

Discovery Activity: Incomplete Combustion and Air Pollution

Introduction: The greatest source of air pollution is the incomplete combustion of gasoline in the engines of automobiles. The internal combustion engine that is used in cars, trucks and buses is only 20 percent efficient. This means that for every 20 L of gasoline in the tank, only 4 L are used to move the car! Some of the unused gasoline heats the engine and the remaining gasoline is pushed out of the engine unburned. It is this unburned gasoline that is the major contributor to photochemical smog. If gasoline were completely burned, the only by-products would be water vapor and carbon dioxide. Several devices, including catalytic converters, have been added to cars to reduce pollution emissions.

Objectives:

- To observe the effects of incomplete combustion;
- To evaluate the effect of temperature increase on by-product production;
- To analyze the effect of continued use of energy inefficient fuels on the environment;

Materials: A tin can, a candle, a drinking straw , matches, paper/ pencil;

Procedure:

1. Collect the necessary materials.
2. Light the candle and place the bottom of the can directly over the flame for a few minutes.
(Be very careful when working with the matches and lighted candle!!!)
3. Observe the bottom of the can. What do you see?
 - Record your observations in the Observation section.
4. Clean off the bottom of the can.
 - Use a straw to blow air on the bottom of the can.
 - Bring the flame of the candle to the same spot as you are blowing air on the can.
 - Be careful not to blow the flame out.
5. After a few seconds, remove the candle and observe the spot that was heated.
 - Record your observations.
6. Answer the questions in the Analysis section.

PART II: OBSERVATIONS

Observation #1: Heating of the bottom of the tin can:

DESCRIPTION	DRAWING

Observation #2: After second heating of the can

DESCRIPTION	DRAWING

PART III: Analysis

1. Would you call what you saw on the can in Observation #1 evidence of pollution? Why?
2. Did you observe any pollutants after heating the can for the second time?
3. How did the additional air affect the combustion of the candle?
4. What would be one way to encourage complete combustion in car and truck engines?
5. Why did you think that internal combustion engines are considered energy inefficient?
6. What could be done to eliminate the amount of waste that presently occurs in most engines?
7. In catalytic converters, a chemical catalyst is present to encourage cleaner burning of the fuel. How do you think this happens?
8. Even if internal combustion engines were able to emit only water vapor and carbon dioxide, why would they still be contributing to atmospheric pollution?
9. Engines in some European cars are promoted as having an 80% efficiency rating. What would the fuel to energy ratio have to be in these cars if they generally have 40 L tanks? 60 L tanks? 80 L tanks? 100 L tanks?
10. What could consumers do to encourage production of cleaner burning engines in U.S.?