Dry Baby Dry: Teacher Information

Objective: The purpose of this experiment is to determine the correct amount of time necessary to dry filamentous algae to a moisture content of 12-20%. It provides students an opportunity to examine a large scale problem using a small scale prototype.

Introduction: On face value the forming of algal pellets seems to be a fairly straightforward and easy process. In theory it is. However, to consider the large scale production of such a feat is a bit more difficult. Unless there is a specific moisture content in the algae pellets will not form. Standardization of a drying process will need to be developed in order to provide pellets quickly and efficiently.

Materials and Equipment

To dewater the algae

Watertight container
Pool skimmer
Latex gloves
Tweezers
Electric balance
Weighing boat
Countertop clothes spin dryer **OR**
Porous fabric/15mL centrifuge tube/twine

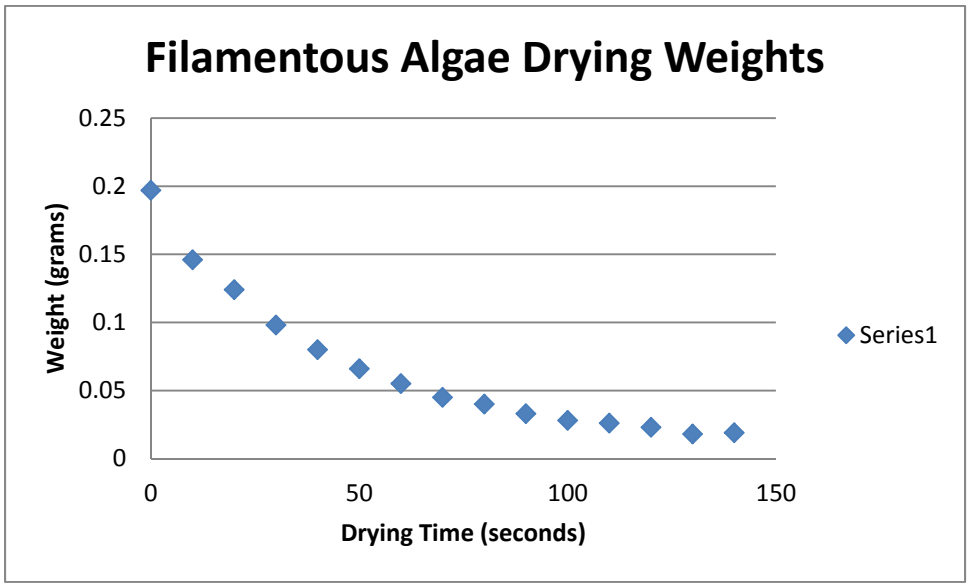
To make drying chamber

Hair dryer
Styrofoam cooler
Well ventilated box-like item to fit cooler (See diagram)
Window screen (cut to fit top of box)
Box knife to cut cooler
Adhesive to glue screen
Duct tape for handles

Dewatering Procedure for Filamentous Algae

1. Find and collect filamentous algae. Local ponds, rivers and reservoirs are great sources. Algae can be scooped using a pool skimmer or net. It should be placed in a watertight container. Note: if algae is unavailable at the time of this experiment, it can be ordered from most biological supply companies.
2. Remove any organisms or plant material intertwined with the algae. (If purchased this step can be skipped). Always wear gloves and use tweezers when handling the algae.
3. To remove the extracellular water from the algae (dewatering), place the clean sorted algae into a countertop clothes spin dryer at 1600 rpm for 5 minutes. It is important to begin with approximately 40 grams of algae. (If the spinner is unavailable, the algae can be placed in a net of material and into a centrifuge tube. Tie a string around the tube and swing it until the largest portion of water is removed OR the algae can be placed between paper towels and pressed dry)
4. Once the algae is dry (this is the dewatering – removal of extracellular water), weigh out approximately 10 grams of algae. Record this weight at time zero.

5. Place the algae on the drying screen and blow dry for one minute. (When algae is placed on the platform it should be spread out as evenly as possible). Make sure the temperature settings used on the hair dryer are held constant. (We recommend using the hot setting).
6. Remove the algae and weigh it. Record this mass for one minute.
7. Place the algae back on the screen and dry for one minute.
8. Remove the algae and weigh it. Record this mass for two minutes.
9. Continue this process until the mass of the algae levels out. We found this to be as long as ten minutes (depending on the amount of algae you started with), so you may want to adjust the drying time intervals accordingly.
10. Graph the data and draw a curve of best fit. Interpolate from this curve the amount of drying time necessary so that the algae will have between 12-20% moisture remaining. This is the moisture content needed to form proper pellets. See sample graph.



