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The effect of excessive steam curing on Portland composite cement concrete

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Abstract

Steam curing at atmospheric pressure is an important technique for obtaining high early strength values in precast concrete production. Cement type, as well as curing period and temperature, is an important parameter in the steam-curing process. PC42.5 is the type of cement that is most commonly used in Turkish precast concrete plants. Its behavior is well known. Nowadays, the production of composite cements is becoming more popular every other day due to its advantages. The object of this study was to determine the properties of this relatively new binder comparatively with conventional PC42.5 under steam curing. For this purpose, 15-cm concrete cubes were prepared with a water/cement ratio (W/C) of 0.44 and were subjected to steam curing for five different curing periods of 4, 8, 16, 24 and 36 h under curing temperatures of 65 and 85 °C. Cement dosage was kept constant (400 kg/m^3) for all specimens. The variation of compressive strength values and maturity for each condition has been presented comparatively within this study. Test results indicated that Portland composite cement (PKC/A42.5) can be used in place of PC42.5 for steam curing at atmospheric pressure in precast concrete production. However, in case of early high strength demand for early demolding purposes, curing temperature should be increased to 85 °C for PKC/A42.5 cement concretes.

Keywords: Concrete; Curing; Compressive strength; Maturity

1. Introduction

Atmospheric steam curing is a heat treatment which has been used for many years to accelerate the strength development of concrete products. Because the hydration rate of cement increases with the increase in temperature, the gain of strength can be speeded up by curing concrete in steam. When steam is generated in atmospheric pressure, the temperature is below 100 °C; the process can be regarded as a special case of moist curing in which the vapour-saturated atmospheres ensures a supply of water [1,2].

Maximum curing temperatures may be anywhere in the range of 40 to 100 °C. However, the optimum temperature has been found in the range of 65 to 85 °C. The curing temperature will be a compromise between rate of strength gain and ultimate strength, because the higher the curing temperature, the lower the ultimate strength [3].

The role of cement type as a binder has a great importance in heat treatment applications. The primary factors determining the behavior of cements subjected to heat treatment are fineness and composition of cements, the type and amount of additives used in blended cements and curing cycle parameters. For compressive strength development of concrete, duration of steam curing is also an important parameter as well as temperature [4]. The treatment period and temperature is adjusted according to the targeted 1-day strength level. It is obvious that heat treatment application at a lower temperature is more economical and energy saving [5].

The length of the total curing period must allow for controlled heating application and cooling of the concrete

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