ANALYSIS OF OXYGEN BLEACH

Ref: Copper, C. L.; Koubek, E. J. Chem Educ. 2001, v78 p652.

INTRODUCTION

This experiment allows students to balance an oxidation-reduction reaction equation and use the reaction to analyze a consumer product. The experiment calls for the balancing of the reaction of H_2O_2 and MnO_4^- two different ways. Then it is necessary to determine which of these balanced equations has the correct Stoichiometry by titrating a standard H_2O_2 solution with $KMnO_4$. The correct equation is used to determine the the mass percent of H_2O_2 in a commercially available, environmentally friendly, oxygen bleach solution.

PURPOSE

To balance the equation for a redox equation.
To determine the mass percent of Hydrogen Peroxide in a full strength bleach sample.
To determine the environmental advantage of an oxygen bleach.

MATERIALS

Analytical balance	1.0g $NaBO_3$ - $4H_2O$
Distilled water	1.0 M H_2SO_4
Non-chlorine bleach	0.0100 MnO_4
100 ml volumetric flask	250 ml beaker
50 ml Burette	

SAFETY

Hydrogen Peroxide, potassium permaganate and sulfuric acid are hazardous, Wear goggles and apron for this lab. Consult an MSDS for details.

PROCEDURE

Parts I and II. Preparation and Titration of standard H_2O_2 solutions:

1. First, using a top loading balance, weigh out, in a plastic dish, ~1.0 g of $NaBO_3 \bullet 4H_2O$.

2. Next, weigh the sample on an analytical balance. Transfer the sample to a 100 mL volumetric flask and reweigh the empty dish. Record, in the Data Section, the actual mass of $NaBO_3 \bullet 4H_2O$ used.

3. Add 20 mL of 1.0 M H_2SO_4 to the flask and mix well. Dilute this solution to the mark and distilled water and mix again to make sure all of the solid has dissolved. Use this solution for all of Parts I and II.

4. Pipet 10 mL of the $NaBO_3 \bullet 4H_2O$ solution that you just prepared into a 250 mL Erlenmeyer flask. Add 20 mL of 1.0 M H_2SO_4 to this flask.

5. Fill a 50 mL buret with 0.0100 m$KMnO_4$.

6. Titrate the $NaBO_3$ solution in the flask with 0.0100 M $KMnO_4$ solution.

7. Repeat steps #1-6 until you get at least two results that are in good agreement (within ~0.5 mL $KMnO_4$ used).

Part III Titration of bleach solutions.

1. Dilute the Seventh Generation Non-Chlorine Bleach by pipetting 10 mL of bleach in a 100 mL volumetric flask and filling the flask to the mark with distilled water. Thoroughly mix the contents of the flask by inverting it several times. (Note: Take care not to get bleach on your skin.)

2. Pipet 10 mL of the diluted bleach solution into a 250 mL Erlenmeyer flask.

3. Add 20 mL of1.0 M H_2SO_4 to the flask.

4. Titrate the bleach solution in the flask with 0.0100 M $KMnO_4$ solution.

5. Repeat steps #1-4 until you get at least two results that are in good agreement (~0.5 mL $KMnO_4$ used).

SAMPLE DATA

Part I Preparation of $NaBO_3 \bullet 4H_2O$ solutions:

	Trial #1	Trial #2	Trial #3
mass of $NaBO_3 \bullet 4H_2O$ + weighing boat			
mass of weighing boat after transfer			
mass of $NaBO_3 \bullet 4H_2O$ added to flask			

Part II Titration of 20 mL of known H_2O_2 solutions:

	Trial #1	Trial #2	Trial #3
final buret reading			
initial buret reading			
volume of 0.0100 M $KMnO_4$ used			

Part III Titration of diluted bleach solutions:

	Trial #1	Trial #2	Trial #3
final buret reading			
initial buret reading			
volume of 0.0100 M $KMnO_4$ used			

SAMPLE DATA TREATMENT SECTION:

Part I and II. Preparation and Titration of standard H_2O_2 solutions:

1. Knowing the mass of $NaBO_3 \bullet 4H_2O$ used, calculate the number of moles of H_2O_2 present in each sample that you titrated in Parts I and II. Use the balanced equation for the reaction.

Trial #1 (show Calculation)

Trial #2_____

Trail #3_____

2. Calculate the number of moles $KMnO_4$ used in each titration in Parts I and II.

Trial #1 (show Calculation)

Trial #2_____

Trail #3_____

3. Determined the CORRECT stoichiometry of the reaction that took place in each titration in Part II. (i.e. find the mole ration of H_2O_2:MnO_4^-).

Part III Titration of bleach solutions:

1. Using the stoichiometry determined in Parts I and II, report the mass percent of H_2O_2 in the full strength bleach solution taking into account the dilution that you made in step 1. of Part III. Assume the density of the bleach solution is 1.00 g/mL.

Trial #1 (show Calculation)

Trial #2_____

Trail #3_____

Average mass percent of H_2O_2 in full strength bleach sample

Balance this equation by the half reaction method

$$H^+(aq) + H_2O_2(aq) + MnO_4^-(aq) \rightarrow O_2(g) + M_n^{2+}(aq) + go(\lambda)$$

Questions for Students to Address:

1. What is the source of $O_{2(g)}$ produced during the titration? Explain.

2. Do you want a faint pink color at the equivalence point of the titration or a dark one? Explain.

3. What was the indicator for this titration?

4. What environmental advantage do you think an oxygen bleach has over a chlorine bleach? (If you don't know, look it up using the Internet and cite your source as part of your answer).