Wednesday, October 21, 2015

8:00 – 9:30 am  Conference registration
9:30 – 9:40  Conference related issues  S. Lackner, Austria  voestalpine Stahl GmbH
9:40 – 9:50  Welcome by voestalpine  W. Neubauer, Austria  Managing director, voestalpine Stahl GmbH
9:50 – 10:00  Opening by the Chairman  H. Motz, Germany  EUROSLAG, The European Slag Association, Duisburg

**Topic 1: Legal and Standardization Issues (Room A)**  
(Chairman: Claus Geiger, voestalpine Stahl GmbH)

10:00 – 10:15  Release of dangerous substances from construction products into soil and ground-water – a status report on tests methods developed by CEN/TC 351/WG1  U. Wiens, Germany  German Committee for Structural Concrete, Berlin

10:15 – 10:30  Resource efficiency and environmental protection: are we losing track of sustainability?  G. Endemann, Germany  Steel Institute VDEh, Düsseldorf

10:30 – 10:45  How environmentally compatible is steel slag? Applications to be benchmarked  H. Schuster, Austria  Greenpeace Austria

10:45 – 11:00  The new Austrian ordinance on recycling of aggregates with emphasis on steel slags: a status report  J. Kraus, Austria  Federal Ministry of Agriculture, Forestry, Environment and Water Management, Vienna

11:00 – 11:15 am  Using steel slag aggregate in road construction: a field report  T. Hittler, Austria  Teerag Asdag
Wednesday, October 21, 2015
Room A, Topic 1

11:15 – noon    Round table discussion

G. Endemann, Germany
Steel Institute VDEh,
Düsseldorf

J. Kobler, Austria
Government Upper-Austria

H. Schuster, Austria
Greenpeace

T. Hittler, Austria
Teerag Asdag

J. Prammer, Austria
voestalpine AG

noon – 1:00 pm    Lunch

Topic 2a: Research and Development (Room A) –
Treatment of Slags (Chairman: Hans Kobesen)

1:00 – 1:15 pm   Factors of influence during and after
the electric steel making process:
characterization and optimization of
electric arc furnace slag

G. Geißler, Germany
Max Aicher Umwelt GmbH,
Piding

1:15 – 1:30 pm   Potential in iron and steel slags with
the use of in situ measurements
and heat recovery

F. Firsbach, Germany
Department of Ferrous
Metallurgy (IEHK)
RWTH Aachen University

1:30 – 1:45 pm   Dry slag granulation with
heat recovery

A. Fleischanderl, UK/Austria
Primetals plc

1:45 – 2:00 pm   The development of Baosteel slag
short flow (BSSF)

H. Jue, China
Shanghai Baosteel Energy
Service Co., Ltd.

2:00 – 2:15 pm   The application and breakthrough
of BOF slag modification technique
in CSC

Y.-H. Tseng, Taiwan
China Steel Corporation

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Euroslag 2015

Wednesday, October 21, 2015
Room A, Topic 2a

2:15 – 2:30 pm  Blast furnace slag as functional fillers in polymer compounds
                A. Mostafa, Austria
                Polymer Competence Center Leoben

2:30 – 3:00     Discussion

3:00 – 3:30     Coffee break

3:30 – 3:45     Development of continuous blast furnace slag Solidification process for low absorption coarse
                H. Tobo, Japan
                JFE Steel Corporation

3:45 – 4:00     Modelling tools for improved recovery of metal and high quality slag
                E. Nagels, Belgium
                InsPyro NV, Leuven

4:00 – 4:15     Automatic liquid BOF slag measurement with LIBS – first experiences
                K. Pilz, Austria
                voestalpine Stahl GmbH

4:15 – 4:30     LD-slag aging: change of chemical and physical properties and the impact on road construction
                F. Weiss, Austria
                University of Technical Vienna

4:30 – 4:45     Valorization of steel slag as a thermal energy storage material for industrial heat storage applications
                I. Ortega, Spain
                CIC energigune, Miñano

