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Effects of Retarder on Cement

Reuben James
Parkland College

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The summer before I started continuing my education at Parkland I worked for Euclid Chemical of Kirkland, IL. I worked mainly in the lab as a quality control technician. At Euclid, we made hydraulic cements, paints, and epoxies. I performed different tests on these products to see if they met certain standards. These tests included color correction, tensile strength, compression, elasticity, and set times. Besides checking the products for the normal conditions, I was sometimes asked to perform tests to see what alterations resulted. One such test I performed was adding retarder to our normal Red Line Speed Crete.

The Red Line Speed Crete is a cement meant to patch. Cement is an ingredient of concrete. The main difference between cement and concrete is that cement doesn't have any aggregates, such as rocks, in it. Cement works by going from a dehydrated powder form to a hardened form in the shape of whatever mold it was put into or on. It does this because of the $2Ca_3SiO_5$ (C_3A) in the cement being hydrated by water to form a gel that hardens. This hydrating process is written:

$$2Ca_3SiO_5 + 7H_20 \rightarrow 3(CaO)*2(Si0_2)*4H_20_{(gel)} + 3Ca(OH)_2.$$

This cures by the two products combining to make a solid hardened product. (Concrete,Wikiedia)

I performed tests on our Red Line. In these tests I added different amounts of tartaric acid ($C_4H_60_6$) (Tartaric, Wikipedia) retarder to a normal batch of the Red Line, to see what changes took place. The reason the company had me perform these test was because we were looking for the set time to decrease so that the product could be used in hotter climates, due to heat speeding up the curing process. The Texas department of transportation had problems because the heat made the concrete harden faster so they asked us to make it so they have more time to work with the Red Line. I tested initial set time to check for workability, final set

time to see the overall curing time, and I used a pneumatic crusher to see how much force the hardened cement could withstand. After running different tests, there was a general trend in the results. The more retarder that was added, the slower the set time and the weaker the concrete became.

Due to chemistry I now have more knowledge as to why the set time was slowed down based on the chemical properties. The first reason the retarder slows down the set time is because it draws the water to it, keeping it away from the cement by forming a type of diffusion barrier. This slows down the overall reaction giving it more time to work with. This also provides for the adverse effect of weakening the final state of the cement because the water wasn't able to fully react with the C_3A making the normal rigidity it produces lessen. Another reason retarder slowed down the set times pertains to the $Ca(OH)_2$ ions that are formed. The retarder is an organic substance and this makes the hydroxide very attracted to it. This forms organic hydroxyl ions that have a very high saturation point. These new ions now suck up the water that is meant for the C_3A. This slows down the curing time on the cement as well as giving you a longer working time with it. (Khan, 64-65)

In conclusion, due to my professor asking me to participate in this honors project, I furthered my understanding of key chemistry concepts. I was able to reflect on a past experience and further my understanding of the situation. I am now more knowledgeable about the effects retarder has on cement.

Works Cited

- "Concrete." *Wikipedia.* Wikimedia Foundation, 18 Nov. 2013. Web. 18 Nov. 2013. <http://en.wikipedia.org/wiki/Concrete>.

- Khan, Bazid and Muhammad Ullah "Effect of a Retarding Admixture on the Setting Time of Cement Paste in Hot Weather." JKAU: Eng. Sci. Vol. 15 no. 1 (2004):pg.63-66.

- "Tartaric Acid." *Wikipedia.* Wikimedia Foundation, 19 Nov. 2013. Web. 25 Nov. 2013. <http://en.wikipedia.org/wikifTartaric_acid>.