

SECTION 5
ANALYZE YOUR DESIGN

Length of Lesson: 120 min

Desired Results:

Mathematical Standards:

1. Students will be able to calculate the amount of materials, measure the thickness of paper and compare the strength of the paper.
2. Students should understand numbers, ways of representing numbers, relationship among numbers, and number systems.
 - Understand and use ratios and proportions to represent quantitative relationships
3. Students should understand measurable attributes of objects and the units, systems, and process of measurement.
 - Understand both metric and customary systems of measurement
4. Students should understand how to apply appropriate techniques, tools, and formulas to determine measurement.
 - Solve problems involving scale factors, using ratio and proportion

Prerequisites:

- Read at sixth grade level or above
- Possess basic computer skills in word processing and search the web
- Science knowledge at fifth grade level or above

- Mathematical knowledge at fifth grade level or above

Tools, Materials, and Equipment Required:

- Computers that have access to program of calculation
- Area for students to have discussions
- Tools for measurements:
Experiment jig, weights, rulers

Active Learning Plan

Preparation of teacher before lesson is taught (20min)

- Review the ideas and objectives of the lesson.
- Review the detailed instructions.
- Obtain enough tools and record paper for students to analyze.

Presentation (40min)

- Discuss the necessity of calculating the productivity of recycled paper.
- Discuss the factors that should be taken into consideration to calculate the productivity.
- Analyze how to calculate the productivity of recycled paper.
- Review the methods of testing the thickness and the strength of recycled paper.

Application (80min)

- Assign each group to calculate the productivity of recycled paper, then test the thickness and strength of recycled paper.

Evaluation

- Assessment (record of analysis) that evaluate student's understanding of the core concepts in the lesson.

Teacher Reflection

- What happened during the lesson? How effective was the lesson plan?
- How the desired results were met? What are next steps to improve student learning?

Ways to Test the Thickness and Strength of the paper

How to measure the thickness of paper

Formula:

N = Number of pieces of paper

T_N = Thickness of all the pieces of paper

T = Thickness of each piece of paper

$T = T_N/N$

Discuss: Can you measure the thickness more accurately?

Method 1: Use more pieces of paper

Method 2: Use more accurate measuring tool

How to test the strength of paper you made



Step1: Cut different kinds of paper into same size (at least 6in X 6in)

Step2: Secure 1 sheet of paper to experiment jig.

Step3: Place coins one-by-one onto center of paper, see Figure 1.

Step4: When it breaks, calculate the total weight.

Step5: Record the total weight that the paper held.

Step6: Repeat steps 2-5 4 times for each type.

Conclusion: the type held most weight is the strongest.

Reference

Science Experiment. (2010). Science Experiment. Retrieved May 29, 2010 from:

<http://sbufoon.webs.com/procedures.htm>

Record of Analysis

1. Test of the strength of the paper

a. Record the number of weights

	Type A	Type B	Type C	Type D	Type E	Type F
1						
2						
3						
4						
5						
Average						

b. The strongest type of paper is: _____

c. The weakest type of paper is: _____

2. Measurement of the thickness of the paper

a. Record the number of you measured

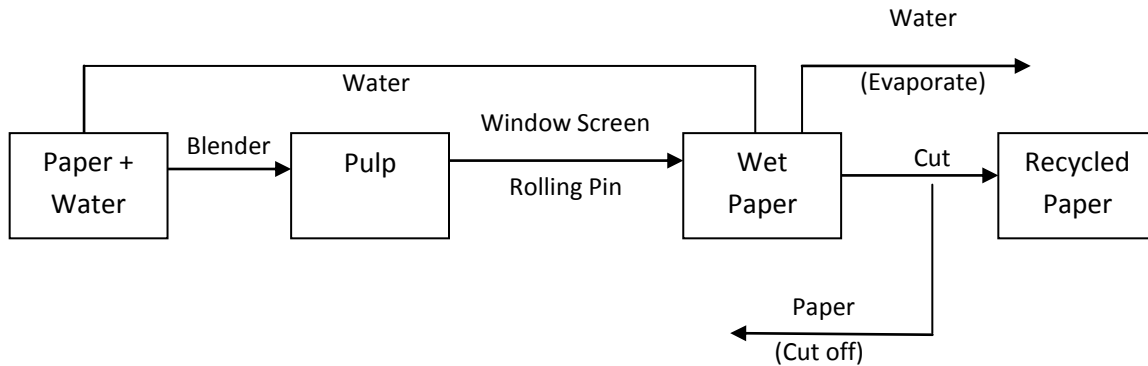
	Type A	Type B	Type C	Type D	Type E	Type F
Thickness of all the pieces of paper						
Number of pieces						
Thickness of each piece of paper						

b. The thickest type of paper is: _____

c. The thinnest type of paper is: _____

3. Calculate: How much waste paper and water is needed to product 100 square feet recycled paper?

Flow chart:



Above is the flow chart of the production, to calculate how much waste paper needed to product 100 square feet recycled paper. We need the area of original paper (S_O) and the area of recycled paper we made (S_R) from Section 3. We can use following formula to calculate.

Formula 1:

S = Area of paper needed to produce 100 square feet recycled paper

$$S = 100/P = 100/(S_R/S_O)$$

$$P = S_R/S_O$$

P = Productivity

S_O = Area of original paper

S_R = Area of recycled paper

Formula 2:

M = Mass of water needed to produce 100 square feet recycled paper

$$S = 100/P = 100/(S_R/S_O)$$

$$P_w = (M_O - M_R)/M_O$$

P_w = Productivity of water

M_O = Mass of water added into the blender

M_R = Mass of water reused from the pulp