Decomposition of H_2O_2 via a Catalyst

Recommended for Chapter(s): 1 & 15

Demo #001

Materials NOT in box

1. Brown tub (on shelf next to demonstration box).
2. Safety goggles.

Procedure

1. Place the graduated cylinder into the brown tub. This way any overflow from the reaction will be contained by the brown tub.
2. Add 50 mL of the 30% H_2O_2 to the 250 mL graduated cylinder.
3. Add a small squirt (~2 mL) of the dish soup to the graduated cylinder.
4. Add the amount of KI that will fit on the end of the spatula (~2 tsp) to the graduated cylinder.
5. See discussion for optional procedures.

Safety

1. Wear safety goggles.
2. The reaction is exothermic; make sure that you do not burn hands on graduated cylinder.
3. It is very important to add the soap to the H_2O_2 before adding the KI. The soap controls (slows down) the reaction. If no soap is added, hot H_2O_2/H_2O will be spewed from the graduated cylinder.
4. 30% H_2O_2 will burn your skin if you touch it. Be very careful when pouring.

Clean Up

1. Return the materials to the cart in the demonstration library room.

Stockroom Notes

1. Rinse out brown tub.
2. Replace the glassware with clean glassware.
3. If needed refill any materials that have been used up.
    a. If more "drug store" H_2O_2 is needed, make it by diluting the 30% H_2O_2 by putting in 1 part 30% H_2O_2 and 2 parts water by volume (ex: combine 30 ml 30% H_2O_2 and 60 mL of H_2O).
4. Return items to demonstration tub.
5. Return tub to the demonstration library.
    a. The goggles go in the goggle box.

b. The brown tub goes under the demonstration tub.

Discussion

This demo can be used to show the effects of different variables on reaction rates.
(Optional)
Ask the students what happens when they put H_2O_2 on cuts.

It bubbles.

Show them the overall reaction that is occurring

$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$.

Ask them if the reaction is spontaneous.

Yes.

Pour the drug store H_2O_2 into a graduated cylinder. Ask the students if the reaction is happening.

The reaction is happening at such a slow speed that very few O_2 bubbles are observed.

Explain to the students that drug store H_2O_2 is only 3% H_2O_2 and the rest is water. Ask them how you could increase the reaction rate.

With any luck a student will suggest increasing the concentration of H_2O_2.

Pour the lab H_2O_2 (30% H_2O_2) into a graduated cylinder. Again ask the students if the reaction is occurring.

Although the reaction did speed up it is still very slow and few O_2 bubbles will be observed.

(Demonstration)
Explain to the students that reaction rates can be greatly increased by adding a catalyst to the system (in this case I^-). A catalyst lowers the activation energy by providing another pathway for the reaction to occur. The overall reaction for both the natural decomposition of H_2O_2 and the catalyst aided decomposition of H_2O_2 are the same. Mechanism for the catalyst aided decomposition of H_2O_2 is seen below.

$H_2O_2(aq) + I^-(aq) \rightarrow H_2O(l) + OI^-(aq)$
$\underline{H_2O_2(aq) + OI^-(aq) \rightarrow H_2O(l) + O_2(g) + I^-(aq)}$
$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

KI and soap can also be added to the drug store H_2O_2 to show that less O_2 bubbles are generated when the concentration is low.

Materials in box

1. 2 250 ml Graduated cylinder
2. Spatula
3. Paper towels
4. KI Fisher P412-500
5. Ivory soap
6. 30% H_2O_2
7. 10% H_2O_2