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CHEM 029

Qualitative Analysis II

Introduction

The goal of this experiment was to separate and identify five metal ions, Pb^{2+}, Ag^{+}, Fe^{3+}, Cu^{2+}, and Ni^{2+}, by using a series of chemical reactions. In the previous week, we observed how each ion reacts in different ways, which helped us figure out which ones were present in the mixture through observations. Our goal was to separate the ions through chemical reactions, and confirm their presence by observing their reactions to certain chemicals.

Procedure and Observations

To begin, we added HCl to the unknown solution to precipitate $PbCl_2$ and AgCl. As we added HCl, the solution turned light blue, and a white precipitate formed. When we added more HCl, the liquid turned green. After centrifuging the mixture for one minute, we obtained a solid containing lead and silver ions. We then washed this precipitate with about 1 mL of deionized water, stirred it, centrifuged for 1 minute, and decanted the liquid, keeping only the solid.
To separate and confirm the presence of Pb^{2+} and Ag^{+}, we added hot water to the solid. This dissolved the $PbCl_2$ while AgCl remained as a solid. We decanted the hot solution and added K_2CrO_4, which formed a yellow solution, confirming the presence of Pb^{2+}. We then added NH_3 to the remaining solid, which dissolved, confirming the presence of Ag^{+}.

Next, we worked on separating Fe^{3+}, Cu^{2+}, and Ni^{2+} from the liquid that remained after the Ag/Pb separation. We added NaOH, which caused the solution to turn green and eventually form a brown sludge. After adding five more drops of NaOH, the test tube became hot. We then added 20 drops of nitric acid, which generated more heat and changed the brown sludge to a light green color. The mixture now contained a dark blue solution with a brown precipitate. We also noticed a bronze/red solution, which we thought might be from Fe^{3+}. We added NH_3, which created a deep blue solution that confirmed the presence of Cu^{2+}. To test for Fe^{3+}, we added KSCN to the solid portion, and it turned into blood-red solution, confirming the presence of Fe^{3+}. Although the

color wasn't as bright as expected, it was still a positive result. Then we added DMG to the liquid portion, which formed a pink/red precipitate at the top, confirming Ni^{2+}.

Discussion

One notable observation was that the Fe^{3+} detection was weaker than expected. This could be due to dilution or loss in the earlier steps. We also observed several color changes, green to brown to bronze/red, that may indicate oxidation/reduction side reactions or shifts in pH.
Overall, we were successful in identifying all the metal ions. However, to improve our results, especially for Fe^{3+}, we would be more careful with decanting and consider additional centrifugation to get a better concentration.

Also, we observed the blue solution from Cu^{2+} and the pink precipitate from Ni^{2+} forming in the same test tube. The pink was stacked on top of the blue, but we could have separated them into different tubes before testing. This would have prevented any interference between reactions and helped us observe each result more clearly.