Teacher packs in Experimental Science

CHE Pack 3

Purification of air –freshener

Pack contents:

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Curriculum areas covered:

- Physical and chemical changes
- Compounds, mixtures, solute and solvents
- Homogenous and heterogeneous mixtures
- Separation of mixtures

Produced as part of DelPHE-funded collaboration between University of Cape Coast and The Open University, UK

Title: Purification of air –freshener
Target group: DBE students

Also suitable for: Senior High School students

Duration: 50 minutes and Discussion time

Learning outcomes

These are the learning outcomes expected after students have gone through this Pack

1. **Knowledge and understanding**

   KN1 explain the term, sublimation
   KN2 sublime and recover the pure air-freshener

2. **Cognitive skills**

   CS1 apply knowledge and understanding to purification of similar mixtures
   CS2 list examples of substances that sublime

3. **Key Skills**

   KS1 Separate other similar mixtures

4. **Practical skills**

   PS1 set up the equipment for sublimation process.
   PS2 observe and record what happens to the solid.

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A. Teacher's Guide

This experiment is best done as a demonstration. As it can take several minutes for anything to happen, it would be advisable to have another activity for students while they wait.

Most of the substances in the air fresheners are harmful. This is not a problem in day-to-day use as the vapour pressure and hence the amount which is in the air is low. However, heating causes them to sublime quickly and they could reach harmful levels in the air so a fume cupboard or other method of preventing escape to the air is necessary.

Assessment Questions

1. Describe the process of sublimation (KN)
2. Give two examples of substances that sublime readily (C)
3. Outline how would you recover pure iodine from a mixture of iodine and sand? (C)
4. It is advisable not to place dry ice in a closed bottle. Why not? (C)

Technical Notes

Solid toilet bowl cleaners work best; if possible, use a coloured one. If cheap ones containing p-dichlorobenzene (*P-dichlorobenzene* is very **harmful and dangerous to the environment**) are used, handle them with tongs in a fume cupboard. ***Gel-type*** air fresheners will not work.

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B. Student Guide

Purpose:

By the end of the experiment, the students will be able to appreciate that a solid can turn directly to a **gaseous state** without passing through the liquid phase or vice versa

Bakcground

Some substances, when heated, change directly from solid to vapour. This process is known as sublimation. It is a separation technique where there is the vaporization of a solid from a solid-solid mixture. Examples of substances that sublime are iodine crystals, ammonium chloride crystals, moth repellents, dry ice (carbon dioxide) etc.

⇒ Iodine is a shiny black crystalline solid at room temperature. On heating, it forms a purple vapor which crystallizes on cooling. It is **harmful and dangerous to the environment** so this activity should be done in a fume cupboard.

⇒ Moth repellents are household chemicals e.g. naphthalene and camphor, used to repel insects and moth larvae from cupboards and wardrobe. They slowly sublime at room temperature.

⇒ Dry ice sublimes at -78.5°C and above. Handle with tongs or thermal gloves. You would not be able to watch this re-form the solid but it is great and a lot of fun for observing the change from solid to gas.

Note: few substances sublime. But for these substances this is a useful method of separation.

If a mixture containing one of these substances is heated, the substance is changed to vapour; the vapour can be **deposited** on a cold surface and the solid substance reappears.
Solid air freshener contains p-dichlorobenzene which is also found in some types of moth balls (be careful, this substance is toxic!). Some of them are coloured and deodorized with nice flavours like vanilla and lemon. Pure samples of the air freshener can be obtained by heating over a water bath to sublime the solid air freshener, and then cooling and collecting it in a cold beaker. If a coloured air freshener is used, a white crystalline substance is collected on the cold beaker. The dye does not sublime because it is not chemically a part of the compound that does sublime. Vapour deposition is an important industrial process for separation and purification.

Equipment/ Materials

a) Eye goggles
b) Hand gloves (for those with sensitive skin)
c) 2 Beakers/glass jars
d) Clamp stand

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e) Shallow dish/watch glass/evaporating basin
f) Thermometer
g) Fume cupboard
h) Hot water
i) Solid air freshener, few lumps (*see technical note*)

Other requirements

- Working bench/table
- open space
- source of water supply
- laboratory coat
- eye goggles
- nose mask
- hand gloves.

