

Mystery Nylon Factory



Introduction

Two solutions are poured together in a beaker. A paper clip is inserted down into the solutions. As the paper clip is withdrawn, almost by magic a very long strand of nylon is pulled from the beaker. A super demonstration to discuss polymer concepts.

Concepts

- Polymerization
- Condensation polymer

Materials

Adipoyl chloride/hexane solution, 7 mL

Beaker, 50-mL

Hexamethylenediamine/Sodium hydroxide solution, 7 mL

Paper clip

Safety Precautions

Hexamethylenediamine/sodium hydroxide solution is toxic by ingestion and is corrosive. Adipoyl chloride/hexane solution is a flammable liquid and is toxic by ingestion and inhalation. Chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron should be worn. Perform this demonstration under a fume hood or in a well-ventilated room. Do not handle the nylon without wearing gloves unless it has been thoroughly washed. This activity requires the use of hazardous components and/or has the potential for hazardous reactions. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Preparation

Purchase or prepare adipoyl chloride/hexane (4.6 g adipoyl chloride in 100 mL hexane) and hexamethylenediamine/sodium hydroxide solution (60 g 1,6-hexamethylenediamine and 20 g sodium hydroxide in 1 L of distilled water).

Procedure

1. Add 7 mL of the hexamethylenediamine/sodium hydroxide solution to a small beaker.
2. Slowly add 7 mL of the adipoyl chloride/hexane solution down the side of the beaker. *Do not stir or mix the solutions.*
3. Note the formation of a white film at the interface of the two solutions.
4. Use a bent paper clip (opened to form a hook) to pull the film from the beaker. Pull slowly until there is no more nylon left. The nylon should be easily pulled from the beaker in the form of strands.
5. Wash the nylon strands by rinsing with water several times.
6. Lay the nylon strands on a paper towel to allow them to dry.

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. The nylon produced may be washed, dried, and treated according to Flinn Suggested Disposal Method #26a.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation

Form and function

Content Standards: Grades 5–8

Mystery Nylon Factory *continued*

Content Standard B: Physical Science, properties and changes of properties in matter

Content Standards: Grades 9–12

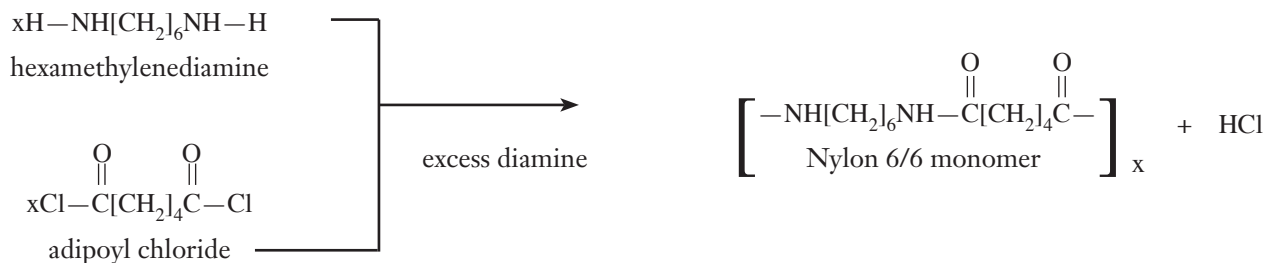
Content Standard B: Physical Science, structure and properties of matter, chemical reactions

Tips

- Let your students observe that the two solutions do not mix. They are immiscible.
- Observe the production of a film at the interface of the two solutions and the removal of the film as a long string of nylon.
- Make sure that the nylon is washed several times before it is handled.
- The hexamethylenediamine solution is slightly pink to make it more visible during the demonstration. If the pink has faded, add 1–2 drops of red food coloring
- Sebacyl chloride can be used in place of adipoyl chloride to produce nylon 6/10.

Discussion

Nylon is a generic name for a family of polyamide polymers. W. H. Carothers at Dupont discovered nylon in 1935. It was quickly commercialized and played an important role in World War II in clothing and parachutes. Nylon is a condensation polymer since a molecule of water or HCl is formed for each extension of the polymer chain. A common nylon product is Nylon 6/6 which is produced from the reaction of two 6-carbon compounds, hexamethylenediamine and adipoyl chloride or adipic acid.



Nylon is a thermoplastic and can be molded into shapes or extruded into a fiber. Nylon fibers are stronger and more elastic than silk and are relatively insensitive to moisture and mildew. Nylon is used in many commercial products such as hosiery, athletic apparel, bristles for toothbrushes, rugs and carpets, sails, parachutes, and some astroturfs.

Acknowledgment

Special thanks to Jim and Julie Ealy, The Peddie School, Hightstown, NJ, who provided us with the instructions for this activity.

Materials for *Mystery Nylon Factory* are available from Flinn Scientific, Inc.

Catalog No.	Description
AP2088	Mystery Nylon Factory—Chemical Demonstration Kit
A0185	Adipoyl Chloride/Hexane Solution
H0032	Hexamethylenediamine/sodium hydroxide solution, 100 mL
S0260	Sebacyl chloride/hexane solution, 100 mL

Consult the [Flinn Scientific website](#) for current prices.