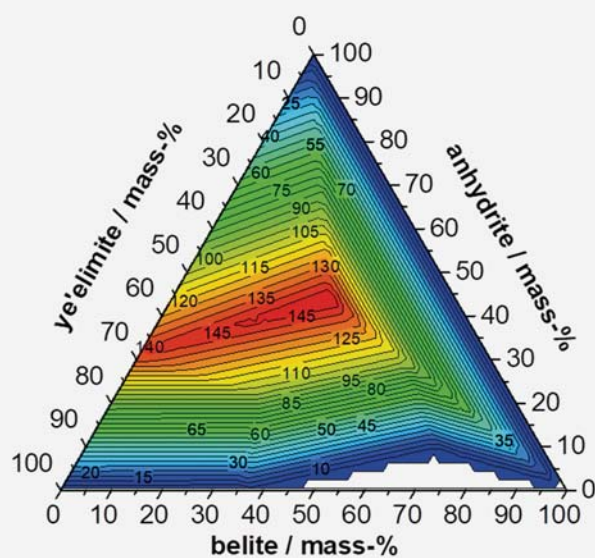




INTERNATIONAL WORKSHOP ON

Calcium sulfoaluminate cements



Theoretical amount of ettringite calculated by thermodynamic modelling
Source: © F. Winnefeld

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TABLE OF CONTENTS

Preface	4
Keynote lectures	7
Belite-ye'elimite-ferrite (BYF) cements as potential low-carbon alternatives to Portland cements: current limitations and research perspectives <i>Gartner E.M., Imperial College, London (UK)</i>	7
Clinkering of calcium sulfoaluminate clinkers: polymorphism of ye'elimite <i>de la Torre A.G., University of Malaga (ESP)</i>	8
Progress and future perspectives of CSA cements in China <i>Sui T., Sinoma Research Institute, Beijing (CHN)</i>	9
Potential of calcium sulfoaluminate cements for stabilization / solidification of radioactive waste <i>Cau Dit Coumes C., CEA Marcoule, Bagnols-sur-Cèze (FRA)</i>	10
Lectures and poster contributions in alphabetical order of the presenting author	11
Overview of recent BYF studies <i>Albert B., LafargeHolcim R&D Center, St Quentin Fallavier (FRA)</i>	11
Advanced synchrotron studies of ye'elimite-based cement pastes <i>Aranda M.A.G., ALBA Synchrotron, Barcelona (ESP)</i>	12
Optimize ettringite formation as a way to reduce environmental footprint <i>Berger S., Kerneos, Vaulx-Milieu (FRA)</i>	13
CSA and slag: towards CSA composite binders <i>Bertola F., Buzzi Unicem, Casale Monferrato (ITA)</i>	14
Belitic calcium sulfoaluminate cement in America: a 60-year history of development, chemistry, and applications <i>Bescher E., University of California, Los Angeles, CA (USA)</i>	15
Study of calcium sulfoaluminate cements and Portland cement blends <i>Bolaños-Vásquez I., National University of Colombia, Medellin (COL)</i>	16
A possible alternative to alkali activation in low clinker cementitious materials <i>Boscaro F., ETH Zürich (CH)</i>	17
Characterisation and hydration of ye'elimite containing cements - effect of iron <i>Bullerjahn F., HeidelbergCement Technology Center, Leimen (GER)</i>	18
Strategies to extend calcium sulfoaluminate cement concrete working time <i>Burriss L.E., Ohio State University, Columbus, OH (USA)</i>	19
Hydration of a calcium sulfoaluminate clinker with ternesite <i>Carmona-Quiroga P.M., Instituto de Ciencias de la Construcción Eduardo Torroja, Madrid (ESP)</i>	20
Early-age expansion of ordinary Portland cement-calcium sulfoaluminate cement blends <i>Chaunsali P., Massachusetts Institute of Technology (MIT), Cambridge, MA (USA)</i>	21
Comparison of different preparation methods for ye'elimite clinker synthesis <i>Chitvoranund N., EPFL, Lausanne (CH)</i>	22
Study of the volume change properties of different OPC/CSA mortar systems <i>Colonna D., University of Salento, Lecce (ITA)</i>	23

