CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
J0524

Project Title
Catalytic Decomposition of Hydrogen Peroxide: Kinetics, Mechanism, and Applications

Abstract

Objectives/Goals
My project is to determine which catalyst, FeCl3, MnO2, Pb, or KI will have the greatest reaction rate in the decomposition of H2O2 in two substrate concentrations as measured by the volume of gas collected over time. Also, to determine the rise of the temperature of the reactants over time, and compare that with the volume of oxygen liberated.

Methods/Materials
Prepare a gas-collecting apparatus by fitting a side arm flask connected to a rubber hose. Insert a digital thermometer with a probe through the rubber stopper of the flask. Fill a 250 ml graduated cylinder completely with water and invert it into a water trough.. Place the end of the tube inside the cylinder. Add H2O2 to the flask, past the temp. probe. Add the catalyst to the flask and stopper the flask. Swirl to mix. Simultaneously record the temperature of the reactants and the volume of oxygen collected in the cylinder. Repeat this procedure 3 times per catalyst / concentration

Results
H2O2 undergoes an exothermic reaction to form O2 and H2O. (H2O2 ¡æ H2O + #ö O2) In my experiment, the decomposition of hydrogen peroxide,was studied with catalysts FeCl3, MnO2, Pb, and KI, with concentrations of 3% and 30%. I found catalytic type, amount of catalyst present, as well as the concentration of the H2O2 had a strong effect on the reaction rate, with increasing rate in the order KI<MnO2<Pb<FeCl3. First order kinetics was observed in all cases. The heat liberated in the exothermic reaction was directly comparable to the oxygen produced.

Conclusions/Discussion
Data analysis showed that my hypothesis was correct; that FeCl3 had the greatest reaction rate in the decomposition of H2O2. The exothermic reaction of H2O2 was spectacular, with temperatures reaching over 400 degrees K. So spectacular, that I was forced to abandon further trials with FeCl3 at 30% concentration, for fear of thermal runaway (which the decomposition of H2O2 is notorious for). Because H2O2 has such a high oxygen density, scientists are studying it for applications such as mono propulsion for automobiles. I would like to pursue the study of hydrogen peroxide propulsion and make a truly green automobile.

Summary Statement
My project was about the kinetics, mechanism and applications of the catalytic decomposition of H2O2.

Help Received
My Mom helped take O2 readings.. My Uncle Paul tutored me and kept me safe, and most of all, my science teacher, Mrs. Armstrong, is probably the best teacher a kid can ever have. She teaches. She inspires.