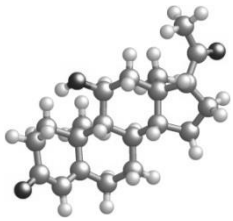

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Name: …… **( )**

Class: ……

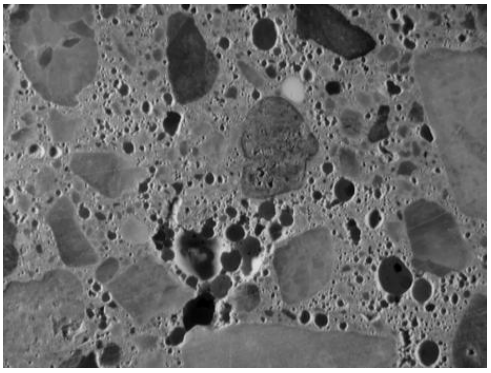
Date: …… **/** …… **/** ……

Chemistry of the Built Environment – Models

Investigating the Properties of Building Materials – Preparing and Testing Concrete Bricks

Introduction

Concrete is a very ubiquitous building material. It has been estimated that each year, the equivalent of two tonnes of concrete are produced for every living person on the planet. Concrete is a mixture of *cement* and *aggregate*. The aggregate may take the form of sand and / or small stones. When water is added to this mixture, a series of chemical reactions occur that result in the cement crystallising around the aggregate to form a strong, durable solid.

	
• The objective of this experiment is to make concrete bricks with varying compositions of sand and cement. The strength of the bricks will be tested in your Physics lesson.	• This photograph shows the detailed structure of concrete, with chemicals in the cement crystallising around the solid particles of aggregate.

Concrete is strong under compression, but weak under tension. To improve concrete's tensile strength, steel bars can be introduced to form *reinforced concrete*.

In this experiment, you will mix sand and cement together in varying quantities to make small concrete bricks that weigh approximately 500 g each. Once the concrete has hardened, the strength of the concrete bricks will be measured in your Physics lesson by determining the force that is required to break them in half.

1. What is the independent variable in this investigation?

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2. What is the dependent variable in this investigation?

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3. Which variable(s) should be kept constant during this investigation?

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4. What would be a good control (comparison) for this experiment?

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5. What is your hypothesis for this investigation? Briefly explain your reasoning.

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Apparatus and Reagents

Cement	Sand	Water
Food Container (Mould)	Plastic Cup	Plastic Spoon
Metal Spatula	100 cm^3 Measuring Cylinder	Digital Balance
Ice-cream Stick	Sticky Note	Sticky Tape

Method

1. Work in your groups assigned for the Built Environment Interdisciplinary Unit. Each group is to make *one* concrete brick. Different groups should prepare concrete bricks of *different compositions* of sand and cement. Use the table at the end of this section to assign different compositions of concrete to each group. The rest of this method gives details for making a concrete brick that contains 250 g of sand and 250 g of cement. You should modify the method accordingly for the concrete brick that your group is going to make.

2. Complete the practical carefully. DO NOT leave the laboratory in an untidy state.

3. Masses given in this experiment are to the nearest *whole gram*. When weighing out your sand and cement, round decimal places up or down accordingly.

4. Collect the apparatus that you will need for the experiment.

5. Use a plastic cup, plastic spoon and digital balance to weigh out 250 g of sand. **Note:** One plastic cup, when almost completely full, holds approximately 150 g of sand.

6. Transfer the 250 g of sand into the plastic food container that you will use as the mould for your brick.

7. Use a plastic cup, plastic spoon and digital balance to weigh out 250 g of cement. **Note:** One plastic cup, when almost completely full, holds approximately 150 g of cement.

8. Transfer the 250 g of cement into the plastic food container that you will use as the mould for your brick.

9. Use the metal spatula to mix the dry sand and cement together. Ensure that they are mixed *thoroughly*.

10. Use the metal spatula to form a depression / space in the middle of the sand and cement. Pour tap water from a 100 cm^3 measuring into this space and mix carefully and thoroughly. Add the water a little-at-a-time, not large volumes in one-go. Take care when mixing not to flick the cement out of the mould.

11. Add sufficient water to form a thick, yet workable mixture. There should be no dry sand or cement in the mould, nor should there be excess water. The exact volume of water that is required will depend upon the mass of sand and the mass of cement that are used to make the concrete. A concrete brick that contains 250 g of sand and 250 g of cement requires approximately 120 cm^3 of water. The *more sand* and *less cement* a brick contains, the *less water* it requires, and vice-versa.

12. Smooth-out the concrete. Push an ice-cream stick, in a vertical position, into the concrete at one end of the mould. This will be used to help remove the concrete brick from the mould once it has completely hardened. Leave the concrete to harden for one week.

Group Number	Mass of Sand / g	Mass of Cement / g	Total Mass of Sand and Cement / g	% Sand in Concrete Brick	% Cement in Concrete Brick	Volume of Water / cm^3
1			500			
2			500			
3			500			
4			500			
5			500			
6			500			
7			500			
8			500			

Results

1. Describe the appearance of the sand at the start of the experiment.

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2. Describe the appearance of the cement at the start of the experiment.

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3. Describe the appearance of the concrete just after it had been made.

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4. Describe the appearance of the concrete after one week.

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5. Which brick required the greatest force to break? The least force to break?

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Conclusion

1. What evidence is there that a chemical change took place when water was added to the sand and cement?

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2. When you investigated the strength of the concrete bricks in you Physics lesson, did the results that you obtained agree with your hypothesis? If not, then suggest a reason why.

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3. What errors are associated with this experiment? For example, what variables should have been controlled, but were actually very difficult / impossible to control?

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4. Concrete is a very important building material. Which alternatives exist to concrete that are more environmentally friendly and sustainable?

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5. Your group has made a *model* of a building brick. It will not be used for constructing a real building, but will be used to investigate the relationships between variables. Where else are *models* used to understand and explain the natural world? Why is this important?

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