

# Handbook of Alkali-activated Cements, Mortars and Concretes

Edited by F. Pacheco-Torgal, J. A. Labrincha, C. Leonelli,  
A. Palomo and P. Chindaprasirt

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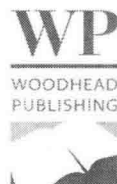
# Handbook of Alkali- activated Cements, Mortars and Concretes

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***F. Pacheco-Torgal, J. A. Labrincha,  
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# **Handbook of Alkali-activated Cements, Mortars and Concretes**

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# Foreword

My tryst with alkali-activated slag (AAS) cement dates back to the 1960s when I was doing my doctoral research at the Baikov Institute of Metallurgy and Moscow State University in the then Soviet Union. One of the earliest publications on the subject I had come across then was by A.O. Purdon (*J. Soc. Chem. Ind.* Vol. 59, 1940, pp. 191–202). The principle of alkali activation therefore has been in the realm of scientific investigation for more than seven decades now. However, a more comprehensive and systematic research on AAS, to the best of my knowledge, was initiated by V.D. Glukhovskii and his team in Kiev, the capital of Ukraine, in the late 1950s. In fact his patent on the binder, possibly the first in the world, was applied for in 1958, although the patent seems to have been formally listed much later (USSR 449894, Pub. No. 42, 1974). In the 1970s and 1980s Glukhovskii took the initiative of publishing at least four books devoted exclusively to AAS binders and concretes covering the theory, properties and use of these materials. All these publications were in the Russian language and in the absence of English translations, the dissemination of knowledge was highly localized.

In the same tradition, at least two national conferences were organized in Kiev, one in 1979 and another in 1984 on AAS-based products and their applications. In the second conference in particular 235 papers from all regions of the then Soviet Union were presented on alkali-activated slag cements, concretes and constructions, reflecting by then about three decades of experience in the field (*Proceedings of the 2nd National Conference on 'Alkali-Activated Cements, Concretes and Constructions'*, Kiev, KISI, 1984). In 1988 a book was published by R.L. Serykh and V.A. Pakhomov, entitled *Constructions from Alkali-Activated Slag Concretes* (Stroiizdat Publishers, Moscow).

It is relevant to mention here that in a span of about three decades the concept of AAS turned into a diverse field of practices. Large water pipelines were manufactured, building elements of different types were cast, road slabs were laid, air-field runways were placed. From all published data these structures proved to be highly durable. The success of AAS concretes in sanitary engineering was observed to be particularly phenomenal. The comprehensive strength of specimens taken from waste water sewers after 10–15 years was reported to be 120–150% higher. Massive breakwater blocks on sea shores reportedly showed a 250% gain in strength.

For obvious reasons the technology of alkali-activated binders spread quite rapidly to the East European countries. In Romania pavement stones, curbs and other precast elements were found to be in excellent condition after 15–20 years. Many road and highway sections, based on AAS formulations, some of them placed with roller compaction, were in visibly good condition in Eastern Europe and in France for 10–25 years. Several publications in the 7th International Congress on Cement Chemistry (ICCC) held in Paris in 1980 as well in the 8th ICCC held in Rio de Janeiro in 1986 bear testimony to the rising and widening interest of the global

community in successful development and application of alkali-activated binder technologies throughout the course of the 1980s.

Notwithstanding such a prolonged period of development and successful application of alkali-activated binders and concretes, to me it appears that there was a perceptible slow-down in dealing with this range of products in the 1990s. The reasons were many, and for brevity, cannot be deliberated on here and now. However, with the advent of the new millennium with renewed emphasis on carbon dioxide emission reduction and sustainable green construction, a revival of the alkali-activated binder technology was clearly perceptible. The repositioning of 'geopolymer concretes' by J. Davidovits, extensive knowledge dissemination through several publications by B.V. Rangan, formulation of Recommended Practice Note on Geopolymer Concrete by the Concrete Institute of Australia, significant investment in geopolymer research by various countries all point towards the likely re-emergence of AAS and associated technologies.

With this backdrop the publication of *Handbook of Alkali-Activated Cements, Mortars and Concretes* edited by Dr F. Pacheco-Torgal and Professor João Labrincha of Portugal, Professor Cristina Leonelli of Italy, Professor Angel Palomo of Spain and Professor Prinya Chindaprasit of Thailand provides a great impetus for an accelerated commercialization of an eco-friendly alternative binder technology with more in-depth understanding of its strengths, weaknesses, opportunities and threats. We must bear in mind that Portland cement has a history of 190 years and yet it is evolving. Compared to that, the alkali-activated binder technology has a history of only 70 years, much of the past of which has got buried in history, compelling 'reinvention of wheel' in many cases.

This Handbook, therefore, will go a long way to fulfil the essential requirements of transferring the technology from the laboratory to the field. But before I conclude, I want all of you to believe that –

‘Knowing is not enough  
We must apply  
Willing is not enough  
We must do’

Then only the challenges, perspectives and social dimensions of the emerging technology can be appreciated and squarely encountered.

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