“Water” in the Erie Canal, Mohawk River, and Schoharie Creek?

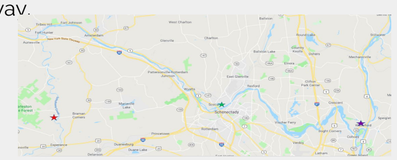
Emily Andrews, Alexa Caruso, Kelsey Masselli

Introduction

Background:

1. The **Erie Canal** (ERE) is a 363 mile long water highway that spans from the Great Lakes to the Atlantic Ocean. It is a center of pollution due to agricultural and travel uses, but in turn provides economic profit.[1]
2. The **Schoharie Creek** (SCH), also known as the Schoharie River, continues 93 miles until it feeds into the Mohawk River as a main tributary. Along the riverbanks, the surrounding land is 75% natural, 20% agriculture, and 5% developed.[2]
3. The **Mohawk River** (MKR) is surrounded by agriculture in residential areas and undeveloped forests in more rural areas. It eventually feeds into the Hudson River, as one of its largest tributaries.[3]

Goals: To compare chemical composition and the ionic species of three different water samples using various analytical techniques. From these comparisons, determine the impact of pollution on each waterway.



SCH
MRK
ERE

Erie Canal

Schoharie River[4]

Materials and Methods

Ion Selective Electrodes were used to measure pH and chloride concentration in water samples. Chloride concentration was measured using external standards and standard addition.

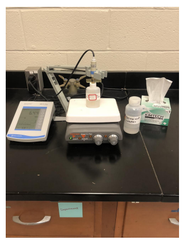
Atomic Absorption Spectrophotometry (AAS) was used to measure Ca^{2+} concentration using the Perkin-Elmer Model 3100 (flame-based). A calibration curve was created using 1, 5, and 10 ppm Ca^{2+} standards. Samples were diluted to fall within range.

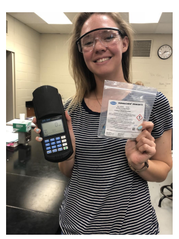
Hach Test Kits were used both in field and in class to measure concentration of various ions (NO_3^-, PO_4^{3-}, SO_4^{2-}). A specific chemical packet was added to the water sample (NitraVer 5, PhosVer 3, SulfaVer 4), then ion concentration was measured using a DR/890 Colorimeter.

Ion Chromatography was used to measure various ion concentrations. These measurements were done in triplicate. The ions were analyzed using DX-500 for cations and ICS-2100 for anions.[5]

Inductively-Coupled Plasma-Mass Spectrometry (ICP-MS) was used to ionize water samples and analyzed them by mass spectrometry for various trace metals via the Agilent 8900 ICP-MS.

Titration 0.02N H_2SO_4 and methyl orange indicator was used to determine the total alkalinity.





Results

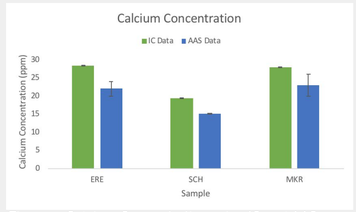


Figure 1. Calcium Concentration using IC and AAS

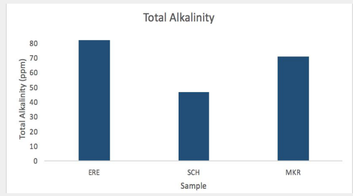


Figure 2. Total Alkalinity of Water Samples

Calcium concentrations are within the typical range found in water (10-60ppm)[6]. This is upheld by Figure 1. The IC data provided larger calcium concentrations in comparison to AAS.

Total alkalinity is the highest in Erie Canal, followed by the Mohawk River. The total alkalinity of the Schoharie River is significantly lower than the others.

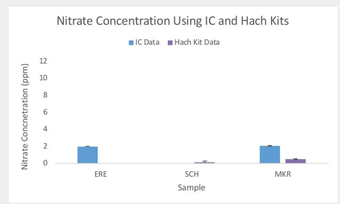


Figure 4. Nitrate Concentration of Water Samples using IC and Hach Test Kits

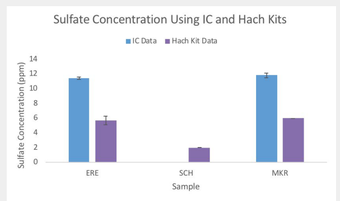


Figure 5. Sulfate Concentration of Water Samples using IC and Hach Test Kits

There was no detection of nitrate and sulfate in the Schoharie River. There were low levels of nitrate in both the Erie Canal and the Mohawk River. Sulfate levels were high compared to nitrate levels in the samples. Both nitrate and sulfate were better detected with IC compared to Hach Test Kits.

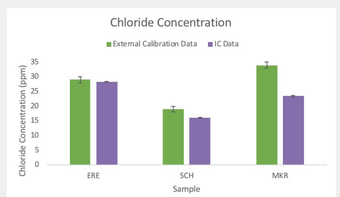


Figure 4. Chloride Concentration of Water Samples using IC and External Calibration

Chloride concentrations are highest in the Mohawk River. The Erie Canal has the second highest chloride concentration. The Schoharie River has the lowest concentration of chloride.

