Acid spill shuts down busy road in Hastings for five hours

In 2024 an acid spill shut down part of a busy road in Hastings for just over five hours. The Hastings senior station officer said it was a 5 litre container of muriatic acid. Firefighters wore "level 3" protective suits to protect against chemicals and used large amounts of soda ash to react with the acid before they absorbed it, packaged it and disposed of it.

Information:

The chemical name for soda ash is sodium carbonate, $Na_2CO_3(s)$

Muriatic acid is also known as hydrochloric acid, HCl(aq)

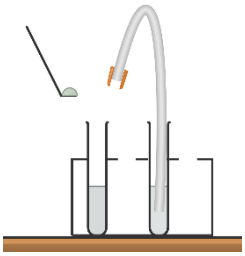
Acid spills can be made safe by reaction with soda ash.

The student modelled this process in the laboratory using some dilute hydrochloric acid solution and some sodium carbonate crystals.

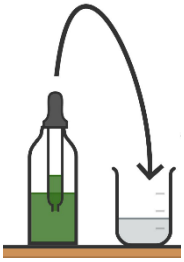
sodium carbonate + hydrochloric acid → sodium chloride + water + carbon dioxide

$$Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$$

Experiment 1



(a) The student put some white sodium carbonate crystals in a test tube with some hydrochloric acid solution, quickly attached a delivery tube and placed the end of the delivery tube into some limewater.



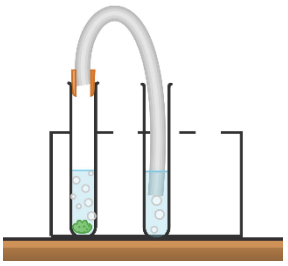
(b) They added Universal Indicator solution to a sample of the hydrochloric acid solution in a beaker.

(c) They added a spatula measure of sodium carbonate crystals to this beaker.

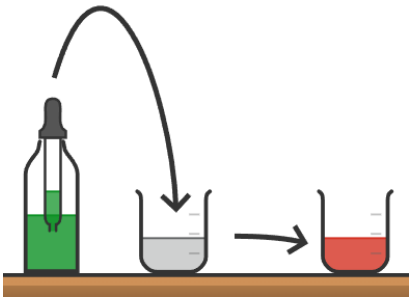
(d) They observed until no further changes were seen.

Observations:

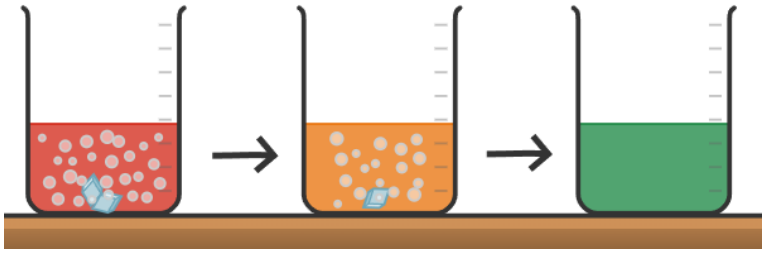
(a) The mixture fizzed steadily and the colourless gas turned the limewater milky.



(b) The Universal Indicator solution turned red.



(c) There was a steady stream of bubbles (fizzing) coming from the sodium carbonate crystals. The white crystals got smaller and smaller until none could be seen.



(d) The Universal indicator solution turned green.

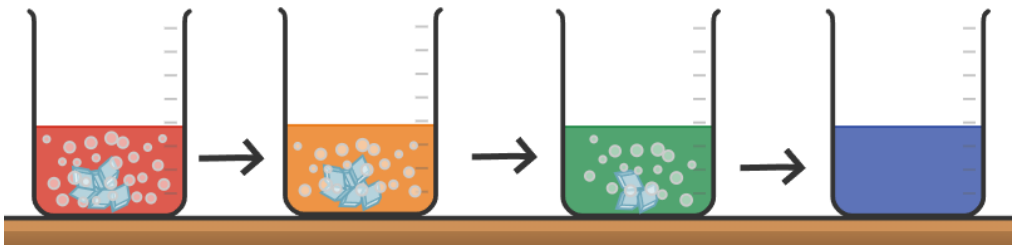
Experiment 2

The student repeated Experiment 1(c) and (d) using the same amount of hydrochloric acid, but this time added 5 spatulas measures of sodium carbonate crystals.

Observations:

(a) The mixture fizzed and the Universal indicator turned blue.

(b) No crystals remained on the bottom of the beaker.



REPORT

Reaction

The reaction is a **neutralisation reaction** as it fits the general equation of:

acid + base (metal carbonate or hydrogen carbonate) → ionic salt + water + carbon dioxide

Hydrochloric acid is an acid and sodium carbonate is a metal carbonate.

The limewater turned from clear to cloudy showing that one of the products formed is carbon dioxide gas (seen as fizzing when the hydrochloric acid and sodium carbonate were mixed.

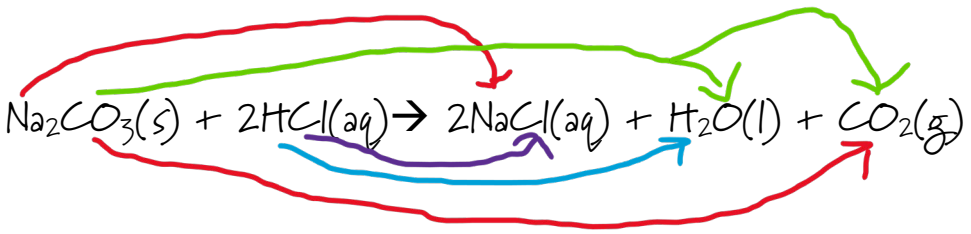
It is a neutralisation reaction because when the universal indicator was added to the hydrochloric caid solution, it turned red but after the white solid sodium carbonate was added, the solution turned green showing a neutral solution of ionic salt, sodium chloride, NaCl(aq) had been produced.

In experiment 1, the acid is completely neutralised as shown by the green colour of the universal indicator.

Conservation of mass

When hydrochloric acid is neutralised by sodium carbonate crystals, the acid contains hydrogen and chlorine and the sodium carbonate contains sodium, carbon and oxygen. After the reaction, all these elements are still present in the products, but in a new combination. As no elements have been lost or gained, the mass remains unchanged.

In the balanced equation, $Na_2CO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + CO_2(g)$ the total # of atoms before reaction are: Na x 2 C x 1, O x 3, H x 2 and Cl x 2, which are still there after the reaction is complete, so matter/mass is conserved.



In experiment 1, the hydrochloric acid turned the indicator red because the solution contained more H^+ ions than OH^- ions, resulting in an acidic solution. As the sodium carbonate crystals were added the pH increased as the added base reacted with the H^+ ions to form neutral water. When enough base was added and the UI indicator turned green, a 'neutral' solution was made where the amount of H^+ and OH^- ions became equal, and the pH is 7.

In experiment 2, excess base was added to ensure that all of the hydrochloric acid had been reacted. This time the pH was > 7 as shown by the blue colour of the indicator since the solution now contained more OH^- ions than H^+ ions. There were no crystals visible because sodium carbonate is soluble in water.

Implications:

When adding a base like 'soda ash' to an acid spill, it is necessary to add more then enough base (an excess) to make sure that all the acid has reacted so that the spill can be cleaned up safely. Otherwise it could be dangerous for the firefighters to remove and dispose of the 'acid spill' as it would still contain some unneutralised acid.