Student Name: Period:

Instructions for Making Paper

Gather and Prepare the Materials

1. Cut the fine-mesh screen to a size that will easily fit in the large tub. You do not need to make the screen as large as the tub. The ideal size for this activity is about the size of a large post-card.
2. Cut the felt into two equal pieces, each slightly larger than your screen.

Prepare the Source Paper

3. Tear the paper into small pieces.
4. Soak the paper in warm water for at least one hour. For best results soak overnight.

Create the Paper Pulp

5. Place the soaked paper in a blender, filling it about a quarter of the way.
6. Add enough warm water to the blender to fill the blender halfway.
7. Blend the water and paper mixture on slow. Gradually increase the blender speed and blend until you have a paper pulp about the consistence of watery oatmeal. If the blender seizes, you can add a small amount of water.

Make the Paper

8. Fill the large tub halfway with water.
9. Place the fine-mesh screen at the bottom of the tub.
10. Add pulp to the tub and mix it into the water. The more pulp you add, the thicker your paper will be. Remove any large clumps of pulp.
11. Add two teaspoons of liquid starch to the tub and stir.
12. Slowly lift the screen from the basin, gently shaking it to even out the paper pulp on the screen. You may need to support the screen underneath as you lift it out of the tub.

Dry and Set the Paper

13. Hold the screen over the tub and let any excess water drip back into the tub.
14. Place a piece of felt slightly bigger than the screen on a flat surface. Lay the screen with the paper pulp still on it on top of the felt and cover it with another piece of felt.
15. Iron the top piece of felt on a low setting. Alternatively, roll over the felt with a rolling pin. This method will take significantly longer to dry.
16. When the paper is dry enough, but not completely dry, remove it from the screen and felt. Place it on a smooth, flat surface, and roll over it with a rolling pin. Flip the paper over and repeat on the other side. Note that you can skip this step, but rolling the paper in this way will make the final product smoother.
17. Allow your paper to dry completely before using it.
18. Trim the edges if desired.

Data Sheet

Paper Engineering

Define the Problem

1. Before attempting to solve a problem, you must be able to clearly state what the problem is.

   What is the problem you are trying to solve? Be sure to identify the contaminant you are trying to remove.

2. Any engineering design must work within certain constraints and considerations. Constraints are absolute limits (example: a bookshelf to go onto a specific wall cannot be larger than that wall). Considerations are other things that must be thought about in the design, but aren't absolutely necessary (example: The bookshelf is going into a blue and white room, so it would be best if it were blue and white; however, a red bookshelf could work if necessary).

   List the constraints for this problem.

   List the considerations for this problem.

3. Develop a set of criteria by which you will judge whether your paper is of acceptable quality. As you develop your criteria, keep in mind both the characteristics of good paper and the quality of paper you were able to realistically produce in part 1.

   What are the criteria you will use to judge if your paper is acceptable?

4. Come up with a method to test your paper to see if it meets the criteria you described.

   How will you test your paper to see if it meets the criteria?

Design a Solution

1. Brainstorm ideas for possible ways to remove the contaminant. Accept any ideas at this point.

   What are your best ideas?_____

2. Do some research into your ideas. This could mean looking things up online or experimenting with materials you are considering. Document your research carefully on a separate piece of paper.

   Summarize your research here. _____

3. Select one of your ideas for how to remove the contaminant during the papermaking process and develop step-by-step instructions on a separate sheet of paper. Attach your instructions to the end of this data sheet. Below, include a detailed, labelled diagram to illustrate how your idea will work.

4. Develop step-by-step instructions for how you will make your paper and remove the contaminants during the process. These instructions should be specific enough that someone else could read them and follow your process.

   Write step-by-step instructions on how you will make the paper and remove the contaminants.

Test and Refine Your Solution

1. Follow the instructions you wrote carefully to make a small batch of paper.
2. Test your paper as you described in step 4 of the Define Your Problem section to see if it meets the criteria you described in step 3. Take detailed notes on any problems you see when testing the paper. You will need these notes when you improve your solution, so be very specific.

   Record your notes here.
3. Evaluate the results of your test. Think about these questions: Was the contaminant successfully removed? Does the paper meet your criteria for acceptable quality? Which criteria were not met? What specific issues did you have?

   Write your evaluation here.
4. Develop a plan for how you will re-engineer your idea to improve it. If you found problems in your testing, be sure your plan addresses each problem.

   Summarize your plan.
5. Follow steps in the Design Your Solution and Test and Refine Your Solution sections again, using your new plan. Repeat this process as many times as you can or until you are satisfied with your results.

Engineering Process