Lab Writeup for Lab 2
CHEM 212
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Purpose: To gain experience using two different methods, the calibration curve and standard addition, and to use these methods to determine the nickel concentration in unknown samples.

Results

The wavelengths at which these absorbencies were gathered were approximately 490nm and 590nm. Below is a graph (**Graph #1**) depicting the general behavior of the blank and unknowns involved in this experiment.
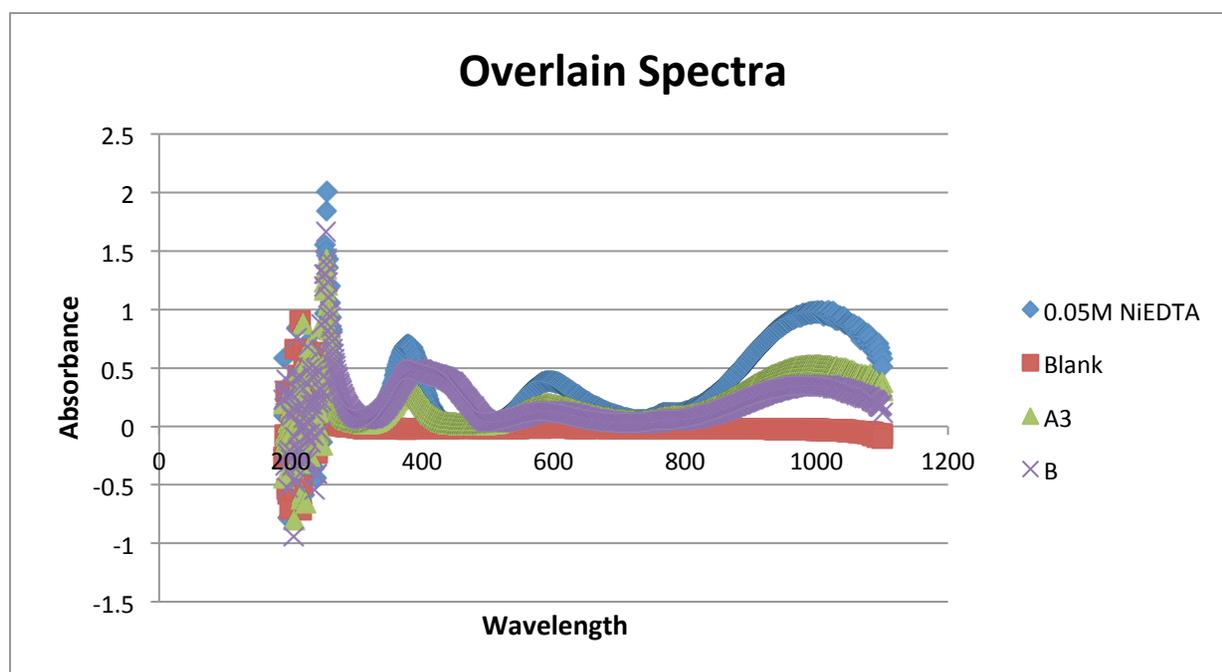
Calibration Curve Method

Through the use of this method, we were able to calibrate the Ultraviolet-visible spectroscopy apparatus, obtain the absorbencies for our standard samples, as well as obtain a calibration curve which will assist us in finding the nickel concentration in our unknown samples.

We used the data gathered from this experiment in order to construct the calibration curve shown below (**Graph #2**). It was made using the least-squares method and the equation of the trendline

(aka line of best fit) which was obtained from this data was: A= 7.49±0.06[Ni] – 0.0016±0.0015, while the R^2 value was approximately 0.99(0.9997). The data used in this analysis is found below (**Table #1**) and the calculations can be found in an Excel Spreadsheet which I can email to you.

Table #1: Data used in the construction of the calibration curve used to quantify nickel in unknown samples.		
[Ni]	Absorbance	[Ni]calc
0.05M	0.375±0.002	0.05 M
0.03M	0.245±0.002	0.03 M
0.025M	0.186±0.002	0.025 M
0.02M	0.151±0.002	0.02 M
0.014M	0.104±0.002	0.014 M
0.01M	0.072±0.002	0.01 M
Unknown (A3)	0.194±0.002	0.0261±0.0002 M
Unknown (B1)	0.031±0.002	0.0044±0.0002 M
Blank	-0.001±0.002	0.0 M

According to my judgment, the results of this experiment are both accurate and precise.

Graph #2: Calibration curve constructed from the data above and used in finding the nickel concentrations of the unknown samples.

