



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

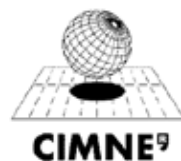
Albert de la Fuente

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
S. Serna, P. Serna, M.J. Pelufo, V. Orero and A. Llano

A case of study for embedding RFID tags in precast concrete 101
R. Alonso-Calvo, M. García-Remesal and D. Fernández-Ordóñez

An experimental study on precast concrete beam-to-column connection using interlocking bars. 102
V. A. Noorhidana and J. P. Forth

Cement based façades for mid-rise commercial sustainable and resilient buildings 103
G. Barluenga, O. Ladipo, G. Reichard and R.T. Leon

Development of environment-friendly blended cement and application of the cement to a building construction project 104
M. Yamada, N. Urushizaki and Y. Kawabata

Durability of concrete exposed to sea water at early age: floating dock method for construction of caissons 105
J. Vera-Agulló, R. Lample, N. Silva, U. Müller and K. Malaga

Eco-mechanical analysis of two lightweight fiber-reinforced cement-based composites 106
A.P. Fantilli, A. Gorino and B. Chiaia

Innovative precast concrete structural floor as a part of a HVAC System. The real application experience in a building..... 107
F. Pich-Aguilera, P. Casaldaliga and U. Muencheberg

Lessons learned from a life-cycle assessment of north american precast concrete 109
D. Frank and E. Lorenz

Reducing energy needs in residential buildings in the Spanish climate through an innovative daily storage based solution..... 110
S. Álvarez, J. A. Tenorio and R. Salmerón

Refuse cork as lightweight aggregate for more sustainable masonry units..... 111
M. C. Pacheco, M. J. Arévalo, A. Macías and P. Serna

Retrofitting with an IAB concept: a sustainable solution 112
M. Muñoz, F. Ariñez Fernández, R. Yadav, M. Iuliano and B. Briseghella

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. Kopecsko</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. Yejiang, 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’Espinose de Lacaillerie, 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>	

Study of environmentally friendly bedding mortars prepared with recycled aggregates and biomass ash.....	249
<i>E. Fernández Ledesma, J. Ramón Jiménez and V. Corinaldesi</i>	
Study of mechanical properties of high performance concrete with addition of stabilized nanosilica.....	250
<i>P. Nollí Filho, A. Gumieri, J. Calixto, C. Silva and A. Quiñones</i>	
Sulphate resistance of concrete containing recycled granulated steel as a partial replacement of fine aggregate.....	251
<i>U. M. T. Qadir, K. Islam, A. H. M. M. Billah and M. S. Alam</i>	
Sustainability assessment of different reinforcement alternatives for precast concrete segmental linings.....	252
<i>A. de la Fuente, A. Blanco, S. Cavalaro and A. Aguado de Cea</i>	
The changing nature of fly ash and its reuse	253
<i>C. Shearer</i>	
The effect of particle size distribution on early age chemical shrinkage of cement pastes	254
<i>X. Gaviria and J.I Tobon</i>	
Use of incinerated sewage sludge ash in concrete production.....	256
<i>N. Stirmer, A. Baričević, D. Nakic and D. Vouk</i>	
Use of photocatalytic cements for heavy duty urban roads	257
<i>G.L. Guerrini, R. Crespo and R. Jurado</i>	
Valorisation of granite chippings in the design of new cement matrices.....	258
<i>G. Medina Martínez, I. F. Saéz del Bosque, M. Frías Rojas, M. I. Sánchez de Rojas and C. Medina Martínez</i>	
Valorization of a waste into cementitious material: dredged sediment for production of self compacting concrete	259
<i>F. Rozas, A. Castillo, I. Martínez and M. Castellote</i>	

Sustainability Assessment of Concrete with Recycled Concrete Aggregates ICCS16

D. García^{*}, A. Lisbona^{*}, J.S. Dolado^{*}, I. Vegas^{*}, J.T. San-José[†] And V. García^{*}

^{*} Sustainable Construction Unit, TECNALIA Research and Innovation,
48160 - Derio, Spain

e-mail: david.garcia@tecnalia.com - web page: <http://www.tecnalia.com>

[†] Dep. Mining, Metallurgical and Materials Science,

University of the Basque Country (UPV/EHU), 48013 – Bilbao, Spain

e-mail: josetomas.sanjose@ehu.eus - web page: <http://www.ehu.eus/es/web/ingeniaritza-bilbao>

ABSTRACT

Concrete is the most widely used construction material. It causes a substantial environmental impact, derived from CO₂ emission, mainly during Portland cement manufacture because of the calcination of the limestone and the fuel consumption. There are several strategies for reducing the amount of Portland cement, e.g. using alternative clinkers, like alkali-activated cements or belite cements, or partial replacement of Portland by secondary cementitious materials, like fly ash, natural pozzolans and/or limestone.

Aggregates, as the largest component of concrete, can also have a significant effect on the environmental cost of the concrete mixture. The choice of aggregate influences a wide range of sustainability attributes and as with most aspects of sustainability there are frequently tradeoffs between one choice and another. Aggregate materials of some kind are usually available locally and making best use of this can be preferable for reducing transport related energy use and carbon emissions as well as keeping expenditures in the local economy.

In many countries recycled concrete aggregates (RCA) have been proven to be practical for low-strength concretes and to a limited extent for some structural grade concrete. When structures made of concrete are demolished or renovated, concrete recycling is an increasingly common method of utilizing the rubble. Using RCA for new concrete reduces the demand for virgin aggregate conserving natural resources, while minimizing the waste stream by diverting demolished material from landfill. However each case should be individually evaluated and transport and recycling process (sorting, crushing and sieving) must be taken into account.

This paper presents a review of the general strategies for reducing concrete environmental impact and a real comparative LCA evaluation of two types of aggregate for precast concrete elements, one natural and one recycled.

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 Lacaille, 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

