Amazing Enviro-Bond™

An Oil Spill Cleanup Demonstration

Introduction

Oil, oil everywhere! Cleaning up oil spills on water surfaces has become a major environmental problem. This oil spill cleanup demonstration will undoubtedly capture student interest, stimulate scientific inquiry, and heighten awareness of environmental issues facing society today.

Concepts

- Pollution
- Polymers

Materials

Enviro-BondTM 403

Marvel Mystery Oil®, 20 mL, or kerosene, 50 mL

Tap water, 250 mL

Heavy duty zipper-lock plastic bag, large

Graduated cylinder, 100-mL

Spatula

Safety Precautions

Enviro-Bond™ 403 may be irritating to eyes; material has slight oral toxicity. Do not burn Enviro-Bond™; combustion products are toxic; keep from extreme heat and open flame. Marvel Mystery Oil® may be mildly irritating to eyes. Combustible liquid; keep away from heat and open flame. Wear chemical splash goggles, a chemical-resistant apron, and chemical-resistant gloves. Please review current Material Safety Data Sheets for additional safety, handling, and disposal information.

Procedure

1. Fill a large zipper-lock bag with about 250 mL of tap water.
2. Add approximately 20 mL of Marvel Mystery Oil. If Marvel Mystery Oil is unavailable, use 50 mL of kerosene. The oil is less dense than the water and will form a thin layer on the surface of the water.
3. Ask students to think of ways to clean up the "oil spill."
4. Add just enough of the Enviro-Bond polymer to completely cover the oil. The polymer will immediately bond to the oil and will form a sponge-like mixture that floats on the surface of the water.
5. Seal the bag. Pass it around and allow students to discover the amazing bonding qualities of the polymer.
6. Initiate the reaction by squeezing the medicine dropper and allowing a few drops of water to enter the flask.
5. Drain out the water and again pass around the bag of "solidified oil" for students to observe. As the polymer dries, it becomes firm and rubbery, like sponge cake. The free molecules find bonding sites and become three dimensionally entan- gled with the polymer structure itself.

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Dispose of Enviro-Bond in the solid waste disposal according to Flinn Suggested Disposal Method #26a. Recycle all oil waste. Take used oil to an automotive service center, oil recycling station or authorized collection site.

Tips

- The entire demonstration can also be effectively performed by using a beaker in place of the zipper-lock bag.

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- Enviro-Bond 403 is a hydrocarbon-encapsulating polymer and is formulated to bond quickly and safely to many types of liquid hydrocarbons. It will effectively treat kerosene, crude oil, diesel fuel, and gasoline.
- A 10 oz-bottle of Marvel Mystery Oil equals approximately 300 mL.
- Marvel Mystery Oil is a proprietary mixture containing mineral spirits and oil distillates. It is a light red-colored liquid with a mild petroleum odor. The color and low odor make this ideal for use in this demonstration. Crude oil, diesel fuel, gasoline or other liquid hydrocarbons may also be used; however, these are discouraged for use in the classroom due to the fumes released and the volatile nature of the substances.
- Students will undoubtedly ask if the polymer will work on other types of oil such as motor oil or vegetable oil. These oils do not have the necessary hydrocarbon components, namely the parafinics, naptinics, or aromatics required to bond to the polymer.

Discussion

Enviro-Bond 403 is a proprietary mixture of organic block copolymers. It is a white, essentially odorless, solid and is in granular form. The chemical formulation of Enviro-Bond 403 is a proprietary mixture. However, the inventor agreed to share some limited information about the product for educational purposes.

Enviro-Bond is a hydrocarbon polymer (much like polyethylene or polypropylene) that is a macromolecule with repeating ends. The polymer chains may consist of linear, alternating, or branched configurations. The hydrocarbon molecules are attached along the polymer chain. The major components of oil (paraffins, naphthalenes, and aromatics) are attracted to and absorbed onto the polymer. The polymer encapsulates the oil, preventing the oil from escaping. The Enviro-Bond particles adhere to one another to form a semi-solid mass.

Enviro-Bond makes an ideal water cleanup product because its density is less than water (0.91 g/mL) so it floats at the oil–water interface. In addition, the polymer is hydrophobic and is attracted to hydrocarbons. Enviro-Bond is used commercially to clean up larger oil spills and small oil leaks in factories. The amount of Enviro-Bond 403 needed to clean up an oil spill is based on a weight ratio. The weight ratios of the polymer to the hydrocarbon have been established as shown in the chart. For sample applications, it is best to add enough Enviro-Bond polymer to the spill until the mass begins to turn white and becomes semi-solid. This is the indication that free hydrocarbons in the oil can no longer undergo addition to the Enviro-Bond polymer chain.

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
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, properties and changes of properties in matter
Content Standard F: Science in Personal and Social Perspectives; personal health; populations, resources, and environments; natural hazards; risks and benefits; science and technology in society

Content Standards: Grades 9–12
Content Standard A: Science as Inquiry
Content Standard B: Physical Science, structure and properties of matter, chemical reactions
Content Standard F: Science in Personal and Social Perspectives, personal and community health, population growth, natural resources, environmental quality, natural and human-induced hazards, science and technology in local, national, and global challenges

Acknowledgments

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Materials for *Amazing Enviro-Bond™* are available from Flinn Scientific, Inc.

Catalog No.	Description
E0058	Enviro-Bond™ 403, 100 g
AP8927	Marvel Mystery Oil®, 10 oz
K0002	Kerosene, 500 mL

Consult the Flinn Scientific website for current prices.