

## **PART III - FLOATING CONCRETE LESSON**

### **SUMMARY**

For this project the concrete professional makes two visits to the classroom. Between the concrete professionals' visits, students will collect data on the concrete specimens. A typical lesson plan is as follows.

1. Classroom teachers introduce the subject with a discussion of the uses of concrete.
2. The concrete professional comes to the class for approximately one hour. During this visit he/she discusses the project, helps the students mix the concrete and instructs the students on how to place the concrete. Each student makes two concrete samples, one with normal aggregate (sand) and one with lightweight aggregate.
3. For the next two weeks, the students monitor the mass (weight) of the two concrete samples. Each student makes a log of the mass changes over the two weeks. At the end of this two-week period, the students make a graph of their data.
4. The concrete professional makes a second follow-up visit he/she discusses the students' data (if the teacher wishes). Then the students test to see which samples of concrete will float (They find that the samples prepared with the lightweight aggregate will float) The concrete professional conducts a discussion about the application of concrete. The industrial professional finishes with a slide presentation or video of how concrete is batched, placed and finished. The slide presentation ends with several concrete buildings showing how concrete is used.
5. The classroom teacher can follow up with further discussions on concrete. This can include history of concrete and manufacture of cement and concrete and/or a discussion of possible science fair projects.

# LESSON PLAN FOR FLOATING CONCRETE

Prior to First Session:

1. Arrange schedule of when the sessions will be conducted with the school teacher.
2. Have newspapers available to protect each desk.
3. Have a large trash bag ready for all waste.

## FIRST SESSION

Briefly introduce yourself. Tell students what you do with concrete.

### WHAT IS CONCRETE?

Concrete is made of

1. Cement
2. Water
3. Aggregates (sand and stone)

Cement and water chemically act to form a "glue" that binds the aggregates together. Cement by itself is a finely ground powder and is finer than flour. By itself, cement has no strength. When cement is mixed with water and aggregates it becomes concrete. Thus, do not say "cement sidewalk," it is a, "concrete sidewalk," (You wouldn't say to Mom, "You made a nice flour," when what you mean to say is, "You made a nice cake.")

Remember - Cement is used to make concrete - cement is not concrete.

### HISTORY OF CEMENT

The invention of cement has been credited to Joseph Aspdin, an English mason. Aspdin patented his product in 1824 and called it "Portland Cement because it resembled the color of natural limestone found on the Isle of Portland, a peninsula in the English Channel. Portland Cement was first manufactured in the United States in 1872.

Today concrete is the most used material in construction. Roads, bridges, schools, foundations of buildings, driveways and large office buildings are made of concrete.

There are boats and ships made from concrete. It would seem we are only limited by our imaginations as to what we can make with concrete.

## MAKING CONCRETE:

Whenever we mix cement, sand and water, it is extremely important that the mix contains the correct amounts of cement, aggregates and water. The basic rules of concrete are the more cement in the mix design, the higher the strength and the more water in the mix, the lower the strength. A typical mix design used in sidewalks, driveways, and floors will have about twice as much cement by weight as it does water. (You should know that a little water goes a long way and it should be added a little at a time.) The best mix for this exercise is one that is dry enough to be handled with a fork. In fact, it should have the consistency of cooked oatmeal.

Concrete does not gain strength by drying. There is a chemical reaction between cement and water that causes the concrete to set up or harden. For this reason, fresh concrete should be covered, so that the cement can continue to react with the water. To obtain the best strength, the concrete should be covered for several days.

## FLOATING CONCRETE

For a material to float it must be lighter than water.

Demonstration: 4 see-through glasses about 112 filled with water.

### WEAR YOUR EYE PROTECTION

1. Put a spoonful of cement into the water. The cement will sink to bottom of glass. Cement is over 3 times as dense as water, thus it cannot float.
2. Put spoonful of sand into water. The sand will sink to bottom of glass. Sand is about 2.5 times as dense as water, thus it cannot float.
3. This step can be omitted if you do not want to use sawdust. Put a spoonful of sawdust into water. The sawdust will absorb water, become waterlogged and will ultimately sink. Dry sawdust is slightly lighter than water and will float. When left in water, the voids in the sawdust become filled (water logged) and the density becomes higher than water, thus the sawdust will not float.
4. Put a spoonful of vermiculite (see note below) into water. It floats and will remain floating. Vermiculite is approximately 1/10 or 10% as dense as water. It has a closed structure and does not absorb water. Therefore, the vermiculite will float

**NOTE:** Vermiculite is an expanded mica with a platy structure, and is found in North America and Africa. When heated to a temperature of 650 to 1000°C, vermiculite expands up to 30 times its original volume. This is similar to popping popcorn the heat makes the material fluff up like popcorn. Like popped popcorn, the vermiculite would also have low strength.

Normal concrete made with cement water and sand will not float; it is over twice as dense as water. To get a concrete that can float, you must limit the amount of cement and use lightweight materials such as vermiculite.