Experimental Procedure

a. Wear eye protection, nose mask and hand gloves.
b. Place a few lumps of air freshener in the bottom of one of the beakers.
c. Fill the other beaker three quarters full with ice.
d. Clamp the beaker with ice carefully in position on top of the beaker of air freshener.
e. Put the shallow dish/watch glass/pan/evaporating basin into the fume cupboard and fill it about one-third full of water which is hotter than 45 °C.
f. Put the stacked beakers into the dish of hot water – *see figure 1.*

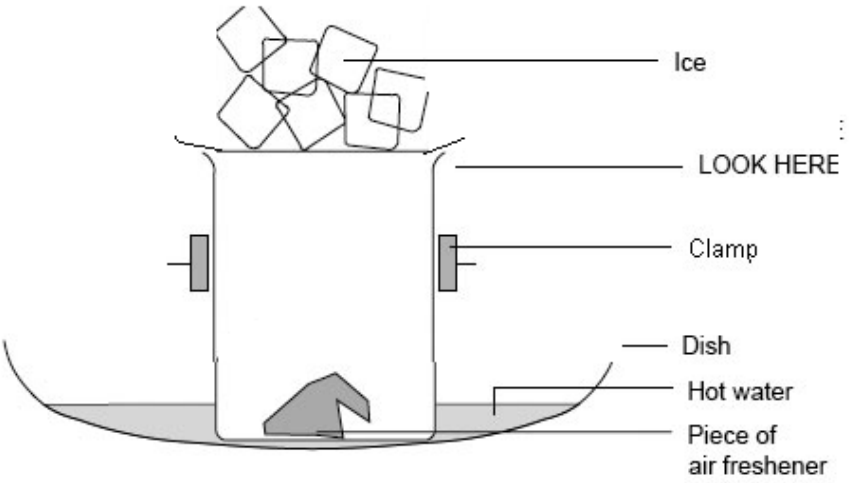

Figure 1: sublimation of air-freshener

g. Observe and record what happens to the solid.

Be patient as it may take a while

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Reflection on the experiment

What did you observe at the bottom of the pan/watch glass?

What was the colour?

Does the dye also sublime? (Yes/No). Give reasons for your answer.

What would happen if the temperature of the water is below $10^{o}C$?

Can this process be used to separate iodine from charcoal?

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C. Assessment – Student's sheet

On completion of the experiment, you should answer the following questions:

1. Describe the process of sublimation. (KN1)

2. Give two examples of substances that sublime readily (CS2)

3. Outline how would you recover pure iodine from a mixture of iodine and sand (KS1)

4. It is advisable not to place dry ice in a closed bottle. Why not? (C)

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D. Extensions to experiment

Carbonation of water to create sparkling water

Dry ice, being frozen CO_2 gas, can be used to carbonate water to create sparkling water. Place some drinking water in a glass, and add some dry ice. Allow it to bubble. Ice may form *around the dry ice. If this happens, you can either leave it alone, or break it up with a spoon to help the process along. When all of the dry ice is gone, taste the water that remains. It should taste slightly carbonated.*

E. Useful links

1. Borgford, Christie L. and Summerlin, Lee R. **Chemical Activities: Teacher Edition.** American Chemical Society, Washington, D.C. 1988.
2. Freemantle M. H. and Tidy J. G. (1983) *Essential Science: Chemistry.* Oxford: Oxford University Press.
3. http://www.practicalchemistry.org/experiments/the-sublimation-of-air-freshener,189,EX.html
4. http://www.west.net/~science/co2.htm

F. Health and Safety

If iodine (**harmful, dangerous for the environment**) is used, use only a few crystals and do the activity in a fume cupboard.

Naphthalene (**harmful, dangerous for the environment**) mothballs must be heated to near 70 °C to sublime.

Dry ice sublimes at -78.5°C and above. Handle with tongs or thermal gloves. You would not be able to watch this re-form the solid but it is great for observing the change from solid to gas.

BASIC SAFETY RULES:

Do not eat, drink or chew whilst doing the experiment.

Keep your face at a safe distance from open flames and heated solutions. Never look into a heated solution from above.

Avoid breathing in dust or vapour of the air freshener. When smelling solution, gently wave the air above the solution towards your nose with your hand.
Wash any spilled solutions from your skin with plenty of water, and notify the demonstrator.

Report any accident, no matter how minor, to the instructor/ health officer.

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COMPULSORY SAFETY DRESS FOR THE LABORATORY:

You will not be allowed to do the experiment unless you are wearing the following items:

a. Long-sleeved overcoat that is long enough to cover the hips, worn closed at all times.
b. Safety glasses. Please note that contact lenses do not provide eye protection and in some cases may complicate an emergency (caustic liquids which splash into the eye can be trapped behind the contact lens). You are advised to avoid wearing contact lenses in the laboratory, if possible.
c. Closed, flat-heeled shoes (no open sandals).
d. Long hair and loose scarves must be tucked away or tied up.

Tidy working

Keep your working area tidy. A cluttered bench is a common contributory factor to accidents. Cleaning the glassware after use should be done immediately. This prevents the organic tarry material from attacking the surface of the glass.

Disposal of chemical waste

Clean up and dispose of your unknown substances according to your teacher's instructions.

Disposable gloves

If you are using toxic or corrosive chemicals you may wish to use protective gloves.

Spills

Always clean up a chemical spill without delay. If you spill a toxic, flammable or corrosive chemical, call a demonstrator or technician immediately

G. Evaluation

a. Was it difficult/easy to have access to the experimental materials listed?
b. Were the experimental procedures easy to follow? Explain
c. Suggest other methods and materials which can be included in this pack

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