CLINKERING OF CALCIUM SULFOALUMINATE CLINKERS: POLY-MORPHISM OF YE'ELIMITE

De la Torre, A.G.¹⁾, Aranda, M. A. G.^{1,2)}, Santacruz, I.¹⁾, Cuesta, A.¹⁾, Zea-Garcia, J.D.¹⁾, Londono-Zuluaga, D.¹⁾, García-Maté, M.³⁾, Álvarez-Pinazo, G.³⁾

¹⁾ Departamento de Química Inorgánica. Universidad de Málaga, 29071 Málaga, Spain

²⁾ ALBA Synchrotron, Carrer de la Llum 2-26. 08290 Cerdanyola del Vallès, Barcelona, Spain

³⁾ X-Ray Data Services S.L., Edificio de Institutos Universitarios, Oficina 11C, C/ Severo Ochoa 4, Parque Tecnológico de Andalucía, 29590 Málaga, Spain.

Corresponding author: De la Torre, A.G. email: mgd@uma.es

The manufacture of CSA cements is more environmentally friendly than that of OPC as it releases less CO₂. This reduction depends on CSA composition and is due to three factors: i) less emissions from decarbonation in the kilns; ii) lower clinkering temperature, consequently less fuel is needed, and iii) it is easier to grind, implying a depletion in indirect emissions.

CSA cements are prepared by mixing the clinker with different amounts of calcium sulfate as a set regulator. Their main performances are fast setting time (followed by a rapid hardening), good-chemical resistance and, depending on the amount of the added sulfate source they can work as shrinkage controllers.

CSA cements present a wide range of phase assemblages, but all of them contain over 50 wt% of ye'elimite (C₄A₃S̄) jointly with belite (C₂S), tetracalcium aluminoferrite (C₄AF) and other minor components such as CA, C₃S̄, C₃H₂ and so on [1]. Ye'elimite is also included (~25 wt%) in BYF (Belite-Ye'elimite-Ferrite) or BAY (Belite-Alite-Ye'elimite) clinkers.

Ye'elimite has a sodalite type structure with general composition, M₄[T₆O₁₂]X. Stoichiometric ye'elimite crystal structure at room temperature will be described in detailed. The role of different amounts of minor elements on the synthetic procedure and crystal structures will be also presented [2,3].

This keynote will be also focused on a revision of the effect of raw materials on the mineralogical composition of CSA, BYF and BAY. Specifically, the role of main elements contents in the ye'elimite formation in these systems will be described. Moreover, the effect of minor elements on the polymorphism of both ye'elimite and belite, especially on BYF and BAY clinkers, will be presented [4,5,6].

References

- [1] Aranda, M.A.G.; De la Torre, A.G. Sulfoaluminate cement in Eco-efficient concrete; Pacheco-Torgal, F. Ed.; Jalali, S. Ed. Labrincha, J. Ed., Woodhead Publ. Cambridge. (2013) 488–522.
- [2] Cuesta, A.; De La Torre, A.G.; Losilla, E.R.; Peterson, V.K.; Rejmak, P.; Ayuela, A.; Frontera, C.; Aranda, M.A.G. Structure, atomistic simulations, and phase transition of stoichiometric ye'elimite, Chem. Mater. 25 (2013) 1680–1687.
- [3] Cuesta, A.; De La Torre, A.G.; Losilla, E.R.; Santacruz, I.; Aranda, M.A.G. Pseudocubic crystal structure and phase transition in doped ye'elimite, Cryst. Growth Des. 14 (2014) 5158–5163.
- [4] Álvarez-Pinazo, G.; Santacruz, I.; León-Reina, L.; Aranda, M.A.G.; De la Torre, A.G. Hydration Reactions and Mechanical Strength Developments of Iron-Rich Sulfobelite Eco-cements, Ind. Eng. Chem. Res. 52 (2013) 16606–16614.
- [5] Londono-Zuluaga, D.; Tobon, J.I.; Aranda, M.A.G.; Santacruz, I.; De La Torre, A.G. Clinkering and hydration of Belite-Alite-Ye'elimite cement, Cem. Concr. Compos. 80 (2017) 333–341.
- [6] Zea-Garcia, J.D.; Aranda, M.A.G.; Santacruz, I.; De La Torre, A.G. Synthesis and scaled-up of standard and active Belite-Alite-Ye'elimite clinker (BAY). Cem. Concr. Res. submitted (2018).