4. Empirical Formula Determination

10/15/24

Partner: Connor Engels

Lab 4. Empirical Formula Determination

Purpose:

To determine the empirical formula for a tin-oxygenated product.

Procedure:

1. Clean and dry an evaporating dish and a watch glass cover. To dry them, heat strongly for 2-3 minutes using a burner. Us forceps or tongs to handle the dish and cover throughout the experiment.
2. Place about 2g of granulated tin in the dish, cover with the watch glass and mass.
3. In the fume hood, add 5ml of 8M nitric acid and replace the watch glass.
4. After the chemical reaction had stopped, heat the dish over a low flame. An excessive amount of popping and spattering indicates that you are heating too rapidly. Continue to heat slowly until the contents are nearly dry.
5. When the popping and spattering no longer occur, remove the evaporating dish from the heat source. Remove the watch glass, taking care not o lose any of the product. Do not clean the watch glass until all the measurements have been made. Break up the solid with a stir rod.
6. Place the dish onto wire gauze. Heat carefully with a hot flame until the solid becomes a pale yellow. Remove the dish from the heat source and let it cool.
7. After the dish has cooled, replace the watch glass and re-mass. Reheat the dish for 2-3 and allow to cool. Re-mass, if the mass does not agree within 0.02g, reheat and re-mass until the last 2 measurements agree.
8. Discard the slid material into the designated container.

Page 12

Data:

Mass of tin: 2g

Mass of tin, evaporating dish, and watching glass: 39.21g

Mass after 1st heating: 39.76g

Mass after 2nd heating: 39.71g

Mass after 3rd heating: 39.71g

Observations:

It started to bubble, turn orange, and let off orange vapor. Bad, sulfur kind of smell. Orange vapor started to turn white. Dumped in a little more that 5ml(nitric acid). Left a residue on the watching glass. Tin dissolved into the acid. Acid kind of disappeared. Eventually stopped bubbling and letting off vapor. Took about 8 minutes to stop reacting. Liquid on top of the watching glass. ~~Starts to turn from white to yellow when heating. Yellow to white when heating.~~ Lets off more vapor when hated. A little popping. Some product fell out as we heated it. Turned orange, to white, to yellow. Has an indescribable smell, kind of like cleaning product. Let off an orange vapor. Pretty dry after heating. Some product stuck to the stir rod, some fell off the watch glass. Began to turn a darker yellow with more intense heating. Much stronger smell after stronger heating was finished. Some got more heated than others. It turns a more uniform color with more heating and stirring. Mass was 0.5g off on the first and second heating. Exact on for second and third heating.

Page 13

10/16/24

Analysis:

Mass of Sn 2.00 g/118.7 g/mol=0.0168 mol Sn

39.71g-39.21g=0.5g O

mass O 0.5 g/16.00 g/mol=0.0313 mol O

0.0313 mol O/0.0168 mol Sn=1.86≈2 O

0.0168 Sn/0.0168 Sn=1 Sn

Empirical Formula=SnO_2

Conclusion:

The purpose of the lab was to determine the empirical formula for a tin-oxygenated product. We achieved this by combining granulated tin and nitric acid, burning out the excess nitric acid and water, and weighing the tin and product to find the moles of tin and oxygen to derive the empirical formula. We got the formula $SnO_{1.86}$, which we rounded to SnO_2, which is the correct formula. We got this formula by calculating the moles of tin, subtracting the final mass from the initial mass, and using that to calculate the moles of oxygen. Then, we divided both answers by the moles of tin to get the empirical formula. If I were to do it again, I would use closer to 5mL of nitric acid, and try to lose less product. Sources of error likely include losing the product from it falling out while heating, and sticking to the stir rod. This would affect the final weight, thus skewing the how much oxygen is calculated, such as with the mole calculations. Not losing any product would have yielded a better result. Other than losing product, everything else went really smoothly.