

PERCENT COPPER IN BRASS

When a brass sample is dissolved in nitric acid, only one colored species is produced in solution:



The copper (II) ion has a blue color when in solution. The concentration of copper in the brass sample is measured by evaluating the intensity of the blue color of the solution. The absorbance of the colored solution is directly proportional to its concentration ($A = abc$), where A is absorbance, a is the molar absorptivity with units of $\text{L mol}^{-1} \text{cm}^{-1}$, b is the path length measured in cm of the cuvette in which the sample is contained. The cuvettes you will use are 1.0 cm. c is the concentration of the compound in solution, expressed in mol L^{-1} . A Beer's Law plot can be constructed using solutions of known concentration. The copper ion concentration of the brass sample is then determined using this plot.

Materials

- Spectrometer
- Cuvettes, (7)
- 0.001 g Precision balance
- Beaker, 50 mL
- Graduated cylinder, 50 mL
- Mohr pipette, 10 mL
- Pipette bulb
- Volumetric flask, 100 mL
- Stirring rod
- Wash bottle
- Standard solutions
- Brass sample 1-2g
- Nitric acid, concentrated, 5 mL
- Distilled deionized water

Safety

This lab uses concentrated nitric acid to dissolve samples of brass. This process evolves a noxious nitrogen oxide gas. This reaction must be performed in a fume hood. Do not do this reaction in an open room. Only a qualified instructor should handle concentrated nitric acid.

Calibration

1. Associate the spectrometer with your device using Bluetooth or USB connection.
2. Open the spectrometry application.
3. Select ANALYZE SOLUTION from the menu at the top of the screen.
4. Select CALIBRATE DARK from the menu at the bottom of the screen. The spectrometer will turn off all of its lights and perform an internal calibration. A check mark will appear when the calibration is finished.
5. Put distilled water into a cuvette. This should be the same distilled water that is used as a solvent for the solutions being analyzed. The spectrometer will send light through the water and then neglect any absorbance it may contain. From this point on, the spectrometer will only see the absorbance of the ions dissolved in the water and not the water itself.

Always handle the cuvette by the ridged sides. Wipe off any fingerprints using a lint free wipe. Place the cuvette into the spectrometer so that the

ridged sides are facing the violet and green light icons and clear sides face the white light and absorbance spectrum icons.

6. Select CALIBRATE REFERENCE from the menu at the bottom of the screen. A check mark will appear when the calibration is complete.

Finding a Wavelength to Analyze

1. Place 4 mL of one of the solutions to be analyzed into a cuvette, or if cuvettes have been prepared in advance obtain the cuvette containing the sample of highest concentration. Always handle the cuvette by the ridged sides. Wipe off any fingerprints using a lint free wipe. Place the cuvette into the spectrometer as you did in the calibration.
2. Start collecting data.
3. Use SCALE TO FIT to rescale your data.
4. Use the ADD COORDINATE tool to locate a wavelength to analyze on the curve.
5. A small hand will replace your cursor. Move it to the box that has appeared on the graph and drag the box slowly toward the curve. As you get near the curve, an arrow will appear that indicates a specific wavelength on the curve. Releasing the box will snap the box to the point on the curve where the arrow is pointing.
6. Drag the box along the curve to find a desirable wavelength to analyze. This is usually a high point on the curve; however, if your curve plateaus near the top of the graph, the absorbance is too large in that area to be used for analysis and another wavelength should be selected.
7. Once you have found a desirable wavelength, select the blue check mark to the left of the selected wavelength value.



CALIBRATE DARK



CALIBRATE REFERENCE



START RECORDING



STOP RECORDING



SCALE TO FIT



ANALYZE SOLUTION



CONCENTRATION



SHOW LINEAR FIT



ADD COORDINATE



EXPERIMENT OPTIONS

Creating a Concentration-Absorbance Calibration Curve

1. Select CONCENTRATION from the menu at the top of the screen. A table will appear on the left side of the screen that has columns for Concentration and Absorbance.
2. Highlight the concentrations in the column titled Concentration and type over the given values with the concentrations of the samples your instructor has prepared.
3. Start collecting data.
4. Place the sample with the highest concentration into the spectrometer and look at the cell in the Absorbance column that corresponds to the respective concentration. Once the absorbance stabilizes, select the Check next to the absorbance to record the value. An absorbance value of three indicates that the solution too concentrated for the selected wavelength.
5. You may wish to turn off SHOW LIVE SCAN DISPLAY.
6. Place the samples of lesser concentration into the spectrometer and record their absorbance values. Continue until all of the samples are analyzed.
7. Stop data collection.
8. Use SCALE TO FIT to rescale your data.
9. Select SHOW LINEAR FIT to create a best-fit line and display the equation for the line.
10. Place the cuvette containing a solution of unknown concentration into the spectrometer.
11. Select the box below Absorbance in the table titled DETERMINE UNKNOWN CONCENTRATION at the bottom of the screen under a column labeled Absorbance.
12. Start Recording Data
13. Once the absorbance stabilizes, select the check mark next to the absorbance to record the value.
14. Stop data collection.
15. Use either the ADD COORDINATE tool on the graph or the equation for the line to determine the unknown concentration and type it into the box below Concentration in the Determine Unknown Concentration table.

Percent Copper in Brass

Nitric acid is severely corrosive. If it gets on your skin rinse it with large amounts of water. The reaction of nitric acid and brass involves large amounts of toxic nitrogen oxide gas. The reaction must be performed in a fume hood.

1. Add between one and two grams of brass to a small beaker. The exact mass must be recorded to $\pm 0.001\text{g}$.
2. Place the beaker in the fume hood and ask your instructor to add 5mL of concentrated nitric acid. Cover your beaker with a watch glass to prevent the acid from splattering.
3. After ten minutes the brass should be dissolved. Using a graduated cylinder add 30mL of deionized water and swirl the beaker in the hood. The beaker is safe to bring to your lab station.
4. Transfer the dissolved brass/nitric acid solution to a 100 mL volumetric flask. Use distilled deionized water from a wash bottle to rinse all of remaining solution into the volumetric flask. Then fill the volumetric flask to the mark. Place a cap on the flask and swirl it to stir the contents.
5. Analyze this solution with the spectrometer and use the calibration curve you created to determine the concentration.

Data Table

Mass of Brass		g
Absorbance of the copper ion from brass solution		
Volume of water added to dissolved brass solution		mL

Calculations

Use your data to calculate the percent of brass in your sample.



CALIBRATE DARK



CALIBRATE REFERENCE



START RECORDING



STOP RECORDING



ANALYZE SOLUTION



CONCENTRATION



TIME



SCALE TO FIT



ADD COORDINATE



SHOW LINEAR FIT



EXPERIMENT OPTIONS



QUICKCALCS