CALIFORNIA STATE SCIENCE FAIR
2004 PROJECT SUMMARY

Name(s)
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Project Number
J1805

Project Title
How Do Different Liquids Other Than Water Affect the Strength of Cement?

Abstract

Objectives/Goals
My project's goal was to see how different liquids other than water affect the strength of cement. I did this project because I wanted to find out how to make stronger cement which might help buildings better survive earthquakes.

Methods/Materials
The liquids I used were water (the control), carbonated water, orange juice, ammonia, and bleach. I made uniform cement blocks out of equal parts of dry cement and each liquid. I tested each block for flexural strength and impact energy. Flexural strength is the ability of the block to withstand a heavy load. I suspended increasing amounts of weight on the center of each block until it broke. Impact energy measures the toughness of something; I measured this in foot-pounds. I did three measurements of impact energy for each type of cement by dropping a one-pound weight on a fragment starting at one-foot heights and then increased the height until the fragment fractured.

Results
By doing my experiment I found that orange juice made cement weaker, while ammonia and bleach made cement stronger. To explain these surprising results I researched the chemistry of cement and tested the pHs of all the liquids I used. I found that the hydration of cement is an alkaline reaction and that the acidic liquid (orange juice) made the weakest cement while the basic liquids (ammonia and bleach) made the strongest cement. By adding basic liquids I must have made the chemical reaction of hydration stronger thus making stronger cement.

Conclusions/Discussion
My experiment proves that basic liquids make cement stronger and acidic liquids make it weaker. In construction, concrete is used, which is cement mixed with gravel and metal which makes it stronger. Maybe if basic liquids were used in cement, concrete would be even stronger which would make buildings and bridges more earthquake resistant.

Perhaps construction sites should check the pH of their water before using it in their cement to make sure that it is not acidic which might affect its strength.

Summary Statement
Testing the strength of cement with liquids other than water shows that basic liquids make cement stronger while acidic liquids make it weaker.

Help Received
My father bought the cement and helped me mix it with the ammonia and bleach. He also helped me with the heavy weights used to measure the flexural strenght of the different blocks.