Chloride Concentration in the Edgewood College Retention Pond

Amber Marti, Frannie Schultz, Liz George, Christina Weigert

Abstract:

Road salt use has led to detrimental effects on our environment, including plants and animals in this area. The purpose of this study was to determine whether there was a correlation between road salt use and chloride levels in the Edgewood retention pond. This location was chosen for testing because it is the primary body of water to be affected by road salt use on the Edgewood campus. Our hypothesis was that as road salt runs off during the melting of winter snow and ice, more chloride will be present in the retention pond. We collected 12 samples from the pond over a course of six months, and used a Hach® Test to measure chloride levels. Results support our hypothesis, in that there is an increasing trend in chloride concentrations in the pond as melting occurred. During the months of September through March, levels in the retention pond increased from 12.5 mg/L to 465 mg/L. To reduce the negative impact of road salt in the Wingra Watershed, our group recommends providing training to city employees as well as Edgewood's maintenance staff, reducing the average road salt use, developing city ordinances focusing on the reduction of salt usage, and closely monitoring sodium and chloride levels in Madison and surrounding communities, including Edgewood's campus.

Introduction:

Salt use for highway deicing began in the 1950's. During the 1950's and 60's, road salt use throughout the U.S. doubled every five years, and by 1970, road salt usage reached ten million tons. Following this increase, the Federal Highway Administration initiated a research program whose goal was to reduce the overall cost of highway deicing. However, high costs were not the only problem that using salt presented. According to the Committee on Rock Salt, high concentrations of chloride may be contained in highway runoff during spring melts (1991). By 2005, the salt usage in the Madison area has dropped to 8,800 tons per year, although this is still not low enough (Salt Use Committee, 2006). This runoff is ending up in our lakes, making it difficult for the native plant and animal species to survive.

The purpose of this project was to test the chloride levels in the campus retention pond. It is known that when the water in the retention pond reaches a certain level, it drains into Lake Wingra. It is also known that the salt and other minerals and toxins may not necessarily settle to the bottom of the retention pond before they flow out. This would mean that these pollutants are ending up in Lake Wingra and can be harmful to the native fish and plants species in the lake. The salt will fall to the bottom of the lake, reducing circulation in these parts. This exchange of the water is critical for providing its creatures with oxygen. Without circulation, oxygen levels drop and the inhabitants of these regions die (Salt Use Subcommittee, 2006). With the knowledge that water from run-off and the retention pond finds its way into Lake Wingra, the intention of this research and testing is to show how high the chloride levels reach and to push for reform in the methods of road deicing.

The chloride levels in the retention pond were tested before and after snowfall to determine how much salt from the street (put out in response to snowfall) was flowing into the retention pond and potentially into the lake. It was our belief that the salt

concentration in the retention pond would be relative to the amount of snowfall; therefore, we hypothesized a positive correlation between salting activity and chloride concentrations in the Edgewood Retention Pond. According to research conducted in previous years, there is, in fact, a relationship between snowfall (and the salt put down in response) and chloride levels in the Edgewood Retention pond (Carson, 2001).

We hypothesized that the salt concentration in the Edgewood Retention Pond will increase from September to March as road salt is applied to the city streets of Madison, and around the Edgewood schools. As snow and ice begins to melt and run down Edgewood College hill, more chloride will be present in the retention pond.

Methods and Materials:

To test the chloride levels in the Edgewood retention pond, we first obtained water samples for testing. The group focused on collecting samples around weather conditions, such as during snowfall or in the days prior to, or following a snowfall, or melting. In the late winter/early spring samples were collected more frequently when snow and ice began to melt. The group chose one member to collect the samples of the retention pond water for the sake of consistency. Before the water in the Edgewood retention pond froze, water was collected from the location at the end nearest the Sondregger Science Building. Following the water freezing, the group member collected samples by drilling through the ice using an auger, in the same location—approximately 3 feet from the edge of the pond. Samples were collected in plastic water bottles and labeled with date, group member's names, and weather conditions. Water samples were sealed tightly and placed in a refrigerator until tests could be conducted. Each sample was tested twice with a Hach® chloride test (low test) to measure the chloride concentration of water. Results were recorded and graphed using Microsoft Excel. The results from each of the set of tests were then averaged and plotted on a graph. We compared our findings from the Edgewood retention pond to previous results of a similar experiment. We found our data to be comparable to their results (Carson, 2001). Both groups experienced similar trends of chloride levels in the Edgewood Retention Pond, especially with reference to a peak in these levels by mid February as snow began to melt.

Results:

Table 1 shows the date in which the sample of water from the Edgewood Retention Pond was taken, the weather conditions on that day, and the average chloride levels based on the two Hach® tests that were done on each sample. According to this set of data, there was a small amount of chloride in the water in the first few samples, however; as there was more snow and cold, icy weather, the chloride levels increased as the fall changed to winter. Figure 1 shows the dates in which the samples were collected and the average chloride levels in the Edgewood Retention Pond. Overall, the chloride levels increased as there was more road salt use. The drastic increases or decreases in chloride levels, marked on the graph, could be due to specific weather conditions. When there were incidents of snowfall accumulating over a half inch, the roads were salted. With warm weather, came the melting of the snow, which resulted in runoff carrying chloride to the pond. This would explain the high chloride levels recorded. Following a significant rainfall from Thursday, February 22nd through Tuesday, February 27th there was less chloride due to the diluting of the pond.