Since the amount of cement is low and the vermiculite is low-strength, the strength of floating concrete will be low.

## **SAFETY CONCERNS**

Cement should be handled with care

Be sure to tell students to wear eye protection while handling cement and to wash their hands after handling cement and fresh concrete. Remember, you are a model - wear eye protection whenever you handle cement or fresh concrete and as you help the students.

## **HAND OUT CONCRETE KITS**

1. Have Students Put on Eye Protection.
2. Follow directions to make the concrete samples.
3. Put concrete samples in a safe, dry place where they will be undisturbed.
4. Explain the graphing procedure.
5. Make sure all waste is put into trash.

## **SECOND SESSION**

(Approximately 10-14 days after first session-) come to classroom with a clear plastic tank. Put on a stable desk in front of the room. Fill with at least 4 inches of water. Have students select which of their samples they think will float and test them. (Encourage the students to select the sample made with Vermiculite. Be kind in determining if their sample floats, and if the sample does not immediately touch the bottom of the tank, it has floated.)

Show slides on batch plant - Text included with slides

Make sure that a slide projector is available that fits your slide tray.

## **SAMPLE ANSWERS FOR TEACHERS**

### **SESSION #1 QUESTIONS**

1. The vermiculite mix should float. The vermiculite is lighter and provides for more air in the concrete.
2. Put it in a warm, dry place.
3. Additional cement can add strength as long as there is enough water in the mix to allow for the chemical reaction. Covering the concrete during the drying period will add strength by keeping water in the concrete to further the reaction.

### **SESSION #2 QUESTIONS**

1. The vermiculite should have floated.
2. The concrete samples have dried when they are no longer losing weight. This is easily seen when the weights are plotted each day on the graph. When the concrete is dry, the plot will become a straight line (plateau).
3. The vermiculite generally drops in weight at a greater pace. The sand mix however, tends to plateau sooner on the graph. The vermiculite concrete normally takes longer to dry completely because it takes longer for the water to exit the air pockets in the vermiculite.

# **MATERIALS NEEDED FOR FLOATING CONCRETE PROJECT**

## **TO BE PROVIDED IN FLOATING CONCRETE KIT**

- A. 1 1 -gallon sealable bag (food storage type)
- B. 4 1 -pint sealable bags (sandwich size)
  - 1) Two bags with 1/8 cup cement
  - 2) One bag with 3/8 cup sand
  - 3) One bag with 3/8 cup vermiculite
- C. 2 plastic spoons
- D. 2 straw – and – cardboard flags
- E. 2 1 1/2 ounce plastic condiment cups
- F. 4 rubber gloves

## **ADDITIONAL MATERIALS REQUIRED**

- A. Goggles (1 per student)
- B. Paper Towels
- C. Newspaper (to cover desks)
- D. Garbage Bags (to dispose of waste)
- E. Water Containers (1 - 1 1/2 ounce cup per student)
- F. Container to Float Samples (1 tank at least 6 inches deep)
- G. Gram Scale (must be able to weigh at least 150 grams)

# FLOATING CONCRETE

You are to make a special concrete that can float. In your kit you have two bags of cement (marked "C"), a bag of vermiculite (marked "V"), a bag of sand (marked "S"), a spoon, two small plastic forms and a finishing tool (craft stick). You should also have newspapers and a paper or plastic cup.

## CAUTION:

- a) **Always wear eye protection (goggles or safety glasses) while working with cement or fresh concrete.**
- b) **Wash immediately if you come into contact with cement or fresh concrete.**
- c) **Never pour cement or concrete into the sink, toilet or any drain. These materials can clog your drainage system. Throw all excess material, spoons and craft sticks into the trash.**

## PROCEDURE:

- 1 Put newspapers on the table. With a marker, put your name on the plastic forms.
2. Fill the cup about 3/4 full with water. This is approximately 40 grams of water.
3. **MAKE SURE YOUR ARE WEARING YOUR GOGGLES!** Empty the sand bag (S) into one of the cement bags (C) close the bag and shake it up.
4. Add some of the water to the bag. Close the bag and mix the contents. Repeat this step until the concrete is uniformly mixed and looks like a thick cookie batter. **YOU MIGHT NOT USE ALL OF THE WATER.**
5. Use the spoon to place the concrete into one of the forms. Be sure to pack the concrete into the form.
6. Use the finishing tool (craft stick) to smooth the concrete surface.
7. Put an "S" on your form. Place the concrete (still in its form) in a safe, dry place.
8. Wipe off the spoon and the finishing stick with a paper towel. Throw the paper towel into the trash.
9. Repeat steps 1 through 6. This time empty the vermiculite bag (V) into the second cement bag (C). Fill the cup about 3/4 full with water. **YOU MIGHT NOT USE ALL THE WATER.**
10. Put a "V" on the form. Put the concrete (still in its form) in a safe, dry place.
11. Clean up by putting the bags of excess concrete, spoon, finishing tool and newspaper into the trash. **DO NOT WASH THE EXCESS MATERIALS DOWN THE DRAIN OR PUT THEM IN THE TOILET.**

12. Everyone who handled cement or concrete should wash their hands.
13. After one day, remove the concrete from the forms. Label each concrete sample the same way you labeled the form it was in. Weigh each of the samples and record the weights on the graph. Store the concrete in a safe, dry place. Dispose of the forms.
14. Continue weighing the samples each day until they are dry. Complete the graph with your information.