4:45 – 5:15     Discussion

5:30            Departure from the Conference Centre to the hotels

7:30 pm         Departure from the hotel to the restaurant
Wednesday, October 21, 2015

**Topic 2b: Research and Development (Room B) – Cement and Concrete application (Chairman: Andreas Ehrenberg)**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter/Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:00 – 1:15 pm</td>
<td>Ferrous slags: a true contribution to low-carbon binders and concretes?</td>
<td>A. Ehrenberg, Germany FEhS – Building Materials Institute, Duisburg</td>
</tr>
<tr>
<td>1:15 – 1:30</td>
<td>More than 65% of slag in composite cement makes it sulfate resistant – really?</td>
<td>W. Matthes, Switzerland Holcim Technology Ltd, Holderbank</td>
</tr>
<tr>
<td>1:30 – 1:45</td>
<td>New perspectives in the use of electric arc furnace slag as coarse aggregate for structural concrete</td>
<td>F. Faleschini, Italy University of Padova</td>
</tr>
<tr>
<td>1:45 – 2:00</td>
<td>Analysis of the application of ladle furnace slags from steel-works, of low and high alumina, in masonry mortars</td>
<td>I. J. V. Ramiro, Spain TECNALIA-Sustainable Construction</td>
</tr>
<tr>
<td>2:00 – 2:15</td>
<td>A real-world experience of valorization of steel slags in the construction sector, two needs and a successful solution</td>
<td>F. Rancaño Lejarraga, Spain Áridos Siderurgicos Andaluces (Asidan), Sevilla</td>
</tr>
<tr>
<td>2:15 – 2:30</td>
<td>Development of high-density steel fiber Reinforced concrete with EAF slag aggregates for radiation shielding applications</td>
<td>M. Papachristoforou, Greece Laboratory of Building Materials, Aristotle University of Thessaloniki</td>
</tr>
<tr>
<td>2:30 – 3:00</td>
<td>Discussion</td>
<td>V. Feldrappe, Germany FEhS – Building Materials Institute, Duisburg</td>
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<tr>
<td>3:00 – 3:30</td>
<td>Coffee break</td>
<td>V. Feldrappe, Germany FEhS – Building Materials Institute, Duisburg</td>
</tr>
<tr>
<td>3:30 – 3:45</td>
<td>Application of ground granulated blast furnace slag as concrete additive in Germany: the k-value concept of DIN EN 206</td>
<td>V. Feldrappe, Germany FEhS – Building Materials Institute, Duisburg</td>
</tr>
<tr>
<td>3:45 – 4:00 pm</td>
<td>The use of ground granulated blast furnace slag as a concrete addition: performance concepts of the European concrete standard EN 206</td>
<td>V. Feldrappe, Germany FEhS – Building Materials Institute, Duisburg</td>
</tr>
</tbody>
</table>
**Wednesday, October 21, 2015**
Topic 2b, Room B

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter and Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00 – 4:15 pm</td>
<td><strong>Performance of self-compacting concrete containing EAF slag as aggregate</strong></td>
<td><strong>A. Santamaria, Spain</strong> Faculty of Engineering – ETSI Bilbao (UPV/EHU)</td>
</tr>
<tr>
<td>4:15 – 4:30</td>
<td>Physical properties of non-opc mortar using blast furnace slag</td>
<td><strong>M. Song, Korea</strong> Kang Won National University</td>
</tr>
<tr>
<td>4:30 – 4:45</td>
<td><strong>A new process for slags from steelmaking for metal recovery and utilization in the cement industry</strong></td>
<td><strong>G. Wimmer, Austria/Germany</strong> Primetals, Linz</td>
</tr>
<tr>
<td>4:45 – 5:15</td>
<td>Discussion</td>
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<tr>
<td>5:30</td>
<td>Departure from the Conference Centre to the hotels</td>
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<tr>
<td>7:30 pm</td>
<td>Departure from the hotel to restaurant</td>
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**Thursday, October 22, 2015**

