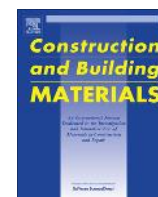


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# Construction and Building Materials

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## Effect of delayed addition time of synthesized SSPF condensate on the durability of sulphate resisting cement pastes incorporating micro-silica

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### HIGHLIGHTS

- 1.5% SSPF with 10 min delayed addition time work together to produce a compact structure.
- The increase of SSPF content enhances the compressive strength and bulk density of cement pastes.
- Delayed addition time, enhance the compressive strength up to 800 °C.
- Delayed addition inhibits the accessibility of penetration  $\text{Cl}^-$  and  $\text{SO}_4^{2-}$  into the cement paste.
- Formation of compact structure and enhances the durability of the cement paste.

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### ABSTRACT

The work aimed to evaluate the effect of delayed addition time of SSPF condensate on the physico-mechanical characteristics and durability of 10% micro-silica (MS)-sulphate resisting (SRC) cement pastes immersed in 4%  $\text{MgCl}_2$  or 4%  $\text{MgSO}_4$  solutions or at elevated temperatures up to 800 °C. The results show that the compressive strength and bulk density increase, whereas, the total porosity decreases with 1.5% SSPF at 10 min delayed addition time (optimum mix) up to 90 days. The compressive strength of thermally treatment cement pastes with 1.5% SSPF increases up to 450 °C, then decreases up to 800 °C. Presence of 1.5% SSPF with 10 min delayed addition time work together to produce a compact cementing structure, which decreases the accessibility of the penetration of chloride as well as sulphate ion penetration and enhances the durability, hence the total chloride and sulphate contents diminished.

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### 1. Introduction

Concrete is the most widely used construction material today, it has a complex structure consisting of cement, aggregate, admixtures, and mixing water. It is termed durable concrete when it keeps its form and shape within the allowable limits when exposed to different environmental conditions. The durability of concrete has been a major concern of civil engineering professionals. In addition, it has been of considerable scientific and technological interest over the last few decades [1]. The properties of plain concrete depend on the chemical reactions mainly between cement particles and water as well as the reactions between other components of concrete. The chemistry of hydration products, pore

structure and mechanical properties of hardened concrete are significantly affected by the environmental conditions in which the concrete is exposed during its service life [2].

It is possible to produce, durable concrete by partial replacement of cement with MS. The use of MS in conjunction with superplasticizers has become the back bone of high strength and high performance concrete with the following advantages (i) high early compressive strength; (ii) high tensile strength, flexural strength and modulus of elasticity; (iii) very low permeability to chloride ions and water intrusion; (iv) enhanced durability; (v) increased toughness; (vi) increased abrasion resistance on decks, floors, overlays and marine structures; (vii) superior resistance to chemical attack from chlorides, acids, nitrates, sulphates and life cycle cost efficiencies [3–5]. The aggressive attack of sulphate and chloride ions is one of the factors responsible for damage to concrete. The corrosive action of chlorides is due to the formation of chloroaluminate hydrate,  $\text{C}_3\text{A}\cdot\text{CaCl}_2\cdot 10\text{H}_2\text{O}$ , commonly known as Friedel's salt, which causes softening of concrete. The formed  $\text{CaCl}_2$

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