |
| Noushini, A. | 160 | Quiñones, A. | 250 |
| Numao, T. | 238 | Rajaie, H. | 130 |
| Ofner, S. | 219 | Ramezaniانpour, A. M. | 143, 155 |
| Ogawa, Y. | 153, 220 | Ramezaniانpour, A.A. | 130, 141, 143, 155 |
| Ohno, K. | 149 | Ramón Jiménez, J. | 249 |
| Ojedokun, O.O. | 135 | Ramos, G. | 184 |
| Oka, K. | 225 | Reichard, G. | 103 |
| Omikrine-Metalssi, O. | 134 | Reis, R. | 131, 151 |
| Onghena, S. | 195 | Reyes, E. | 121 |
| Ooishi, H. | 153 | Rheinheimer, V. | 183 |
| Ootaishi, K. | 220 | Ribeiro, M. | 131 |
| Orero, V. | 100 | Río, O. | 165 |
| Ortega, J.M. | 154, 187 | Rodríguez, A. | 165 |
| Ortiz Quintana, F. | 243 | Rodríguez de Sensale, G. | 217 |
| Ortolano González, J.M. | 87 | Rodríguez García, F. | 87 |
| Pacheco, J. | 127 | Rodríguez Viacava, I. | 217 |
| Pacheco, M. C. | 111 | Roeser, F. | 148 |
| Pacios, A. | 203 | Rolfi, R. | 217 |
| Palacios, M. | 228 | Romero-Esquinas, A. | 244 |
| Palaniappan, S. | 198 | Rostami, H. | 141 |
| Palomar, I. | 165 | Roy, S. | 140 |
| Pantazopoulou, S. J. | 233 | Rozas, F. | 259 |
| Papastergiou, P. | 139 | Russo, V. | 234 |
| Pardo, F. | 212 | Röser, F. | 146 |
| Pardo, P. | 200 | Sáez del Bosque, I. F. | 211, 240, 258 |
| Park, W.S. | 84, 246 | Saillio, M. | 134, 172 |
| Passalacqua, D. | 234 | Saito, A. | 230 |
| Patel, A. | 198 | Saito, H. | 230 |
| Pelufó, M.J. | 100, 242 | Sakai, K. ... | 94, 116, 123, 193, 230 |
| Pereiro, J. | 248 | Salmerón, R. | 110 |
| Perez, G. | 145 | Salomon, N. | 242 |
| Pérez Caldentey, A. | 87 | Samimi, K. | 171 |
| Pich-Aguilera, F. | 107 | San Jose, J. | 205 |
| Pilakoutas, K. | 139 | San-José, J.T. | 89 |
| Pilvar, A. | 130 | Sánchez, I. | 154, 187 |
| Ping, Z. | 218 | Sánchez, J. | 205 |
| Pompeu-Santos, S. | 115 | Sánchez, M. | 122 |
| Pons, A. | 145 | Sánchez de Rojas, M. I. | 211, 240, 258 |
| Pourebrahimi, M. R. | 143 | Sánchez Lavin, J.R. | 83 |
| Pradelle, S. | 172 | Sánchez Moreno, M. | 138 |
| Prakasan, S. | 198 | | |
| Proske, T. | 215 | | |
| Prota, A. | 182 | | |

| | | | |
|---------------------------|--------------------|-------------------------|---------------|
| Sanjuán, M. A. | 136 | Unluer, C. | 85 |
| Santamaría, A. | 89 | Urano, T. | 116 |
| Sato, R. | 153 | Urushizaki, N. | 104 |
| Schneider, M. | 219 | Valcke, S. | 96 |
| Schneider, M.J. | 42 | Valdivieso, R. | 83 |
| Scrivener, K. | 162, 202 | Valentini, L. | 234 |
| Seara Paz, S. | 247 | Van Belleghem, B. | 164 |
| Seki, F. | 116 | Van Hoorebeke, L. | 164 |
| Sepulcre, A. | 165 | Van Tittelboom, K. | 164 |
| Serna, P. | 100, 111, 169, 242 | VanGeem, M. | 117 |
| Serna, S. | 100 | Varga, C. | 161 |
| Sharbaf, M. | 237, 239 | Vegas, I. | 89, 205 |
| Sharma, P K. | 93 | Vera-Agulló, J. | 105 |
| Shearer, C. | 253 | Vogel, M. | 31 |
| Sheikh, S. | 124 | Vogt, O. | 148 |
| Shibata, T. | 94 | Vouk, D. | 256 |
| Shumei, G. | 241 | Vrijders, J. | 55 |
| Sierra, K. | 237 | Vyncke, J. | 55 |
| Silfwerbrand, J. | 181 | Witkowski, H. | 194 |
| Silva, C. | 250 | Yadav, R. | 112 |
| Silva, N. | 105 | Yamada, M. | 104 |
| Singh, S K. | 93, 114 | Yang, E.H. | 88 |
| Soares, M. | 235 | Yejiog, S. | 218 |
| Someya, N. | 152 | Yepes, V. | 206 |
| Steindlberger, E. | 148 | Yokota, H. | 142, 147, 193 |
| Steiner, S. | 215 | Yoshikawa, K. | 226 |
| Steiner, T. | 219 | Yuanzhi, B. | 241 |
| Stirmer, N. | 256 | Yun, H.D. | 84, 221, 246 |
| Sukontasukkul, P. | 123 | Yun, K. K. | 158 |
| Sun, Z.M. | 99 | Zahedi, M. | 155 |
| Taguchi, N. | 147 | Zhang, P. | 99 |
| Tamura, M. | 185, 225 | Zhang, P.G. | 99 |
| Tanabe, S. | 116 | Zhang, Y. | 236 |
| Tanaka, S. | 173 | Zhang, Y.M. | 99 |
| Tarelho, L. | 213 | Zimmer, M. | 231 |
| Tavassoli, A. | 124 | Zimmermann, A. | 146 |
| Tebar, A. | 189 | Zimmermann, J. | 177 |
| Teixeira, E. | 213 | Zolfagharnasab, A. | 143 |
| Tenorio, J. A. | 110 | | |
| Tobon, J.I. | 254 | | |
| Torres-Acosta, A. A. | 120 | | |
| Torres-Gómez, A.I. | 113 | | |
| Touma, A. | 207 | | |
| Touma, T. | 207 | | |
| Tremiño, R.M. | 154 | | |
| Ueda, T. | 168 | | |
| Ueno, A. | 149 | | |
| Uji, K. | 149 | | |
| Ukrainczyk, N. | 148 | | |

Platinum Sponsor



Gold Sponsor



Supporting Organizations