**Topic 3: Optimization of Products and their Application**
(Chairman: Heribert Motz)

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Presenter and Location</th>
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<tbody>
<tr>
<td>9:00 – 9:15 am</td>
<td><strong>Utilization of steelmaking slag in Japan and recent progress toward soil amendment</strong></td>
<td><strong>Xu Gao, Japan</strong> Tohoku University</td>
</tr>
<tr>
<td>9:15 – 9:30</td>
<td><strong>Use of iron and steel slag in Japan: the state of the art</strong></td>
<td><strong>T. Isawa, Japan</strong> Nippon Slag Association, Tokyo</td>
</tr>
<tr>
<td>9:30 – 9:45</td>
<td><strong>Challenges contemporizing Australian Standards: Supplementary Cementitious Materials</strong></td>
<td><strong>C. Heidrich, Australia</strong> Australasian Slag Association</td>
</tr>
<tr>
<td>9:45 – 10:00 am</td>
<td><strong>How to use iron and steel slags: a German view</strong></td>
<td><strong>R. Bialucha, Germany</strong> FEhS – Building Materials Institute, Duisburg</td>
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<tr>
<td>Time</td>
<td>Session</td>
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<tr>
<td>10:00 – 10:15 am</td>
<td>Innovative use of BOF slag in agriculture by enrichment with phosphorus</td>
<td>P. Drissen, Germany</td>
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<tr>
<td>10:15 – 10:30</td>
<td>Impact of long-term application of blast furnace and steel slags as liming materials on soil fertility and crop yields</td>
<td>A. Morillon, France</td>
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<tr>
<td>10:30 – 10:45</td>
<td>Discussion</td>
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<td>10:45 – 11:15</td>
<td>Coffee break</td>
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<tr>
<td>11:15 – 11:30</td>
<td>Ladle slag: usage as sealing material</td>
<td>K. Arlt, Germany</td>
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<tr>
<td>11:30 – 11:45</td>
<td>Porous asphalt mixtures containing ladle furnace slag</td>
<td>M. Skaf, Spain</td>
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<tr>
<td>11:45 – 12:00</td>
<td>Road asphalt performance properties using LD-slag</td>
<td>J. Grönniger, Austria/Germany</td>
</tr>
<tr>
<td>12:00 – 12:15</td>
<td>Pavement solutions for low-volume roads using steel slags</td>
<td>V. Ortega-López, Spain</td>
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<tr>
<td>12:15 – 12:30</td>
<td>The actual safety performance of steel slag asphalt</td>
<td>N. Jones, UK</td>
</tr>
<tr>
<td>12:30 – 12:45</td>
<td>Laboratory and field evaluation of hot-mix asphalt with basic oxygen furnace slag</td>
<td>J.S. Chen, Taiwan</td>
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<tr>
<td>12:45 – 1:00 pm</td>
<td>Discussion</td>
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<tr>
<td>1:00 – 2:00</td>
<td>Lunch</td>
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<tr>
<td>2:00 – 2:15</td>
<td>New recycled aggregates with enhanced performance for railway track bed and form layers</td>
<td>C. Saborido, Spain</td>
</tr>
<tr>
<td>2:15 – 2:30 pm</td>
<td>The effect of chemical composition, microstructure and geometrical features on leaching behavior of electric arc furnace (EAF) carbon steel slag</td>
<td>D. Mombelli, Italy/France</td>
</tr>
</tbody>
</table>
Thursday, October 22, 2015

Topic 3

2:30 – 2:45 pm  V leaching in EAF slags
F. Cirilli, Italy
Centro Sviluppo Materiali SpA, Rom

2:45 – 3:00  New applications for an aluminum slag byproduct
H. Epstein, France
RVA, Les Islettes

