De-Inking Paper for Recycling

Introduction

Teach the basic scientific principles behind the de-inking process involved in paper recycling.

Concepts

- Separation technology
- Recycling
- Papermaking
- Surfactants

Background

The first step of the recycling paper process is often "de-inking." This process of de-inking is just as it sounds—the removal of ink from a pulp slurry.

Ink toners, as well as other hydrophobic substances, are removed from the pulp slurry and ultimately the finished paper product by the process demonstrated in this activity. Since the pulp slurry is aqueous, air bubbles running through the solution attract hydrophobic substances in the mixture. The bubbles and hydrophobic molecules rise to the surface and foam out of the slurry. This process is aided by use of a chemical *surfactant*. A surfactant reduces the force of surface tension in water thus allowing the hydrophobic substances to be removed from the pulp. The chemical used as a surfactant in this lab is regular dish soap, which also works as a foaming agent to carry the hydrophobic substances away from the pulp. The de-inking process in this activity is similar to the commercial process.

Materials

Detergent, dishwashing, 2 drops
Water, tap, 350 mL
Air pump with plastic tubing
Air stone
Balance
Bin or demonstration tray, plastic
Beaker, 600-mL
Blender
Paper printed with ink, several sheets
Stirring rod

Safety Precautions

Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Tear approximately 20 g of paper sheets into 1–2 inch squares and add the paper to a 600-mL beaker.
2. Add 2 drops of dishwashing detergent to the same 600-mL beaker.
3. Add 350 mL of water to the same beaker and mix the soap and water solution with a stirring rod.
4. Pour the paper, water, and soap mixture into a blender and blend until the mixture is a uniform oatmeal-like consistency.
5. Pour the mixture from the blender back into the beaker.
6. Place the beaker containing the pulp slurry inside a plastic bin or demonstration tray.
7. Connect one end of the plastic tubing to the air pump and the other end to the air stone (see Figure 1).
8. Submerge the air stone with the tubing connected down into the pulp slurry.
9. Plug in the air pump. The soapy pulp mixture will begin to foam. In about a minute, ink particles will become visible in the foam layer. Students will need to come up to the demonstration table to observe the process unless a FlinnCam™ Camera or similar demonstration camera is used.

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Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures, and review all federal, state and local regulations that may apply, before proceeding. Leftover pulp may be flushed down the drain with excess water according to Flinn Suggested Disposal Method #26a.

Figure 1. Schematic drawing of the de-inking demonstration.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
MS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions
MS-ESS3 Earth and Human Activity
ESS3.C: Human Impacts on Earth Systems

Disciplinary Core Ideas: High School
HS-PS1 Matter and Its Interactions
PS1.A: Structure and Properties of Matter
PS1.B: Chemical Reactions
HS-ESS3 Earth and Human Activity
ESS3.C: Human Impacts on Earth Systems

Science and Engineering Practices
Asking questions and defining problems
Developing and using models

Crosscutting Concepts
Cause and effect
Systems and sytem models
Structure and function

Tips

- Black and white newspaper or regular, white paper that has been printed with ink or toner will work well for this activity.
- This demonstration is a great introduction to the Flinn Paper-Making Kit, Flinn Catalog No. FB1486.
- Although ink particles will be observed after a few minutes, it will take several hours to remove most of the ink in the pulp slurry. You may choose to allow the air pump to run after completion of the demonstration, do not leave the air pump running unsupervised overnight because the plastic bin will overflow with soap bubbles.
- If the pulp mixture will be used later to make paper, place the "de-inked" contents in a strainer and rinse the mixture well with tap water to remove soap residue.

Reference

Venditti, R. A. A Simple Floatation De-Inking Experiment for the Recycling of Paper. J. Chem. Ed., **2005**, 81, 693.

Materials for *De-Inking Paper for Recycling* are available from Flinn Scientific, Inc.

Catalog No.	Description
FB0218	Air Pump, 5 gal
FB0262	Air Stone
C0241	Cleaner, Dishwashing, 22 oz
AP8373	Tubing, Plastic, 10 ft
FB1486	Paper-Making Kit
AP9176	Plastic Utility Pan

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.