



Hazardous Materials & Spill Response

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Introduction

The purpose of this presentation is to provide college instructors and industry trainers with a low- cost activity that will demonstrate the effectiveness of a variety of chemical absorbents. What follows here is a brief description of concepts and terminology related to chemical spills. In addition, procedures for demonstrating these activities in a classroom or laboratory setting are also provided. There is no single best method or material for handling all spills. The size of the spill, the inherent dangers of different chemicals, and environmental conditions are never exactly the same. This laboratory activity is only a starting point for explaining fundamental information. Preparation for real-world spill response takes many hours of practice and the knowledge base to assess site-specific hazards.

Background

Uncontrolled chemical spills, both small and large, can result in injuries to personnel and damage to the environment. Quick response with the proper materials can mitigate the negative impact. Emergency responders within an organization must be aware of options available to control spills. A number of effective materials can be utilized but the wrong choice can actually increase the amount of hazardous waste, which will require costly disposal.

Absorbents

All absorbent materials have their strengths and weaknesses. Traditional bulk absorbents are made of clay and have approximately 1:1 absorption ability. In addition, the clay is likely to contain minerals that can damage machinery. (On the Mohr or Mohs Hardness Scale steel has a hardness factor of 6, while the quartz in clay absorbents has a factor of 7). Other products, made of substances such as recycled cellulose, peat and polypropylene, have a higher initial cost, but can absorb many times their weight in liquids.

Once the chemicals are absorbed, handling of the waste becomes a major issue. Incineration, land filling, recycling and catalytic transformation (digestion) are all possibilities. Biodegradability of absorbents presents some surprising problems. As the absorbent degrades, a secondary release of the chemical can



occur in a landfill. Depending on individual company remedial needs and local environmental regulations, you may not want to utilize biodegradable materials.

Personal Protective Equipment

The amount of hazardous chemicals used in this activity are kept to a reasonably safety level. The only safety equipment required is safety glasses. Spill teams and HazMat responders are likely to be dealing with much larger quantities and must always wear personal protective equipment designed to protect them from the hazards involved.

Cost of Clean-Up

The cost of clean-up and disposal of chemicals and absorbents can vary widely. For example, 55 gallons of diesel fuel weighs approximately 400 lbs. To clean up a spill of that quantity, you might need 400 lbs. or more of a clay absorbent but maybe only 50 lbs. of specially processed polypropylene or peat. According to one manufacturer, the Waste Solutions Corporation:

You will need five (5) 55 gallon drums to dispose of the clay while the (our absorbent) will fit in just a little over one (1) 55 gallon drum. To incinerate the five drums of clay, you will spend \$500 per drum. To incinerate (our absorbent), you will spend a total of \$168. As you can now see, total costs using (our absorbent) are \$238 while the total costs using clay are a whopping \$2557.75! Disposing of the waste in a landfill produces similar savings. When you take (this waste) to an approved landfill, the cost would be just \$25. (

Conclusion

As you go through these laboratory activities, have students pay attention to the amount of hazardous waste created and the capabilities of different products. Regardless of the absorbent material being used, the hazards associated with the spilled chemicals remain and need to be handled with caution.

If students are conducting these experiments in small teams, you can have them complete the Laboratory Report sheet as a way of assessing their understanding. Remember, you will always have a student named Murphy. If something can go wrong, it will! But if you choose your chemicals carefully and supervise students diligently, this will end up being a great learning activity.



LABORATORY ACTIVITIES ON HAZARDOUS MATERIALS & SPILL RESPONSE

Lab Objectives

At the completion of this activity, you should be able to:

1. Identify a variety of absorbents used on chemical spills.
2. Describe why absorbents need to be matched to the chemical.
3. List the materials contained in an emergency response spill kit.
4. Explain the difference between hydrophobic and hydrophilic absorbents.

Needed Laboratory Equipment

Safety glasses or safety goggles

Tweezers

250 ml beaker

2 trays

Water

100 ml Graduated Cylinder

Acetic acid (C₂H₄O₂)

Kerosene or Vegetable Oil

Absorbent Pads

Clay absorbent

Scale

50 ml Graduated Cylinder

Definitions

Absorbent Socks—Polypropylene or acid resistant fabric tubes of absorbent material. Sometimes referred to by the trade name PIGS®.

Booms—Floating absorbent tubes containing hydrophobic materials.

HazMat Pads—Fabric mats or pads that can encapsulate and neutralize hazardous chemicals.

Hydrophilic absorbent— material that absorbs water and water based liquids.

Hydrophobic absorbent—A material that repels, rather than absorbs, water.

Peat Moss—An organic, hydrophobic absorbent made from sphagnum moss. The moss is dried and packaged in bulk, booms and socks. The material contains acids and microbes that transform hydrocarbons into water, carbon dioxide and fatty acids. Brand names such as Biomatrix Gold and Exsorbet



Polypropylen—A polymer that can be made into plastics and fibers. As a fiber, it can be made into textiles such as carpet, fabric or hydrophobic absorbent materials.

