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Crystal Growth of Friedel's Salt Originated from Pozzolan and Portland Cement

Lidia Trusilewicz,[a] Rafael Talero,[b] Alberto Delgado,[b] Cesar Pedrajas[b] and Raul Lannegrand[c] [a]*Escuela Universitaria de Ingeniería Técnica Industrial, Universidad Politécnica de Madrid, Ronda de Valencia 3, Madrid, 28012, (Spain).* [b]*Institute for Construction Science "Eduardo Torroja", CSIC, Serrano Galvache s/n, Madrid, 28033, (Spain).* [c]*"Lafarge-Asland", Sagunto, Valencia, (Spain).* E-mail: lidia.trusilewicz@upm.es

In the present paper, the Equilibrium Crystal Growth theory is applied to describe Friedel's salt (*Fs*) formation from two different routes C_3A phase of Portland cement (PC) and $Al_2O_3^{r-}$ (reactive alumina) of pozzolans. Both of the reaction courses are contrasted and the role of reactive components (with an emphasis on $Al_2O_3^{r-}$ particularly) is discussed in detail.

The experimental part consisted in PC blends elaboration with different natural and artificial pozzolans, (metakaolin, natural pozzolans, diatomite, silica fume), which were after subjected to chloride attack (3.75% NaCl). For this purpose, two Portland cements of different chemical composition from the C_3A content point of view, have been selected. The samples have been analyzed by XRD and SEM techniques, as well as by selected Cement Chemistry standard methods.

The applied methodology has permitted to opine about the kinetics aspect involved and their direct relation to the physical aspect of the originated crystals. The results show a significant difference in morphology of the Friedel's salt in function of its origin (Figure 1), which is directly related to its formation rate.

The importance of reactive alumina, $Al_2O_3^{r-}$, component of pozzolans is once again exhibited because of its contribution to the *direct*, *non-direct*, but above all, *indirect* stimulation of the C_3A phase saline hydration (or non-saline) from the fraction of OPC with which it was mixed, due to its high, fast and early pozzolanic activity and, for this reason precisely, it is found more *specific* than *generic*, intensifying at the same time the Friedel's salt formation from the OPC origin. In contrast, the also high, fast and early pozzolanic activity of reactive silica, SiO_2^{r-}, of pozzolans for the same results is not *specific* at all, on the contrary, it is *unspecific*, or perhaps more precisely, *insufficiently specific* for the same purpose than $Al_2O_3^{r-}$.
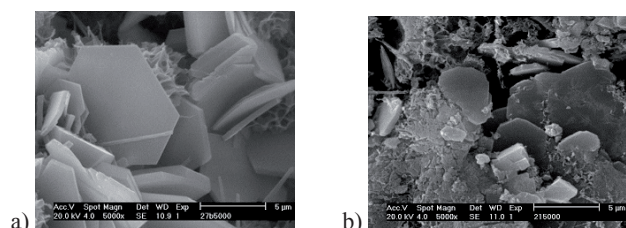

Figure 1, SEM morphology for the Friedel's salt from a) Portland cement and b) pozzolan origin

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FeSe-based superconductors (11, 122-type): phase diagram, crystal growth and characterization

Ekaterina Pomjakushina,[a] Anna Krzton-Maziopa,[a] Kazimierz Conder,[a] and Vladimir Pomjakushin,[b] [a]*Laboratory for Developments and Methods, Paul Scherrer Institut, 5232 Villigen (Switzerland).* [b]*Laboratory for Neutron Scattering, Paul Scherrer Institut, 5232 Villigen (Switzerland).* E-mail: ekaterina.pomjakushina@psi.ch

For over twenty years after discovery by G. Bednorz and K.A. Müller in 1986, complex oxides of copper seemed to be the only compounds showing high temperature superconductivity. This picture of exclusivity was busted by the discovery of superconductivity in MgB_2 (2001) and more recently (2008) in Fe-based compounds. The last discovery was absolutely unexpected as iron spins are usually supposed to be polarized creating magnetic field acting against tendency to build Cooper pairs accountable for superconductivity. Among the iron-based superconductors FeSe has the simplest structure with layers in which Fe cations are tetrahedrally coordinated by Se. The superconducting transition temperature (T_c) was found to be only 8K, but it can be significantly increased (up to 37K) by applying a high pressure or by intercalating potassium into the structure between the FeSe layers [1].

In our recent work [2] we have reported on the discovery of the second member of the family of alkali metal intercalated iron chalcogenides grown by the Bridgman method. This is $Cs_{0.8}(FeSe)_2$ with T_c around 30K. For the alkali metal intercalated layered compounds known so far, ($K_{0.8}(FeSe)_2$, $Rb_{0.8}(FeSe)_2$, $Cs_{0.8}(FeSe)_2$), the dependence of T_c on the anion height (distance between the layers of Fe and Se) was found to be similar to those reported for As-containing Fe superconductors and $Fe(Se_{1-x}Ch_x)$, where Ch = Te, Se. The steep slope of T_c as a function of anion height suggests that even higher superconducting transition temperatures might be found in the newly discovered FeSe based systems by applying either chemical (substitutional) or hydrostatic pressures.

I will present our recent results of crystal growth and studies of chemical phase diagram and crystal structure of $Fe(Se_{1-x}Te_x)$ and $A_y(Fe_{1-x}Se)_2$ superconductors (A=K, Rb, Cs) performed by x-ray and neutron diffraction [2-4].

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