

5.5: Catalysts That Make Reactions Go

Carbon monoxide will certainly burn in the presence of oxygen from air as shown by the reaction



Carbon monoxide is a product of automobile exhausts and an undesirable, toxic air pollutant. One way of ridding automobile exhaust gases of this pollutant is to pump air into the exhaust and convert the carbon monoxide to carbon dioxide as shown by the reaction above. However, even in the presence of oxygen, this reaction does not proceed to completion in an ordinary automobile exhaust system. It is enabled to occur, however, by passing the exhaust mixed with air over a solid honeycomb-like surface of ceramic coated with a metal that enables the reaction to occur, but is not itself consumed in the reaction. Such a substance is called a **catalyst**. Most people who have an automobile are vaguely aware that they have an automotive exhaust catalyst. They become much more acutely aware of this fact if the automobile's exhaust system fails an emissions test and the catalytic converter in it has to be replaced at a cost of several hundred dollars!

We do not have to go any farther than our own bodies to find catalysts. That is because all living organisms have biological catalysts that enable reactions to occur. Such living catalysts consist of specialized proteins called **enzymes**. Enzymes are discussed in Chapter 7.

A common enzyme-catalyzed process is the reaction of glucose (blood sugar, $\text{C}_6\text{H}_{12}\text{O}_6$) with molecular oxygen to produce energy mentioned at the beginning of this chapter:

This is the important process of **oxic respiration** carried out by all organisms that live in contact with air and utilize oxygen from air to react with food materials. Although the overall reaction for oxic respiration can be written very simply, the actual process requires many steps and several catalytic enzymes are used. Other enzymes are used for various life processes, such as protein synthesis. There are enzymes that detoxify toxic substances, and in some cases they inadvertently make toxic substances out of nontoxic ones. Some of the more common cancer-causing substances are actually synthesized from other molecules by enzyme action. Obviously enzymes are very important in life processes.

Catalysts speed up reactions. Depending upon the conditions the **rate of reaction** can vary significantly. Rates of chemical reactions are addressed by the area of **chemical kinetics**.

Catalysts are very important in green chemistry. One reason that this is so is because catalysts enable reactions to be carried out very specifically. Also, the right catalyst can enable reactions to occur with relatively less energy consumption and at relatively lower temperatures.

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