3:00 – 3:15  Study of leaching process of EAF steelmaking dust with sulfuric acid
M. Sharaf, Egypt
Ezz Steel Company, Sadat city

3:15 – 3:30  Automated sorting of refractory waste for high value recycling
L. Horckmans, Belgium
VITO NV, Mol

3:30 – 4:00  Discussion

4:00 – 4:10  Closing remarks of the Chairman

4:10 – 4:40  Closing drinks

Thursday, October 22, 2015
Room A

4:40 – 5:30  Workshop RFCS: project utilization of EAF slag („SLACON“)
D. Algermissen, Germany
F EhS – Building Materials Institute, Duisburg

5:40 pm  Departure from conference centre to the hotels

Friday, October 23, 2015

8:45 am  Arrival at the steel plant of voestalpine Stahl GmbH, Linz
Assignment during registration

9:00  1st plant tour: group 1 (50 participants)
Assignment during registration

9:15  2nd plant tour: group 2 (50 participants)
Assignment during registration

9:30  3rd plant tour: group 3 (50 participants)
Assignment during registration

11:30 am  Small farewell lunch
Assignment during registration
Analysis of the application of ladle furnace slags from steel-works, of low and high alumina, in masonry mortars

\(^1\)TECNALIA-Sustainable Construction (SPAIN), \(^2\)UPV/EHU – ETSI Bilbao (SPAIN), \(^*\)Corresponding author

Abstract

Ladle Furnace (basic) Slag (LFS) by-products from the steel industry are generated after the basic refining of steel. This manufacturing process yields two types of LFS that are either low or high in alumina, depending on the saturation method. Over the past decade, the hydraulic reactivity of LFS, among its other properties, has been exploited in the construction sector by the addition of LFS fines in Portland cement matrixes (pastes and masonry mortars). This research work focuses on two aspects: the study of LFS in itself and the assessment of its performance in cement matrixes. To do so, a characterization of LFS is performed by DRX, TGA, and chemical analyses. Moreover, its volumetric stability and a series of controlled hydration reactions are studied. Our experimental studies of LFS in cement matrixes involve the preparation of cement pastes and (non-structural) masonry mortars, to analyse their volumetric instabilities and shrinkage. In these studies, masonry mortar designs in which under 20% of the cement by weight was replaced by LFS with a high content of alumina showed a better physical-chemical performance than mortar designs incorporating LFS with a high content of silica.
The CEM I mortars, with a partial substitution of EB1, improved their mechanical responses under compression loads, when compared with CEM II and lime filler mixes.

Interestingly, a dimensional variation of the cement mortars with 10% EB1 and EB2 in substitution of type I cement was observed in relation to mortar shrinkage analysis.

Slag mortars are expansive. After 28 days the EB1 and EB2 mortars presented values of 0.09 mm/m and 0.05 mm/m, respectively. After 75 days the expansion values stabilized in values of 0.120 mm/m for EB1 and 0.08 mm/m for EB2. The average expansion value was 0.1 mm/m for both slags and could partially compensate the expected shrinkage of the dry mortars, at around 0.5 mm/m.

5 Conclusions

- This paper has mainly analysed the characterization and stabilisation of EB1 and EB2 and the corresponding pastes and masonry mortars containing LFS in partial substitution of cement.
- The conclusions are that the physical-chemical performance of high-alumina LFS is better than the physico-chemical performance of high-silica LFS. The LFS should not be wetted.
- Ladle furnace basic slag can induce slight hydraulic reactivity. Partial replacement of cement by ladle furnace (basic) slag under 20% by weight of cement has no negative effect on mechanical performance and shrinkage.

Acknowledgements

We express our gratitude to both the Basque Regional Government (IT781-13 Research Group) and the Spanish Ministry of Science and Innovation (BIA2014-55576-C2-2-R), as well as to the Iñaki Goenaga Foundation for financing this research work. It would not have been possible without the generosity of Arcelor Mittal and Morteros and Revocos Bikain, the companies which supplied the materials.