

## Chemical and Physical Factors Influencing Behavior of Sodium Silicate-Cement Grout

*Byung-Sik Chun*

Department of Civil Engineering, Hanyang University  
Seoul, Korea

*Hyung-Chil Yang*

CGM Corp.  
Seoul, Korea

*Duk-Hyum Park*

Department of Civil Engineering, Hanyang University  
Seoul, Korea

*Hyuk-Sang Jung*

Department of Civil Engineering, Hanyang University  
Seoul, Korea

### ABSTRACT

This paper evaluates the influence of the additive on the compressive strength of the sodium silicate-cement grouts. When not using any additive, the compressive strength of silicate-cement grout homogenized showed limited increase. It is estimated that complex salts ( $\text{Na}_2\text{O}$ ,  $3\text{SiO}_2$ ,  $\text{CaSO}_4$ ,  $\text{H}_2\text{O}$ ) were produced by the sodium silicate and the plaster retard the hydration of cement. The strength of the homo-gel increased significantly when using Sodium Tripolyphosphate as the additive. The strength is further increased when using the Circulation Grinding-Mixing method, which reduces the particle size of cement from 100-150  $\mu\text{m}$  to 50-100  $\mu\text{m}$ .

In addition to laboratory tests, in-situ tests were performed to characterize the influence of the grout on the ground permeability. The test results indicated that the grouting significantly reduces the permeability of the ground.

**KEY WORDS :** Permeability; Circulation Grinding-Mixing; Sodium tripolyphosphate; Strength; Sodium silicate-cement.

### INTRODUCTION

Since 1980 it is applied in South Korea and Japan, the age compressive strength of LW grouting was lower than data (refer to fig. 2).

Thus, it was investigated into effect of concentration of sodium silicate on strength of Homo-gel when it varies the content of the sodium silicate in A solution 150  $\ell$ , 200  $\ell$ , 250  $\ell$  and fix the content of the cement is 200 kg in B solution.

When the cement hydrate (calcium hydroxide) was 20% of cement weight and the Molar Ratio was less than 1.0, the strength of the

Homo-Gel was not higher than 5  $\text{kg}/\text{cm}^2$  within 3 days. The results showed that Calcium Aluminate and Ferrite Complex Salts (Lea, 1971) and sodium hydroxide (NaOH) made cement hydrate delay.

When sodium silicate gel, much calcium hydroxide which is essential to crystallization of a particle of cement is used. Based on calcium hydroxide poverty, the strength was not revealed (Yonekura et al., 2000). This is result that concentration of  $\text{Na}^+$  ion in absorption water of cement particle in spissate by ion exchanging reaction between  $\text{Na}^+$  ion and  $\text{Ca}^{+2}$  ion of sodium silicate. The strength of gel is increased when the changing time of curing water is reduced (Shibazaki, 1982), because solubility of calcium oxide is increased by sodium hydroxide (NaOH) in curing water is eluviated and the solubility of sodium hydroxide (NaOH) in the water ( $\text{H}_2\text{O}$ ) is increased. Calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) add to concentration of outward ion of Semipermeable membrane (Taylor, 1998; Gani, 1997; Lea 1971) is formed by initial hydration of cement particle (Oxtoby et al., 2002; Raff, 2001).

Therefore, the hydrate water of cement induce that it prevents passing through  $\text{C}_3\text{SH}_n$  membrane by reverse osmosis.

Consequently, poverty of hydrate water delay hydration of cement particle. Based on Osmotic bursting of cement was delayed, the time revealed of the strength was delayed.

In addition, this is estimate by the thickness of silica gel in film. When the thickness of silica gel is thick, it delay hydration of cement because moving velocity of hydration of cement particle flowed into Semipermeable membrane was slow (Taylor, 1998; Gani, 1997; Lea 1971). It was estimated that the time revealed of the strength was delay because it was not caused Osmotic bursting of cement (Taylor, 1998).

Consequently, it was made a difference at manifestation of the strength of Homo-gel of sodium silicate and cement by ages because the above two phenomenons by concentration of sodium hydroxide (NaOH) of