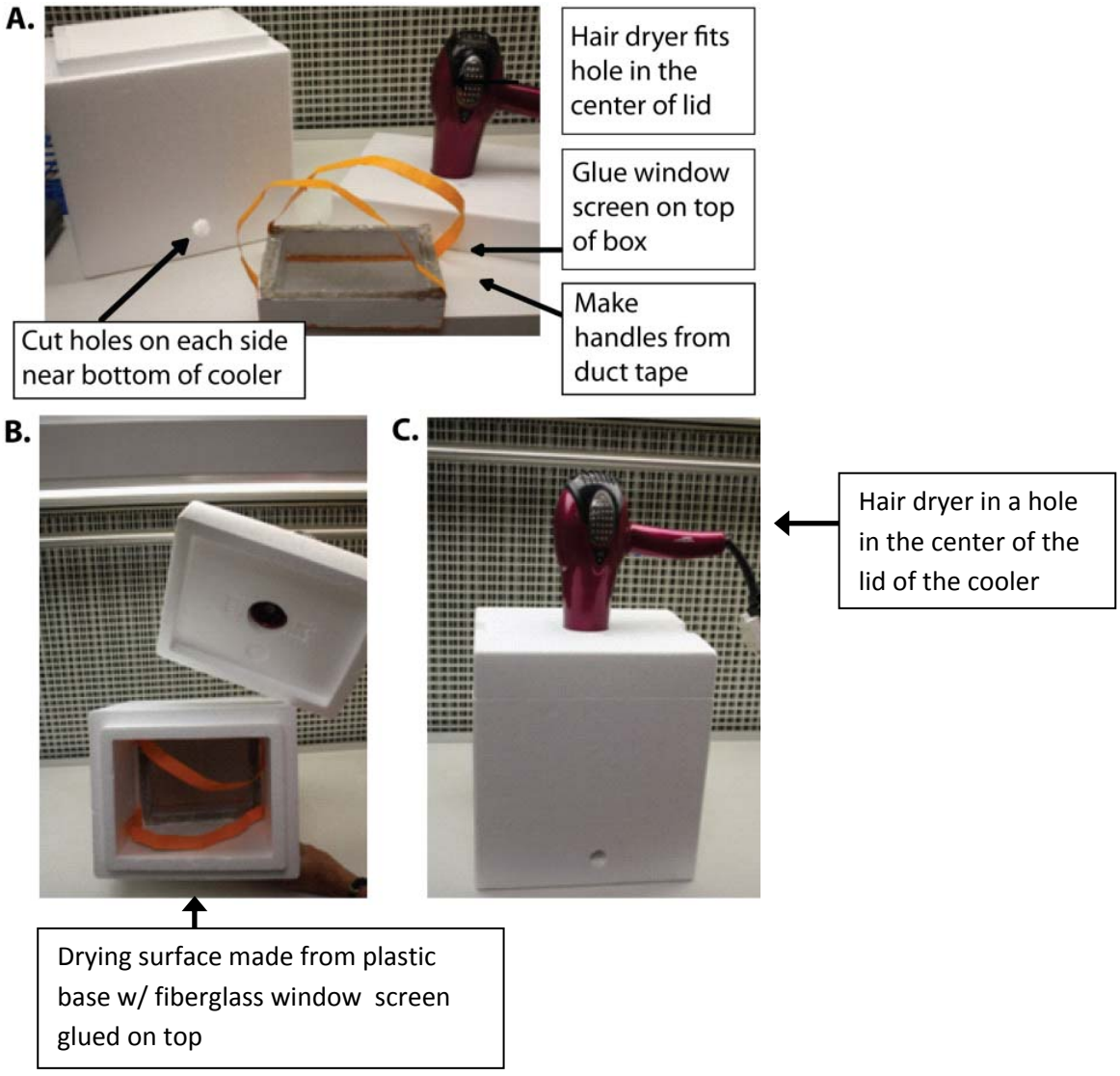
11. Place 0.5 grams of properly dried algae into a 5mL syringe. Plunge syringe (as hard as possible) to form an algal pellet. Using a mallet to hammer the end of the syringe works well.
12. Use a thin object to push pellet away from the end of the syringe, but not completely out. Remove the plunger. Allow to dry overnight.

<u>Day two:</u>

13. Blow dry the pellet to make sure all moisture is removed. ** Note: algal pellets must be as dry as possible to burn in calorimeter.

Procedure for Building a Drying Chamber for Filamentous Algae

1. Use an insulated Styrofoam cooler with a lid.
2. Cut a small (3/4" diameter) hole on each side approximately 1" from the bottom. These four holes will allow proper air flow in the dryer.
3. Make a hole in the center of the lid that will snugly fit the diameter of the hair dryer to be used for drying.
4. To build the drying platform: use a Styrofoam box that will fit inside of the Styrofoam cooler, with top and bottom cut out (or any type of box-like item that is well ventilated). Use an adhesive to glue screen material to the top. Allow to dry.
5. Use any type of tape to wrap around the two ends of the platform and then doubled back on itself to be used as handles.
6. Place platform inside of the Styrofoam cooler.



