# ENGINEERING SCIENCES

## INVESTIGATING THE EFFECT OF PLASTICIZERS ON STRUCTURE FORMATION OF GYPSUM BASED SYSTEMS

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***Relevance.*** Relevance of using gypsum binders is that their production requires extremely low energy consumption and the hydration process can be controlled broadly. Besides, the single-phase structure significantly simplifies the product manufacturing technology. These advantages encourage researchers to proceed with further attempts to obtain a gypsum structure exhibiting the properties of cement binders. One of the trends is the study of impact of additives on the hydration processes of gypsum binders.

***Problem statement.*** Structure formation process generally depends on the initial content of binding substances interacting during the hydration process. The analysis of technical publications shows that production of composite binders is a priority in the manufacture of mineral binders [1, p. 15; 2, p. 217; 3, p. 291; 4, p. 104]. The second trend is the use of various additives and factors affecting the hydration process [1, p. 41].

One of these factors is an increased interfacial surface energy arising in 'binder-water' systems [5, p. 577; 6, p. 93].

However, most studies involving additives were focused on trying to structure gypsum and cement materials in order to obtain products with enhanced structural and physical, physical and mechanical as well as engineering and performance properties.

The analysis of publications conducted by the authors showed a lack of information on reliable mechanisms of hydration processes of mineral binding substances in the presence of modifiers.

***Purpose of the Article.*** To assess the effects of surfactants on the hydration process, structure formation and main physical and mechanical properties of mineral binding substances.

According to the purpose, the research program involves exploring the structure of gypsum binder formed with minimal impact of other factors. Counterdiffusion crystal growth technique was applied for this reason using solutions of $CaCl_2$, $Na_2SO_4$, and $H_2O$.

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The second research technique includes counterdiffusion growth of gypsum crystals in the presence of surfactants, i.e., the effects of surfactants on the structure and properties of hydrated gypsum and cement binders.

***Conclusion.*** The studies conducted helped identify the effects of surfactants on the structure and properties of hydrated gypsum binder and cement binder; furthermore, the most effective additives were identified allowing to reduce water-to-gypsum ratio significantly, improve strength values and obtain a binder with a higher density structure.

If crystals are grown using a solution of $CaCI_2+Na_2SO_4+2H_2O\rightarrow CaSO_4\cdot 2H_2O+2NaCl$, gypsum specimens will have a high-porosity fibrous microstructure.

As a result of counterdiffusion growth of gypsum crystals in the presence of surfactants, filling of interlayer voids can be observed in the microphotographs. Furthermore, the crystals shape and size begin to change as well as the framework structure and strength (Figure 1).

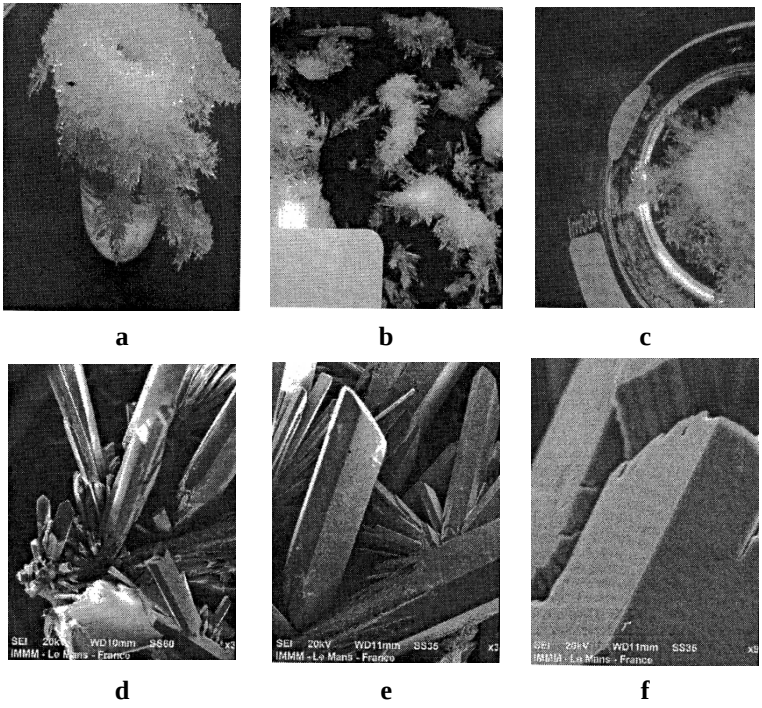


**Figure 1. Photos (Figure 1 a, b, c) and micrographs (Figure 1 d, e, f) of crystals grown in the medium containing ACE 430 plasticizer**

The main factors are the nucleation rate of facial surface energy and solution concentration. The best results have been achieved with Sika and ACE 430 plasticizers.

Modifying the initial cement binder with a superplasticizer additive results in a reduced normal density of cement paste, reduced W/C ratio, increased ultimate compressive and bending strength values both at an early and mature ages.

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