Catalase Concentration Effects on Reactions

Summary: My group and I attempted to find whether different concentrations of the enzyme catalase would affect the rate at which of oxygen (O_2) gas and water (H_2O) are formed from hydrogen peroxide (H_2O_2). We did this by measuring the rate of the reaction of dilute hydrogen peroxide (H_2O_2) in various concentrations of liver homogenate, ranging from 0.05% to 10%. Our results showed that the amount of catalase enzyme does have an effect, with larger amounts contributing to greater and faster overall reactions.

Methods & *Results:* My group and I began the experiment by constructing a respirometer out of a 150mL Erlenmeyer flask, a rubber stopper with a hole in it, and a 5mL pipette. The flask was filled with 50mL of 3% hydrogen peroxide (H_2O_2) solution in water and then placed in a ~22°C water bath to keep it at a relatively constant temperature throughout. These preparations were replicated for each of the six separate samples of dilute liver homogenate, which contained our catalase enzymes. These samples were diluted with water to make 0.05%, 0.10%, 0.50%, 1.00%, 5.00% and 10% concentrations.

For each concentration, a ~1mL amount of dilute liver homogenate was added to the flask and sealed with the rubber stopper and pipette. Oxygen gas began to form, which increased the pressure in the flask and caused the mixture to rise inside the pipette. The flask was "burped" as the liquid reached the 5+1mL mark on the pipette and then allowed to drain back into the flask. Because of the loss of oxygen during this time, we decided to add 1mL extra to the measured O₂ for each "burp", meaning that a total amount of ~7mL of total gas was measured. We continued this process for three minutes and recorded the number of burps and/or mL readings on the pipette individually for each minute. A rate was determined for each concentration by dividing the total mL of oxygen gas produced by three minutes. This data produced the following graph:



The orange line shows recorded data, which is relatively consistent and represents a loose linearity. The green line represents a trendline for this data, which is the equation y = 353.31x + 0.4556.

As our results show, the amount of catalase enzyme has a significant affect on the speed of the reaction. It is reasonable to say that the presence of catalase is directly proportional to the amount of oxygen gas and water produced from hydrogen peroxide over a selectively short interval of time. Increasing the quantity of available catalase enzymes will provide lower activation energies for the surrounding H_2O_2 molecules, which expedites the reaction H_2O_2 \longrightarrow $H_2O + O_2$.