

Peer review

A good effort but needs to be cleaned up and several discrepancies explained. Also, it would help if you could include the US patent application number in the manuscript so that readers could look that up from the US patent site. The points of concern below need to be addressed in the manuscript (I have addressed some of them with locations and highlighter, see attached file) but you need to go through and answer the questions.

1. How did you determine or measure that 0.04 Amps was passed through the solution during electrolysis ? When I calculate the theoretical amount of copper that should have been electrolyzed, I obtain 0.38 g (half that you actually obtained)

The equation is

$[0.04 \text{ coulomb/s}][4 \text{ hours}][60 \text{ min/hour}][60 \text{ s/min}][1 \text{ mole electrons}/96500 \text{ coulombs}][1 \text{ mole Cu solid}/1 \text{ mole electrons}][63.55 \text{ g copper}/1 \text{ mole copper}] = 0.38 \text{ grams of Copper should have been electrolyzed.}$

I assumed that 1 mole electrons are required to oxidize 1 mole copper per the equation $\text{Cu(solid)} \rightarrow \text{Cu}^{+1} + 1\text{e}^{-1}$

Explain how you then obtained $2.032 - 1.246 = 0.786 \text{ g}$ of copper actually oxidized.

In addition, include this calculation under the 'results' section in the manuscript.

2. Why were none of the filtered residues not washed copiously with distilled water. That would have been a very easy method to flush out any CuCl_2 impurity since this species is soluble in water, whereas CuCl is not. Explain in the manuscript. (I have placed this under a section called limitations)

3. Assuming your yield was 0.786 g mix of Cu^{+1} and Cu^{+2} . the K_{sp} of $\text{CuCl} = 1.2\text{e-}6$, but the solubility of CuCl in 0.1 M HCl is considerably greater due to the formation of a $[\text{CuCl}_2^-]$ complex - of the order of $9.4\text{e-}3 \text{ M}$ (if you do the equilibrium ICE calculations). This represents 0.03 g in 50 mL which represents $0.03/0.38 = 7.8\%$ of CuCl yield loss in the 0.1 M HCl. In this case the denominator is 0.38 because according to point 1, the theoretical yield of CuCl should be 0.38 g. Hence, in your process to remove the Cu^{+2} impurities by combining the mixture of precipitates with 0.1 M HcCl you lose 8% of the yield. This leads me back to point 2. Had you washed the precipitate on the filter with plenty of water, not only would you have removed the Cu^{+2} impurity, but would have been had a much higher yield of Cu^{+1} . Please present these calculations in the manuscript.

4. You mention that the product was dried in a microwave. Provide the wattage of the microwave and time the product was kept in the microwave.

5. I do not understand where the Theoretical future method comes from. There is no mention of it in the introduction section.

6. Please clean up the equations and formulas with correct superscripts and subscripts. Where-ever possible, present the data in tables for easy readability.

7. Present realistic scenarios of electrolysis on an industrial scale, i.e. if .04 amps produces 0.4 g of CuCl , a 1000 tons ($1 \text{ e}^{+109} \text{ g}$) per year process will require 1e^{+8} amps or 100,000 kA, will be 1200 kW i.e. 28.8 Mwh in 24 hours. If you assume solar, with a one acre farm generating 1000 kWh per hour, this would mean, 24000 kWh per day or 24 MWh in 24 hours, enough to meet the electrolysis requirement with a green source of energy. Include these calculations in the manuscript under a section called scale up to industrial production. Check my calculations. For reference, look up the Hall-Herault process for smelting Al, which uses a lot more energy due to its special requirements.

8. Double check all your GHG calculations.

Manuscript Changelog - Replaced abstract with longer, more detailed version. - Added information about the roles of Cu₂O and HCl in the process to the Methods section, before Figure 3 and after Figure 2. - Added information about the Copper-Chlorine Cycle (“Theoretical Future Method”) to the end of the second paragraph of the Introduction. - Added information about the microwave used in an experiment, Methods section between Figures 3 and 4. - Removed section “Calculation of electrolyzed copper” because the mass measurements are enough to show how much copper was electrolyzed. Replaced with section “Calculation of current”, because the current measurement was the only one that wasn’t certain. - Current measurements were removed from everywhere they were present (before calculations) because they were incorrect. - Adjusted GHG calculations to account for the new current value. Final GHG emissions increased by 0.11g CO₂/g CuCl. - Corrected information in the Calculation of CuCl lost to HCl section - Removed limitations section because the information wasn’t correct, water would not have worked better than HCl. - Added “scale up to Industrial capacity” section exactly as suggested.

Thank you for addressing my comments. Your calculations for the heat required for Cu melting etc. are correct. I have moved content around and added more content where it was necessary for explanation. Iteration 4 is attached to this review. Please revise this iteration as per my comments below.

I would like you to

1. Convert all numbers (except experimental masses for your electrolysis experiment) to one decimal place. i.e. 30.0088 becomes 30.0. Since you are estimating, it is unlikely that you will be able to estimate beyond one decimal place.

2. For your electronic balance used in the electrolysis experiments, find its precision (plus/minus 0.001 g? for example), then convert your masses to match that precision. Also present that precision of the balance (d=0.001 g) in the manuscript in the materials section.

3. Write all unreasonably non-interpretable decimals (less than 1×10^{-1}) in scientific notation (for example 0.000345 becomes 3.5×10^{-4}). Make sure to use one decimal place and provide proper superscripts using the word software.

4. Present the ammeter used to measure amperage in the materials section; make, model # and country of manufacturer, and precision. This will provide justification for correction of the Ampere readings (although not for the choice of ammeter). If you used a variable adjustable DC supply, some also display Amps. See if you can revisit the instrument to find out what amps it put out (if possible) at 12 V. Another way is to connect an oscilloscope (if you have one) to the leads and find the Amps. Yet another way is to find the wire size (from the leads from the DC supply) for the maximum amps it can carry.

5. I would like for you to re-introduce the “12 V” for the DC potential difference into figure 1. You can leave out the amps.

6. renumber the references (same numbers) but use manual numbering (not automatic numbering provided by the word software). Our copyediting software is incompatible with the automatic numbering for word or writer software.

7. Renumber the figures so that they appear in sequential order in the text. Make sure the text references to figures is correct after renumbering. Some of those figures may have to be relocated in the text.

8. Make sure the bars representing the numbers in the currently labeled figure 8 are still correct. If not, replace with correct bar graph.

9. Rewrite (re-present) Faraday's equation using proper software. It looks extremely unprofessional as currently written.

10. Rewrite Cl to either Cl^{-1} or $Cl_{subscript 2}$ depending on species wherever "Cl" by itself appear in the manuscript.

11. Populate the "Limitations" section.

I look forward to the revised manuscript.

Accepted