Note: Concrete gains strength through a chemical reaction between cement and water. This reaction will continue as long as there is water in the concrete. Floating concrete is a special kind of concrete. It must be dry so that the air pockets in the aggregate are not filled with water.

### **SESSION #1 QUESTIONS**

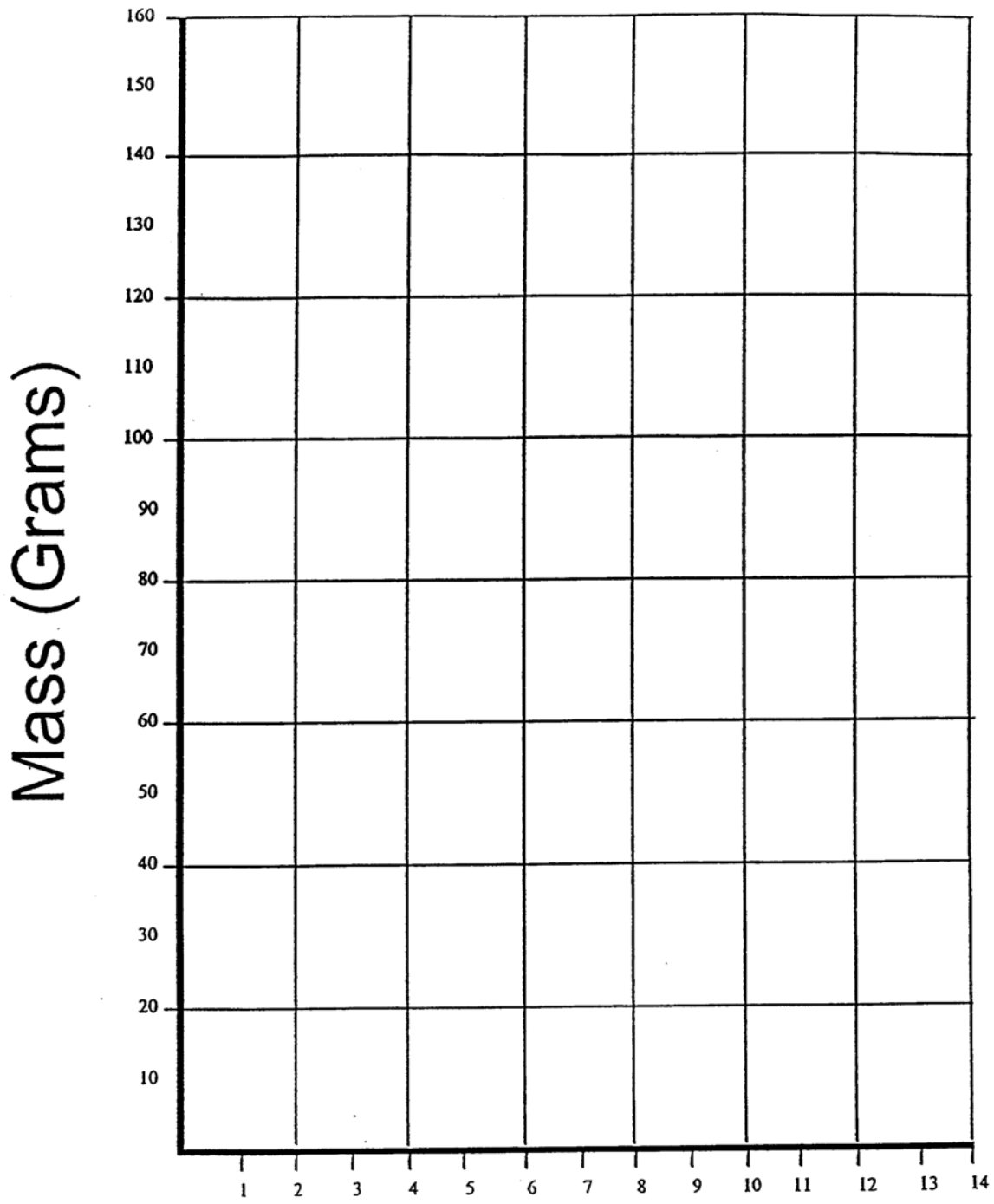
1. Which concrete do you think will float? Explain why.
2. What can you do to make sure the concrete will dry?
3. If you want more strength in concrete, what can you do?

### **SESSION #2 QUESTIONS**

1. Which concrete sample floated? Explain why.
2. How did you know when the concrete was dry?
3. Which concrete dried faster? Explain why.



# CONCRETE DRYING GRAPH



Days After Casting