Moles of Iron & Copper

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| **!! SAFETY PRECAUTIONS !!** |
| * C:\Users\ying.gu\OneDrive\Courses\Chem 11 - Collingwood\Unit 0 - Safety\poisonous.jpgbroken glass * excess reagents go into a waste container * HCl is corrosive and will burn skin. Wash immediately for 10 min if contact occurs. * CuCl2 is poisonous |

Purpose

1. To determine the number of moles of copper produced in the reaction of iron and copper (II) chloride.
2. To determine the number of moles of iron used up in the reaction of iron and copper (II) chloride.
3. To determine the ratio of moles of iron to moles of copper.
4. To determine the percent yield.

Materials

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| Equipment   * 250 mL beaker * wash bottle with distilled water * stirring rod | * centigram balance * drying oven * sand paper * crucible tongs | Reagents (Reactants)   * copper (ll) chloride dihydrate * 2 x iron nails * 1 M HCl |

Procedure

1. Find the mass of a clean, empty, dry 250 mL beaker. Record the mass to the nearest 0.01 g.
2. Add a generous scoop of copper (II) chloride to the beaker. Record the mass of copper (ll) chloride.
3. Add 150 mL of distilled water to the beaker. Dissolve all of the copper (II) chloride crystals.
4. Obtain two clean, dry nails. Use a piece of sandpaper on the nail to expose the nail. Find and record the combined mass of the nails.
5. Place the nails into the copper (II) chloride solution. Leave them un-disturbed for approximately 25 minutes.
6. Use the tongs to carefully pick up the nails one at a time. Swish the nails in the copper (ll) chloride solution to dislodge the solid product. Use a wash bottle and stirring rod to rinse and scrape off any of the solids on the nails. When the nails are clean, rinse them with water and set aside to dry on a paper towel.
7. After the nails are completely dry, use the paper towel to clean it completely. Find and record the mass of the nails.
8. Carefully decant the liquid from the solids. Pour the liquid into another beaker in case you accidentally pour out the solids.
9. After decanting, rinse the solid again with about 25 mL of distilled water. Decant again. Repeat this step three times.
10. Wash the solid with about 25 mL of 1 M hydrochloric acid. This removes residual iron ions from the solid. Decant again.
11. Clean the solid again three times with 25 mL of distilled water.
12. Place the beaker with the solids in a drying oven to dry overnight.
13. After the solids are completely dry, find and record the mass of beaker plus the solid.
14. Clean up all the materials. Thoroughly wash your hands with soap and water.

Results

1. Using your lab data,
2. Find the mass of the iron consumed in the reaction (1 mark).
3. Find the moles of iron consumed (1 mark).
4. What is the solid produced in this reaction? Find it’s mass (1 mark).
5. Find the number of moles of the solid produced (1 mark).
6. Look at your answers for questions 1b and 1d.
7. Calculate the ratio of moles of iron used to the moles of solid produced (1 mark).
8. Iron is a multivalent metal. Write two possible chemical reactions between iron and copper (ll) chloride. Include phases (2 marks).
9. Compare 2a with 2b. Which reaction was the one that you observed in this lab? (1 mark).
10. Using your data,
11. Calculate the theoretical yield of this reaction by finding the amount of solid that should have been produced based on the mass of iron consumed (2 marks).
12. Find the percent yield of this lab (1 mark).

Discussion

1. A limiting reagent is the reactant that will run out first in a reaction, or the one that is completely used up in a reaction. The reactant that is left over after the reaction stops is called the excess. Find the limiting reagent and the excess reagent if the reaction was allowed to go to completion over several days (3 marks).
2. In every experiment, there is error. This error is clear when percent yield is less or over 100%. Sources of error in every lab include random error (mistakes that you have made), and systematic error (errors within the experimental design and errors with the reaction itself, which have little to do with you). It is important to always identify the errors so that we can make sense of our results, and know how to improve next time to reduce error.

Describe one human error and two systematic errors that lead to your percent yield (3 marks).

For each error,

1. Explain **specifically** how each error influenced your results. Did the error make your yield too high or too low? (3 marks)
2. Describe what you could do in the future to avoid each of these errors (3 marks).