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CHM. 121.004
Inst. Mark Novak
Lab Report – Experiment 5
10/2/17

100

well done.

Experiment Objective

The objective of this experiment was to perform multiple chemical changes to copper wire and convert it back into pure copper by the end of the experiment. At the end of the experiment, we would also calculate our percent recovery; the goal was to get 100% of the copper back.

Conclusion

We were told that this experiment was going to take up most, if not all, of the class time we had available, which it did. The part that took the most amount of time but was also most likely the reason why we had such a decent percent recovery, was vacuum filtrating the Copper (II) Oxide a second time. This allowed us to recover most, if not all, of the solid that originally was floating around in the filtrate; in fact, the filtrate was perfectly clear. However, there still may have been some solids floating around in the filtrate, this is one point of the experiment where we may have lost some of the copper. At the end of the experiment, we had .415 grams of recovered copper. Because we started off with .437 grams, our final percent recovery was 94.97% of copper.

Name George Pappas

DATA AND CALCULATIONS TABLE for a Copper Ring or Wire

Mass of Beaker and Ring/Wire	152.584 g
Mass of Beaker	152.147 g
Mass of Ring/Wire (Theoretical Yield)	.437 g
Mass of Evaporating Dish (and filter paper) and Recovered Copper	107.243 g
Mass of Evaporating Dish (and filter paper)	106.828 g
Mass of Recovered Copper	.415 g
Percent Copper Recovered from Ring/Wire $\frac{\text{(Mass of Recovered Copper)} \times 100\%}{\text{(Theoretical Yield)}}$	94.97% good

Show calculations.

mass of Beaker and Ring/wire − mass of Beaker = mass of Ring/wire (Theoretical Yield)

152.584 g − 152.147 g = .437 g

mass of Evaporating Dish (and filter paper) and Recovered Copper − mass of Evaporating Dish (and filter paper) = mass of Recovered Copper

107.243 g − 106.828 g = .415 g

$$\frac{(.415\text{g}) \times 100\%}{(.437\text{g})} = 94.97\%$$

QUESTIONS AND CALCULATIONS

NET IONIC EQUATIONS (Be very neat to receive full credit!)

Copper to copper nitrate

$$Cu_{(s)} + 4HNO_{3(aq)} + 4H^+_{(aq)} \rightarrow Cu^{2+}_{(aq)} + 2NO_3^-{}_{(aq)} + 2NO_{2(g)} + 2H_2O_{(l)}$$

Copper nitrate to copper hydroxide

$$Cu^{2+}_{(aq)} + 2OH^-_{(aq)} \longrightarrow Cu(OH)_{2(s)}$$

Copper hydroxide to copper oxide

$$Cu(OH)_{2(s)} \xrightarrow{\Delta} CuO_{(s)} + H_2O_{(l)}$$

Copper oxide to copper sulfate

$$CuO_{(s)} + 2H^+_{(aq)} \longrightarrow Cu^{2+}_{(aq)} + H_2O_{(l)}$$

Copper sulfate to solid copper

$$Cu^{2+}_{(aq)} + Zn_{(s)} \longrightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$$

Solid zinc to zinc (II) ion and hydrogen gas

$$Zn_{(s)} + 2H^+_{(aq)} \longrightarrow Zn^{2+}_{(aq)} + H_{2(g)}$$

QUESTIONS AND CALCULATIONS

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CALCULATION TABLE

Start with your theoretical yield. Use the balanced net ionic equation and stoichiometry to calculate the mass of each of the following. Show calculations.

Mass of copper in penny/ring/wire/solution (theoretical yield) .437g ÷ 63.546 g/mol = .0069 moles	.437 g
Mass of copper nitrate, $Cu(NO_3)_2$ .0069 x 1 = .0069 moles Cu .0069 moles x 187.554 g/mol = 1.29 g $Cu(NO_3)_2$	1.29g
Mass of copper hydroxide, $Cu(OH)_2$ .0069 x 1 = .0069 moles Cu .0069 moles x 97.56 g/mol = .671 g $Cu(OH)_2$	.671g
Mass of copper oxide, CuO .671 g ÷ 97.56 g/mol = .0069 moles .0069 moles x 1 = .0069 moles $Cu(OH)_2$ .0069 moles x 79.545 g/mol = .547 g CuO	.547g
Mass of copper sulfate, $CuSO_4$ .0069 moles x 1 = .0069 moles Cu .0069 moles x 159.602 g/mol = 1.10 g	1.10g

QUESTIONS AND CALCULATIONS

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List two reasons why your percent yield might be less than 100.0%

1. Some of the Copper (II) oxide went around the filter paper and into the filtrate.

2. Instead of heating, the aqueous copper (II) ion was boiling

List three reasons why your percent yield might be more than 100.0%

1. left over zinc from changing aqueous copper (II) ion back into solid copper.

2. Not allowing the copper to completely dry.

3. Drying the copper too much, this adds oxygen in the form of copper oxide

QUESTIONS AND CALCULATIONS

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1. Digestion of a precipitate is one of the best methods to increase particle size. In this experiment, why would that be advantageous?

With increased particle size, it would be less likely to loose copper during the vacuum filtration process. It would also be easier to transfer the copper into different containers. ✓

2. A 1995 penny has a mass of 2.489 g. How much copper (in grams) is in this penny? (*or* What is the theoretical yield of copper from this penny?) 2.5% copper

$2.489 \cdot .025 = 0.0622\,g$ ✓

3. The mass of the recovered copper is 0.051 g. What is the percent yield of copper? (Note: Refer back to question #2)

$$\text{Percent Yield} = \frac{0.051\,g}{0.0622\,g} \times 100 = 81.99\,\%$$ ✓