Traditional absorbents—A clay-based, abrasive material that can absorb its weight in liquids and may contain silica.

Universal Absorbents—Cellulose materials (usually manufactured from recycled products) that are non-selective in the liquids they absorb.

Required Safety Precautions

1. Read all instructions carefully before proceeding with any lab activity.
2. Primary eye protection must be worn at all times.
3. All laboratory experiments must be conducted with adequate ventilation.
4. Review emergency eye wash procedures with your lab partner.
6. Dispensing and collection of all liquids must be from the distribution table.
7. All combustible liquids must be disposed of properly at the end of each procedure.
8. All contaminated paper towels and absorbent materials must be placed in the red triangular waste containers with self-closing lids.
9. Immediately wash off any liquids that you spill on your hands no matter how small the amount.
10. If an unintentional liquid spill occurs in the lab, cover with absorbent pad.
11. All beakers, trays, etc., must be thoroughly cleaned and rinsed at the conclusion this laboratory activity.

Lab Procedure—Part 1 Absorbent Pads

- 1.1 Place exactly 75 ml of water into the “hex base” graduated cylinder. Then pour the water into the tray provided for this experiment.
- 1.2 Add exactly 10 ml of kerosene (or vegetable oil if instructed) to the water.
- 1.3 Use a 4” x 4” pad of hydrophobic material (white PIG® Oil-Only Spill Mat) and place on the surface of the tray. With the tweezers, drag the pad over the surface until all the kerosene is absorbed. If a scale is available, weigh tray and contents.



- 1.4 Remove the pad with tweezers. Place used pad in the triangular container.
- 1.5 Pour the remaining liquid from the tray into the 100 ml graduate cylinder and record the amount of liquid that was absorbed by the hydrophobic pad.
Amount of Liquid Absorbed _____ ml.
- 1.6 Pour the contents of the cylinder back into the tray. Once again add 10 ml of kerosene (or vegetable oil if instructed) to the water.
- 1.7 Use a 4" x 4" pad containing a universal absorbent (gray PIG® Universal Mat) and place on the surface of the tray.
- 1.8 Remove the pad with tweezers and observe the results.
- 1.9 Place used pad in the triangular waste container.

Lab Procedure—Part 2 Absorbent Clay

- 2.1 Place 50 ml of water in the tray provided for this experiment.
- 2.2 Add 10 ml of kerosene (or vegetable oil) to the water. If a scale is available, weigh tray and contents.
- 2.3 Sprinkle 2 teaspoons of clay absorbent on the surface. Gradually add more until the liquid is fully absorbed. Observe the results. If a scale is available, weigh tray and contents again and compare with step 1.3.
- 2.4 Dispose of all materials in the waste container provided.

Lab Procedure—Part 3 Acid Resistive Absorbent Pads

- 3.1 Place exactly 75 ml of water into the “hex base” 100 ml graduated cylinder.
- 3.2 Pour the 75 ml of water into the tray provided for this experiment.
- 3.3 Add exactly 25 ml of dilute acetic acid (vinegar) to the tray water.
- 3.4 Use a 4" x 4" pad of hydrophobic material (white PIG® Oil-Only Spill Mat) and place it on the surface of the tray. Remove the pad with tweezers.
- 3.5 Pour the liquid from the tray back into the graduated cylinder.
- 3.6 Record the amount of liquid that was absorbed by the hydrophobic pad.
Amount of Liquid Absorbed _____ ml.



- 3.7 Place used pad in the container provided.
- 3.8 Pour the contents of the cylinder back in the tray. Use a 4" x 4" acid neutralizing pad (pink PIG® HAZ-MAT) and cover the surface of the tray.
- 3.9 Remove the pad with tweezers and observe the results.
- 3.10 Place used pad in the container provided.

Summary

After completing this laboratory activity, you should have a thorough understanding of the capabilities of different absorption materials. It is important to consider effective hazardous material control and waste minimization. Reclaiming or recycling petroleum-based chemicals is simpler and less costly if it is not contaminated with water.



Lab Report

Name _____
_____ *Date* _____
_____ *Lab Section* _____

(This assignment must be submitted within 24 hours after completing lab experiments)

1. Explain what happened when the hydrophobic material was used on the kerosene (or vegetable oil) spill.
2. Explain what happened when the universal material was used on the kerosene (or vegetable oil) spill.
3. Explain what happened when the clay material was used on the same spill.
4. Explain what happened when the neutralizing absorbent material was used on the acetic acid/water spill.
5. How much liquid was absorbed by the hydrophobic pad in Lab Procedures—Part 1 and Lab Procedure—Part 3?
Amount of Liquid Absorbed in Part 1 = _____ ml. (from 1.5)
Amount of Liquid Absorbed in Part 3 = _____ ml. (from 3.6)
6. List the materials you would want in an emergency response spill kit.