Dry Baby Dry: An Investigation in the Production of Algae Pellets

Name: _____

Date: _____

Introduction: On face value the forming of algal pellets seems to be a fairly straight forward and easy process. In theory it is. However, to consider the large scale production of such a feat is a bit more difficult. Think about pulling algae out of its water source; it's dripping, it's heavy, and it won't burn. If one could form pellets it would be easy to package and transport, however, unless there is a specific moisture content in the algae, pellets will not form. Standardization of a drying process will need to be developed in order to provide pellets quickly and efficiently.

Discussion

1. Discuss with your partner how you could go about dewatering filamentous algae. (That means taking it from dripping wet, to "toweled" dry). Jot down your ideas.

2. Discuss your ideas as a class. Come up with a class procedure to dewater algae using the tools available to you in your lab. Write your procedure here. (Think about other processes used to separate solids from liquids).

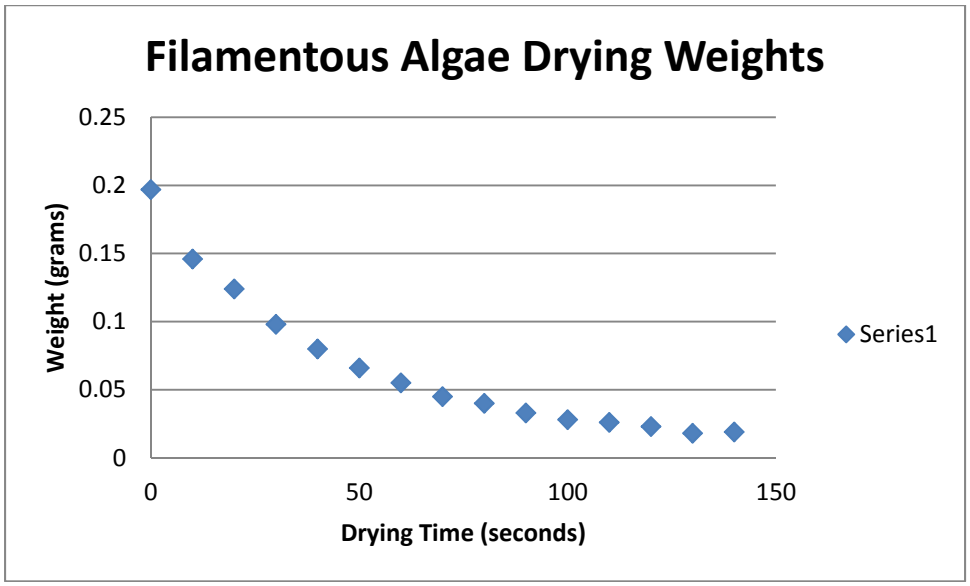
3. Now you need to figure out how to develop a way to standardize a drying procedure so that you know you will get the same result each time. Keep in mind you need anywhere from 12-20% moisture content left in the algae in order to form a proper pellet. If you were to build a drying chamber, what would be the necessary components of the chamber? Make a bulleted list.

4. Diagram what this chamber would look like if you were to build it using the components from #3.

5. What measurements could you take that would quantify the amount of water left in the algae? (What would happen to the algae as it lost water?)

6. How can you use this information to develop a drying time that will give you the amount of moisture you want in a specified mass of algae? (Hint: what does it mean to say that information can be interpolated from a graph?)

7. Use the graph below to determine how long it will take to dry this algae to 10% moisture content. List your answer and describe how you arrived at this answer.



Drying time: _____
The reason I think this is:

8. Build a data table that you could use to develop a drying curve for your own experiment.

9. You should now be able to dewater and dry your algae with a specific moisture content in order to form it into pellets. Run your experiment and fill in your data table from #8.

10. Graph the data you collected.

10. Once you have algae that has the correct moisture content you need to form it into a solid pellet. How could you use a simple syringe to do this? Jot your ideas below.

11. Form your algal pellet and let it dry overnight.

Analysis

1. What was the drying time that produced algae with 12-20% moisture content? Explain how you derived your answer using data for support.

2. What problems did you encounter with your drying chamber procedure?

3. How would you go about fixing these problems? i.e. how would you change your experimental design?

4. If you were to build a “large scale” device to dry large amounts of algae to form into pellets, what type of problems might you encounter?

5. Choose one of your problems from #4 and explain how you could solve this problem.

Extra Credit:
Design/draw a device that would dry large amounts of algae.