

## FACTORS INFLUENCING SETTING TIME OF ALKALI ACTIVATED BLAST FURNACE SLAG

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Fast setting of geopolymers and alkali activated materials is often presented as an advantage. However, if setting is so fast that forming and molding becomes problematic, this turns into a disadvantage. In most civil applications a setting time between 1 and 2 hours is the minimum for proper and safe operation. Especially when using blast furnace slag based alkali activated materials, the setting time can be in the order of minutes only, and therefore there is a need for ways of extending the setting without compromising the resulting final strength.

Activation of blast furnace slag with a water glass solution results in short initial setting times in the order of 10 to 40 minutes. The setting time slightly increases with increasing  $\text{SiO}_2/\text{Na}_2\text{O}$  molar ratio of the water glass ( $M_s$ ), but optimal final strength of around 50 MPa is found for  $M_s$ -values in the order of 1 to 1.6.

Addition of borax gives hardly any improvement if the borax is added as powder to the solids. However, if borax is first dissolved in the activator solution, 5% w/w addition of borax is capable of almost doubling the initial setting time.

Addition of soda showed an increased setting time from 45 minutes with no soda up to 90 minutes with 5% soda. Compressive strength also shows an increasing trend with increasing soda addition. Higher soda additions decreased both setting time and compressive strength.

Instead of adding new components to the mixture design, changing the physical conditions of operation can as well have an effect on the setting time. By cooling the activator solution to 5 °C and then mixing with the precursor at 20 °C, the initial setting time was already extended from 30 minutes (for everything at 20 °C) to 50 minutes. Conversely, preheating the activator solution to 30 °C decreased the initial setting time to 20 minutes. Further heating up to 50 °C resulted in instantaneous setting. In general, the relation between activator temperature and setting time follows a linear trend. Temperature has also a significant influence on the viscosity of the solution, which may have an impact on the extent of mixing. However, within the range of 5 °C and 30 °C, at laboratory scale the same compositions could be mixed for the same mixing times without any practical problems.