Calibration Curve: [Ni] vs. Absorbance

y = 7.4899x - 0.0016
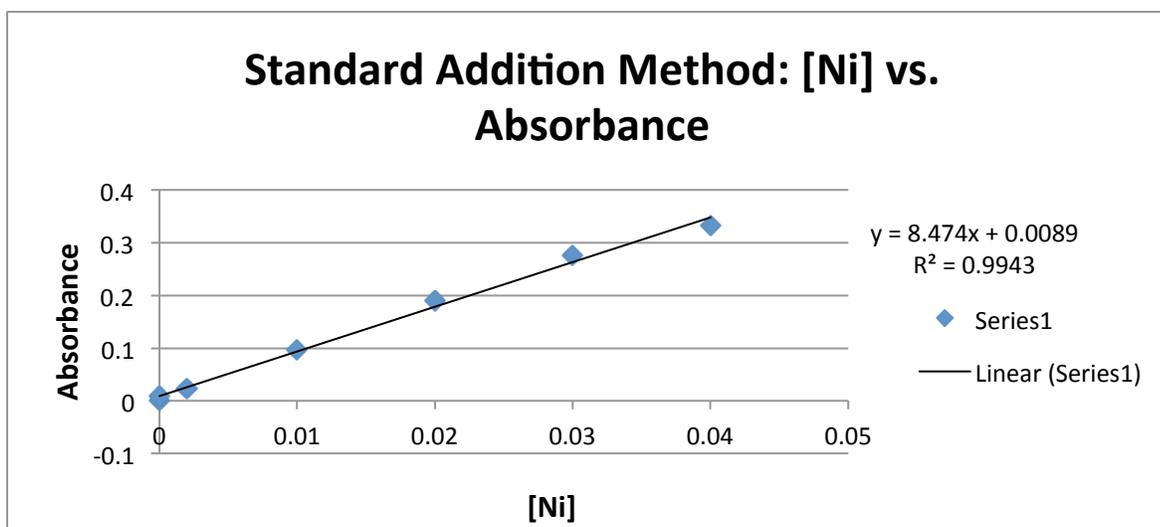R² = 0.99972
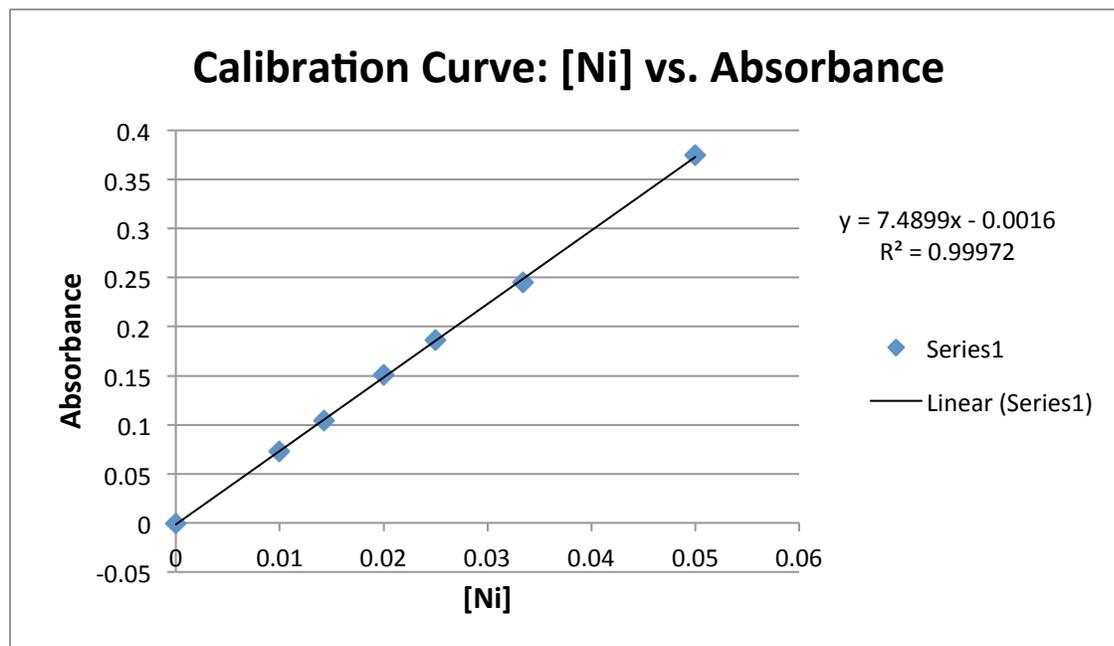
Standard Addition Method

In this lab, we also used the standard addition method in order to use the nickel concentrations in our standard solutions to quantify the nickel concentration in our unknown (we only used one unknown in the standard addition portion of this experiment).

