

Editorial

Fred Glasser Cement Science Symposium

K. L. Scrivener and D. E. Macphee

EPFL, Switzerland; University of Aberdeen, UK

Fred Glasser celebrated his 80th birthday in May, 2009. To mark this event, and in recognition of his outstanding contribution to cement science over several decades, a three-day conference was held in Aberdeen in June, 2009, structured around six key themes in which Fred has made significant impact towards our understanding of the relevant chemistry: cement clinker, novel cement systems (sustainability), hydration and durability, thermodynamic modelling, cements for waste management and hydrate characterisation.

Three papers were presented in each of the conference sessions and each session, dedicated to a conference theme, was co-ordinated by a session facilitator who ensured continuity and connectivity between the relevant oral presentations, as well as facilitating discussion contributions from the wider conference. Consequently, it has been possible to provide a single paper from each session which comprises this special issue of *Advances in Cement Research*. In some cases, presenters/facilitators were former students of Fred but in all cases, participants in the conference were his close research colleagues and friends over his many years of research in this field.

The conference began with an overview of cement clinkering. The session, chaired by Hugo Boleo Arceo, addressed developments in clinkering from historical perspectives, through current state-of-the-art to future prospects, and is the basis of the paper by Herfort *et al.* (2010). Its focus is on the optimisation of alite formation and it illustrates the thermodynamic and kinetic impacts of minor constituent additions which have led to increased technological and environmental performance, higher production output and product consistency.

Combined, these factors have brought convergence to the composition of clinkers from different producers, such that today, most developments in clinker production are focussed on factors such as kiln efficiency, kiln emissions and the accommodation of alternative fuels.

Reducing the environmental impact of cement production provided the framework for the session on novel cement systems, chaired by John Sharp, which addressed alternatives to Portland cement. Whilst the emphasis was on systems enabling a reduction in carbon dioxide emissions, the need to provide comparable in-service performance was also recognised and so attention was given to established alternatives such as calcium aluminate and calcium sulphoaluminate binders. The growing interest in 'geopolymer' systems was also reviewed leading to a general description of the acid-base chemistry underlying all cementing reactions but with a specific focus on the alkali-activation of aluminosilicates. The paper by Sharp *et al.* (2010) summarises the presentations, posters and discussion related to this session.

Session 3, chaired by Ole Mejlhede Jensen, addressed cement hydration and durability. The structure of this session was based on recent findings related to understanding the hydration process and to the durability of the final products. The paper by Hooton *et al.* (2010) focuses on specific durability issues such as alkali-silica reaction, reinforcement corrosion and delayed ettringite formation, which involves ion transport through porosity, limited by ion binding in hydration products.

Thermodynamic modelling of phase stability and distribution in cement-based systems has progressed

substantially in recent decades due to validation against direct experimental observations in both the laboratory and in the field. Coupling these with transport models offers considerable advances in interpretation and prediction of materials durability, but the time to achieve equilibrium can limit the applicability of exclusively thermodynamic approaches. The introduction of reaction kinetic modelling capability offers considerable advantages and these topics provided the content of Session 4 of the conference, chaired by Urs Berner, and are reflected in the paper by Lothenbach *et al.* (2010).

The waste management theme of Session 5, chaired by David Read, has for many years been a key area for cement chemistry research. Applications range from nuclear wastes to municipal waste incinerator ash, mine sites, etc. Radioisotopes from spent nuclear fuel have been incorporated in cement clinker phases and aqueous solutions of inorganic wastes (both radioactive and non-radioactive) have been used to hydrate cement powders with the intention of the hazardous waste ions being 'immobilised' in the hydration products. Retention mechanisms for key heavy metal and metalloid ions in cement matrices are reviewed in the paper by Jantzen *et al.* (2010).

The fundamental knowledge providing the essential framework for any of the foregoing themes depends on the reliability of measurement and our current state of understanding of cement systems must acknowledge the advances made in instrumental techniques such as, amongst others, electron microscopy, NMR and, more recently, FTIR, Raman and X-ray photoelectron spectroscopy. It is these techniques, their development and application to cement science that provided the theme for Session 6 of the conference, chaired by Jim Kirkpatrick. Due to their lack of long-range order, cement systems are challenging to characterise and the paper by Richardson *et al.* (2010) reviews recent advances in TEM, NMR and Raman spectroscopy in the characterisation of cement hydrates.

In reflecting on the conference and on the papers in this special issue, it is quite humbling to realise the depth of Fred's involvement in all of these conference themes, witnessed by his many hundreds of publications. This has earned him a truly international reputation which has been recognised in numerous prestigious awards, including fellowships of the Royal Society of Edinburgh and the American Ceramic Society, the Copeland award of the American Ceramic Society in 1997 and the Kroll Medal of the Institute of Materials in 2001.

We are delighted that we were able to host such a conference in honour of Fred and we are indebted to all those who offered their enthusiastic support in provision of sponsorship, preparation and presentation of papers and posters, session organisation and conference organisation and, not least all, of those who attended this event.

References

- Herfort D, Moir GK, Johansen V, Sorrentino F and Bolio Arceo H (2010) The chemistry of Portland cement clinker. *Advances in Cement Research* 22(4): 187–194, doi: 10.1680/adcr.2010.22.4.187
- Hooton DE, Thomas MDA and Ramlochan T (2010) Use of pore solution analysis in design for concrete durability. *Advances in Cement Research* 22(4): 203–210, doi: 10.1680/adcr.2010.22.4.203
- Jantzen C, Johnson A, Read D and Stegemann JA (2010) Cements in waste management. *Advances in Cement Research* 22(4): 225–231, doi: 10.1680/adcr.2010.22.4.225
- Lothenbach B, Damidot D, Matschei T and Marchand J (2010) Thermodynamic modelling: state of knowledge and challenges. *Advances in Cement Research* 22(4): 211–223, doi: 10.1680/adcr.2010.22.4.211
- Richardson IG, Skibsted J, Black L and Kirkpatrick RJ (2010) Characterisation of cement hydrate phases by TEM, NMR and Raman spectroscopy. *Advances in Cement Research* 22(4): 233–248, doi: 10.1680/adcr.2010.22.4.233
- Sharp JH, Gartner EM and Macphee DE (2010) Novel cement systems (sustainability). Session 2 of the Fred Glasser Cement Science Symposium. *Advances in Cement Research* 22(4): 195–202, doi: 10.1680/adcr.2010.22.4.195