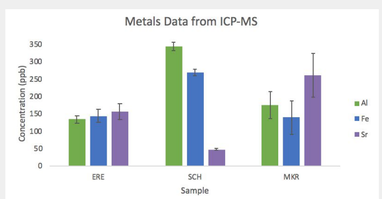
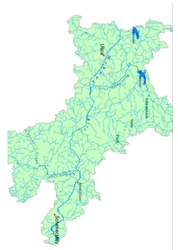


Figure 5. Metal Concentration from ICP-MS. Metals include Aluminum, Iron, and Strontium

The Schoharie River has the highest concentration of aluminum (Al) and iron (Fe) in comparison with the other samples. The Mohawk River has the highest concentration of Strontium (Sr), followed by the Erie Canal. The Schoharie has the lowest concentration of Sr. The three metals in this graph are the highest metals in concentration found in these three water bodies.

Discussion



Mohawk River Watershed[8]

We compared the precision of IC and AAS for measuring calcium concentration, IC data were found to be more precise than AAS data. A case 3 t-test was performed to compare these methods.. The results of the test showed that these two methods produced results that were in fact significantly different.

The trends seen in the concentration of calcium follow the trends in the alkalinity data.

The nitrate and sulfate concentrations were detected at higher levels using IC compared to the Hach Test Kits. This indicates IC had a higher sensitivity than Hach Test Kits.

A case 2 t-test was also done to compare the concentration of iron in the Erie Canal and the Mohawk River. The $t_{calculated}$ was 0.134 and t_{table} at 95% confidence and 4 degrees of freedom was 2.776.[7] Since $t_{calculated}$ is less than t_{table}, the concentration of iron in the Erie Canal and Mohawk River is not statistically different.

Conclusions

Fireworks on the Mohawk River[12]

Calcium concentration and total alkalinity is highest in the Erie Canal. This could be due to the large presence of cement in the canal which breaks down into Ca^{2+} and $CaCO_3^{2-}$.[9]

Chloride concentrations are found to be highest in the sample taken from the Mohawk River. This could be due to more rock salt being placed on the roads in the highly residential area surrounding the Mohawk.[10]

Aluminum and Iron are found in high concentrations in the Schoharie Creek. This could be due to two major bridge collapses on the creek, raising the levels of these metals.[11] Furthermore, the samples were taken in close proximity to a bridge.

Strontium is found in high concentrations in the Mohawk River. This could be due to fireworks along the river or paint runoff. Strontium is a major component in paint, so runoff could be likely in residential areas.[13]

Acknowledgements and References

Prof. Matt Manon, Union College Geology Department for performing IC and ICP-MS analyses
Prof. Laura MacManus-Spencer, Union College Chemistry Department
Prof. Karen Lou, Union College Chemistry Department

1. History.com Staff. “Erie Canal.” *History.com*, A&E Television Networks, 2018, www.history.com/topics/erie-canal.
2. “Schoharie Creek Biological Stream Assessment.” *Department of Environmental Conservation*, 9 Sept. 2015, pp. 1–27., dec.ny.gov/docs/water_pdf/schoras15.pdf.
3. “Mohawk River Watershed.” *Freshwater Wetlands Program - NYS Dept. of Environmental Conservation*, www.dec.ny.gov/lands/58571.html.
4. Image. *Times Union*
5. 6.“Ion Chromatography.” *Using Media to Enhance Teaching and Learning*, 12 May 2018, serc.carleton.edu/microbelife/research_methods/biogeochemical/ic.html.
6. Carroll, M. K.; Lou, K.A. “CHM 240 Water Project: Calcium Concentration.” Union College, 2018
7. Harris, D. D. *Quantitative Chemical Analysis*, 9th ed.; W. H. Freeman: New York, ,2016.
8. “Mohawk River Watershed Map.” *Freshwater Wetlands Program - NYS Dept. of Environmental Conservation*, www.dec.ny.gov/lands/53752.html
9 National Center for Biotechnology Information. PubChem Compound Database; CID=10112, https://pubchem.ncbi.nlm.nih.gov/compound/10112 (acc.
10. “Rock Salt vs Magnesium Chloride.” *Difference Between Rock Salt and Magnesium Chloride*, www.dukecompany.com/news-expert-advice/rock-salt-vs-magnesium-chloride.
11. Wilkin, Jeff. “Thruway Bridge Collapse of 1987: ‘It Sounded like a Bomb Going off’.” *The Daily Gazette*, 3 Apr. 2017, dailygazette.com/article/2017/04/04/thruway-bridge-collapse-of-1987-it-sounded-like-a-bomb-going-off.
12. Image. *Daily Gazette*)
13. McKinnon, Mika. “These Are the Minerals That Give Fireworks Their Colors.” *Gizmodo*, Gizmodo.com, 4 July 2017, gizmodo.com/these-are-the-minerals-that-give-fireworks-their-colors-1715822644.