Similarly to the calibration curve method, we used the data gathered in this portion of the experiment in order to generate a curve from which we can obtain an equation and, in turn, determine the concentration of nickel in our unknown sample.

The table below (**Table #2**) shows the data that was gathered in this experiment. It is from this data that the curve below was constructed (**Graph #3**), from which we will be able to determine the nickel concentration of our unknown. Through the use of least-squares analysis, we found that the equation for the trendline was A=8.47$\pm$0.29[Ni] + 0.0089$\pm$0.0059 and that R^2= 0.99.

Table #2: Data from the standard addition method used in quantifying nickel in our unknown and standard samples			
[Ni]added		Absorbance	[Ni]calc
0.04 M		0.33$\pm$0.01	0.04 M
0.03 M		0.28$\pm$0.01	0.03 M
0.02 M		0.19$\pm$0.01	0.02 M
0.01 M		0.097$\pm$0.01	0.01 M
0.002 M		0.023$\pm$0.01	0.002 M
0M		9.1 x 10^{-3} $\pm$0.01	2.4 x10^{-5} $\pm$0.00105 M
Blank	-7.9 x 10^{-5} $\pm$0.01	-1.1 x 10^{-3} M	

In my judgment, the results of this experiment seem to be relatively accurate and precise.

Standard Addition Method: [Ni] vs. Absorbance

y = 8.474x + 0.0089
R² = 0.9943

Series1

Linear (Series1)

Graph #3: This curve was constructed from the data in the table above and can be used to find the nickel concentration of our unknown.

Discussion

A table (**Table #3**) below illustrates the equations and R^2 values obtained from each method. Each method resulted in a different equation, though they had very similar R^2 values. The R^2 values are both very acceptable (at approximately 0.99) and I would expect both to result in good nickel quantification results for our unknowns. These quantification results can be found in the second table below (**Table #4**).

Table #3: Summary of Two Methods Used in Quantification of Nickel		
Method	Equation	R^2 Value
Calibration Curve	A= 7.49±0.06[Ni] – 0.0016±0.0015	0.99
Standard Addition	A=8.47±0.29[Ni] + 0.0089±0.0059	0.99

Table #4: Nickel Quantification Results from Both Methods		
Method	Unknown #1 (A3)	Unknown #2 (B1)
Calibration Curve	0.0261±0.0002 M	0.0044±0.0002 M
Standard Addition	Not Tested	2.4 x10^{-5} ±0.00105 M

As we can see above, our calculated value for the concentration of nickel in the unknown solution B1 is very different from one method to the next. I think that there could have been a few different major sources of error which would cause this. First of all, we could have made an error two weeks ago when we first made the stock solution, resulting in its not being the molarity which we thought it should be from our calculations. There could also have been human error on our part when we were mixing the standard solutions for the standard addition portion of the experiment as each member of our group was performing a different task, resulting in a slightly busy and confusing atmosphere where measurements for the solutions could have been done incorrectly. There is also the very great possibility that I could have erred when I performed these calculations through the Microsoft Excel program, which would have caused multiple errors in the rest of my data. There could also have been random errors associated with measurements taken by the UV-vis spectrophotometer (as well as other instrument error), the weight apparatus (both human and instrument error), and the pipettes (both instrument and human error).

 In order to avoid these errors next time, I would try to be even more precise when performing measurements for the stock solution and the standard solutions and would also try to enhance my knowledge of the process of constructing, and getting information from, the curves which we made using the calibration curve and standard addition methods.

Conclusion

In this experiment, we used two methods in order to quantify the concentrations of nickel in unknown solutions: the calibration curve method and standard addition methods. While both methods resulted in very linear calibration curves (both had an R^2 value of approximately 0.99), they had very different equations and resulted in different calculated concentrations for Unknown B1. These differences could be the result of the different sources of error which presented themselves throughout the course of this experiment (human error when mixing standard solutions and mixing the stock solution, and error in calculations done through the Microsoft Excel program, instrument error, etc). From the concentrations obtained for the unknown from the two methods and their comparison to the standard solution data, I would say that it appears as though the calibration curve method possibly delivered a more accurate result than the standard addition method in this case.

Group Dynamics

I worked with AAA and BBB in this experiment. In my opinion, we all contributed equally during the time in lab and worked well together. In regards to the writing of the lab report, I would say that AAA and I each contributed 100% to our individual reports while I contributed significantly to BBB.