Teacher and Technician Sheet

In this practical students will:

- Experiment to see what happens when ethanoic acid is reacts with sodium hydrogen carbonate.
- Describe what is observed.
- Explain their results using their scientific knowledge and understanding, accurately using terms such as **reaction**, **fizzing** and **gas**.

Introduction:

A simple kitchen science experiment that is fun to do, but can be used to introduce reactions between acids and carbonates. It can also be used to introduce what happens when a cake mix is made using a carbonate. The reaction of a carbonate with an acid creates a strongly bubbling reaction and the colour just adds to the drama and fascinates younger children.

Chemically the ethanoic acid reacts with the sodium hydrogen carbonate to form carbon dioxide gas and water.

ethanoic acid + sodium hydrogen carbonate → sodium acetate + water + carbon dioxide

$$CH_3COOH + NaHCO_3 \rightarrow NaCH_3COO + H_2O + CO_2$$

The carbon dioxide gas produced rushes away from the water. This is seen as bubbles. Because carbon dioxide is heavier than air, it cannot escape away from the reaction so it appears to flow down over the edges of your cup cake tin looking a little like lava flowing out of a volcano.

Curriculum range:

This practical is designed for upper age primary pupils or lower end secondary students to introduce them to simple chemical reactions and the aim is to gain some understanding of the way the materials are used to create reactions such as some of the simpler ones in cooking. It links with:

- Setting up simple practical enquiries, comparative and fair tests;
- Reporting on findings from enquiries and observations, including oral and written explanations, displays or presentations of results and conclusions;
- Using straightforward scientific evidence to answer questions or to support their findings;

- Build a more systematic understanding of the chemistry of acid and carbonates by exploring the way sodium hydrogen carbonate reacts with an acid can be used to make a useful property;
- Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience;
- Use appropriate techniques, apparatus, and materials during laboratory work, paying attention to health and safety;
- Make and record observations using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements;
- Present observations using appropriate methods;
- Interpret observations and identify patterns using those observations to draw conclusions;
- Present reasoned explanations, including explaining data in relation to predictions and hypotheses;
- Learn about the concept of chemical reaction, effervescence, acid and carbonate reactions.

Hazard warnings:

Sodium hydrogen carbonate - liberate carbon dioxide on gentle heating (or with acids). Sodium hydrogen carbonate is an approved food additive, E500, and is used as baking soda. 'Bicarb' or 'bicarbonate of soda' are alternative names. **Low Hazard**.

Ethanoic acid – if less than 1.7 M It may still cause harm in the eyes or in a cut. This includes vinegar. Shop bought vinegar is generally a 5% to 6% solution (0.8M to 0.9M) and is **Low Hazard** at these strengths.

Equipment:

For a group of 2 pupils:

- 1 teaspoon
- 1 cake tin for making cup cakes
- 1table
- 1 newspaper
- Sodium hydrogen carbonate (bicarbonate of soda or baking powder($Na\ HCO_3$)) (50 g)
- 1M Ethanoic acid (or white vinegar $CH_3\ COOH$) (250 cm^3)
- 4 different food colourings (e.g. blue, red, green and yellow- These need to be artificial since 'natural' ones are not concentrated enough
- Pipette

For going further:

- 1 narrow necked bottle (or 25cm^3 measuring cylinder)
- 1 balloon
- Top pan balance
- Weighing boat or similar

Technical notes:

Students need to take care when using the dyes since the artificial dyes can dye the skin if they come in contact. They are not hazardous but can look unsightly.

Wear disposable gloves.

In doing the 'Going Further' activity students will need to make a good seal between balloon and bottle top and this can mean the balloon will be difficult to get on so adult help might be needed.

Results:

There will be a very visible fizzing reaction when mixing the sodium hydrogencarbonate (bicarbonate of soda) and the ethanoic / acetic acid (vinegar). The food colouring makes for a colourful display as the reaction takes place. The fizzing subsides as the reactants are used up. The reaction can be repeated by adding more reactants.

Students/children could be able to understand that the fizz is made of bubbles of CO_2 similar to those observed in fizzy (carbonated) drinks.

This experiment could also be carried out using disposable plastic cups situated in a bowl or tray. Cones could be made from circles cut from plastic or card, with smaller circle cut into the middle of the circle. These cones could then be placed over the cup containing the reactants, which then 'erupt' through the hole similar to a real volcano. Red food colouring is most effective for this.

Using different carbonates will achieve the same reaction. Potassium carbonate (HARMFUL IF SWALLOWED, IRRITANT) and calcium carbonate LOW HAZARD. One teaspoon or spatula of carbonate (approximately 2.5 to 3.5g depending on which carbonate is used) placed in the balloon, which is carefully fixed over the lip of the bottle or measuring cylinder containing 15cm^3 of ethanoic acid, then weighed before lifting the balloon upright to empty its contents into the measuring cylinder will result in the balloon being inflated a small amount.

Students may be able to observe that different carbonates have different weights but using the same amount of reactants results in the same reaction, and that the total mass of reactants will equal the total mass of the products. (Some carbonates may be a finer powder than others so will need a little swirl of the container to help to mix the reactants and start the reaction). This is to demonstrate the conservation of mass even though it is a gaseous

reaction and if the gas escapes the mass will seem to decrease – a strong source of misconception with some weaker students.

Going Further:

1. Try using other carbonates but take the mass of the chemicals before mixing them and after mixing the chemicals.
2. Put the ethanoic acid inside a bottle with a narrow mouth.
3. Put the carbonate inside a balloon and fix this on the top of a jar without pouring the carbonate into the bottle.
4. Find the mass before you mix the two chemicals.
5. Now turn the balloon up so the carbonate falls into the bottle and swirl to mix the chemicals.
6. Watch what happens and describe what happens to the mass.
7. Explain your result