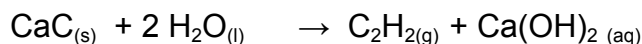


SCH - Complete and Incomplete Combustion

Purpose: In this investigation, you will produce acetylene (ethyne) gas by mixing solid calcium carbide with water.



The acetylene will be combined with different quantities of air to determine the best reaction ratio for complete combustion.

Question: What is the ideal ratio of fuel to air for the complete combustion of acetylene gas?

Prediction:

Air contains 20% oxygen, $\text{O}_{2(g)}$. How much air do you think is needed for the complete combustion of acetylene gas? Predict which proportion will react best. (100% acetylene to 0% air ; $\frac{1}{2}$ acetylene to $\frac{1}{2}$ air ;; $\frac{1}{10}$ acetylene to $\frac{9}{10}$ air). Explain your reasoning.

Materials

Eye protection,	test tube clamp
Scoop to handle the calcium carbide,	15 mL of lime water in a beaker
3 test tubes with stoppers, 1 test tube rack	10 mL graduated cylinder
400 ml beaker for water	
wooden splints	

Procedure

Collecting the gas:

1. Fill 500mL beaker half full with water.
2. Fill 3 test tubes with water. Ensure no bubbles. Invert the test tubes into the beaker of water.
3. Drop calcium carbide in the container to produce acetylene gas:
4. Put the mouth of one test tube over the calcium carbide and collect gas. Collect the following amounts of gas in each test tube.
 - a) allow one test tube to fill completely with acetylene gas.
 - b) allow one test tube to $\frac{1}{2}$ fill with acetylene gas.
 - c) allow one test tube to $\frac{1}{10}$ fill with acetylene gas
5. **Keeping the test tube inverted.** Take the test tube out. Let the water fall out and then quickly put the stopper on the test tube. Place it in the rack.
6. Repeat 4 and 5 until you are finished all of the test tubes

Igniting the gas:

1. Using a test tube clamp, hold the test tube with open end pointing down and not too near the bench surface. **IMPORTANT :** Ensure the opening is pointing AWAY from you and others.
2. Remove the stopper, and immediately bring a burning splint to the mouth of the test tube to ignite the acetylene gas. Record your observations.
3. As soon as the combustion is complete add 5mL of limewater to the test tube. Replace the stopper and shake the tube vigorously. Record your observations. Describe any residue left on the test tube.

Observation Table:

Create your own observation table.

Analysis

1. In which test tube(s) did you observe complete combustion? Explain your answer.
2. Write a balanced chemical equation for the complete combustion of acetylene gas.
3. In which test tube(s) did you observe incomplete combustion? Explain your answer.
4. a) What products are formed during the incomplete combustion of acetylene gas.

b) Write an equation for the incomplete combustion of acetylene gas. Explain why it's difficult to balance this equation.
5. Why did the amount of soot produced in the test tube vary? Explain.
6. An automobile engine requires a carburetor or fuel injector to mix the fuel with air. The fuel and air must be mixed in a particular ratio to achieve maximum efficiency in the combustion of fuel. What might happen if the fuel and air mixture is too rich (if there is too much fuel)? What impact will these products have?
7. a) What does the limewater indicate?

b) Write the balanced chemical equation for the limewater test. (Hint: Limewater is a solution of calcium hydroxide. A carbonate forms.)