

Investigation - Catalysts for the decomposition of hydrogen peroxide (Student Handout)

Objective

- To facilitate students in interpreting results qualitatively from experiments on factors affecting rate of reaction due to the use of catalysts;
- To provide opportunity for students to discuss on difference of the catalytic properties of common catalysts in chemical industries and biological systems.

Background

Hydrogen peroxide decomposes slowly in air to give oxygen and water. In this investigation, the effect of different catalysts on the decomposition of hydrogen peroxide will be studied.

Curriculum link

Topic IX Rate of reaction (Chemistry)

Topic XIII Industrial Chemistry (Chemistry)

Safety precautions

- Handle all chemicals with care. The experiment should be performed in a well-ventilated area.
- Wear eye protection and disposable nitrile gloves when handling the catalyst and hydrogen peroxide solution.

Materials and apparatus (per group)

3% H_2O_2 solution



100 cm^3

One of the following catalysts:

Powdered manganese(IV) oxide (MnO_2)

0.5 g

A small piece of fresh potato

10 – 15 cm^3

A small piece of fresh celery

10 – 15 cm^3

A small piece of fresh pig liver

about 1 cm^3

1 M $\text{Fe}(\text{NO}_3)_3(\text{aq})$ / $\text{FeCl}_3(\text{aq})$

10 cm^3

1 M $\text{KI}(\text{aq})$

10 cm^3

Spatula

x 1

25 cm^3 measuring cylinder

x 1

Data logger system with pressure sensor

x 1

250 cm^3 conical flask with side arm

x 1

Delivery tube and stopper

x 1

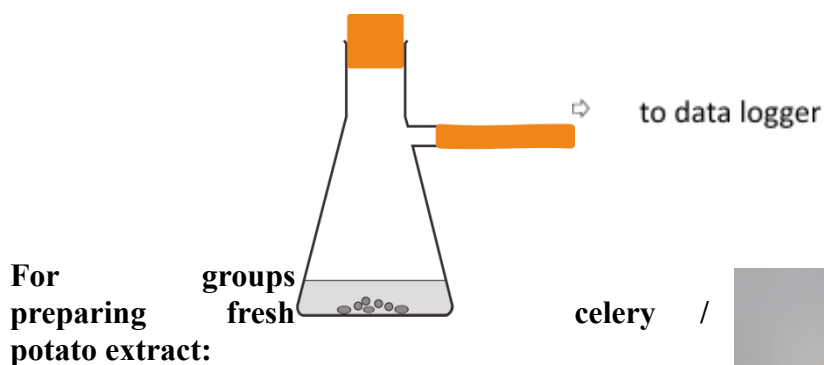
Pestle and mortar

x 1 (for fresh celery / potato)

Procedure

- Measure 50 cm^3 of the 3 % hydrogen peroxide solution using measuring cylinder and transfer it into the conical flask.
- Set up the data logger interface device and connect it to the computer.
- Start the data logging software and select the pressure sensor with graph display screen format.

- Transfers the catalyst into the conical flask and quickly reassemble the apparatus.



For preparing fresh potato extract:

Blend the celery / potato provided using pestle and mortal. Transfer the extracted liquid into a beaker and measure 10 cm^3 of the extract. The extract can be used to transfer into the conical flask in step 4 for the experiment.



- Observe the change in pressure. Stop the data acquisition when there is no gas bubble evolved inside the conical flask / the pressure does not change.
- Save the data file.

Results

- Obtain the experimental data of the experiment using different catalysts from your classmates in other groups. Using spreadsheet software, create a graph of pressure against time for the decomposition reaction of hydrogen peroxide using different catalysts.
- From the graph, calculate the initial rate of the decomposition of hydrogen peroxide using different catalysts.

Powered manganese(IV) oxide (MnO_2) :

Fresh potato extract :

Fresh celery extract :

Fresh pig liver :

$1\text{M Fe(NO}_3)_3(\text{aq})$ / $\text{FeCl}_3(\text{aq})$:

$1\text{M KI}(\text{aq})$:

- What conclusion can be drawn from this experiment?

Discussion questions

1. Write down a balanced equation for the decomposition of hydrogen peroxide. Hence, suggest a chemical test to confirm the identity of the gas given off in the experiment.

2. Suggest a procedure to prepare 100 cm³ of 3% hydrogen peroxide solution from 6% hydrogen peroxide solution.

3. Explain why pressure sensor can be used to follow the rate of decomposition of hydrogen peroxide.

4. Give ONE advantage of using data logger to follow the rate of the decomposition of hydrogen peroxide.

Assessment

1. Suggest an experiment to confirm the following statement:
“Fresh pig liver contains an active enzyme that catalyzes the decomposition of hydrogen peroxide.”