Table 1

Date	Weather Conditions	Average Chloride Levels
9/18/2006	Sunny, No Rain	12.5 mg/L
11/15/2006	After Snowstorm	42.5 mg/L
11/29/2006	Cloudy and Rainy	35 mg/L
12/14/2006	No Snow	112.5 mg/L
12/15/2006	Snow day before and after	102.5 mg/L
1/15/2007	Snow roads salted	260 mg/L
1/21/2007	Snow roads salted and plowed	232.5 mg/L
1/26/2007	Snow melting	237.5 mg/L
1/28/2007	Ice melting warm snow last nite	270 mg/L
2/20/2007	Sunny/warm	465 mg/L
2/21/2007	Sunny/Snow Melting	465 mg/L
2/22/2007	Sunny/warm	450 mg/L
3/11/2007	sunny/warm	60 mg/L
3/12/2007	Sunny/warm	70 mg/L
3/13/2007	Sunny/warm	230 mg/L

Table 1 shows the date on which the samples were collected, the weather conditions on that day, and the average chloride levels as measured by the Hach® Test.

Figure 1

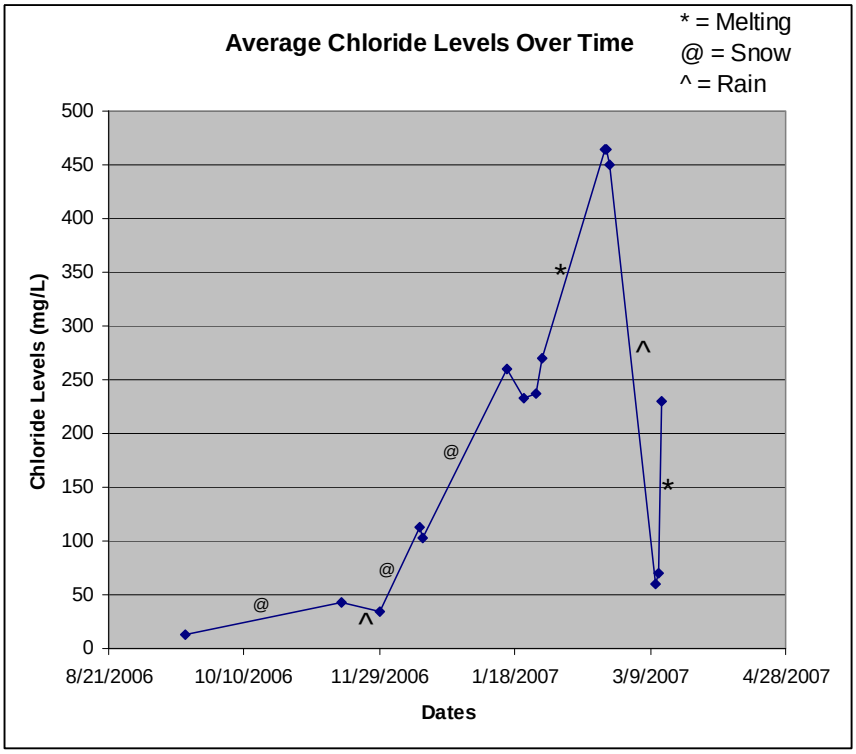

Figure 1 shows a trend of chloride concentration vs. time. The important weather events are shown so that we can draw some possible conclusions about the data. The specific test dates are not listed. The diagram above shows a scale of dates in the months tested.

Discussion:

Our group hypothesized that the salt concentration in the Edgewood Retention pond would increase as snow from the retention pond watershed melted causing runoff to enter the pond. According to the data collected from the pond, our hypothesis held true until mid-February. At this point there were several rainstorms, which led to the diluting of the water. The majority of data supporting our hypothesis was collected from February 20th through February 22nd (please note: Figure 1 does not show each test date) when temperatures increased to the mid 40's. Because the weather changed so rapidly, much of the snow surrounding Edgewood College's campus melted and traveled down the slope of Edgewood College Drive into the retention pond. The water samples collected during this time show an increase in chloride concentration from 270mg/L to 465mg/L. Although chloride levels increased steadily in the retention pond before the week of February 18th, it is clear that warm weather conditions had a greater effect on our results as the weather significantly changed. In addition, Madison received over fifteen inches of snow between February 24th and 27th, and more salt was applied during this time in response (National Weather Service, 2007).

The small decreases in the chloride levels may be due to errors in collecting samples, testing the samples, or the fact that there was less melting of the snow and ice during certain months which would result in fewer run-offs from the roads to the pond. In addition another possibility is that the drops of silver nitrate did not mix well enough in the container.

If more consistent data were collected, it would likely be easier to see an overall trend in chloride concentration in the Edgewood College Retention Pond and Lake Wingra and researchers would be better able to develop conclusions about annual trends of sodium chloride concentration over the course of many years. Also, if any of the suggestions such as providing training to city employees as well as Edgewood's maintenance staff, reducing the average road salt use, closely monitoring sodium and chloride levels in Madison, and especially creating city ordinances to regulate salt use for homes and businesses were implemented, it would be much easier to reduce the overall effects of salt use in the Wingra Watershed.

There are correlations between road salt use and high chloride levels in the bodies of water in the Wingra Watershed, and also the vegetation, soil, and drinking water. Our group proposes the following recommendations to the city, residents, and business owners of Madison, and also the management and maintenance staff of Edgewood College: to reduce road salt in the Wingra Watershed, our group recommends providing training to City employees that operate snow plows and salt trucks, reducing the average road salt use to 100 lbs per lane mile (as recommended by the Transportation Research Board), developing city ordinances, and closely monitoring sodium chloride levels in the Wingra Watershed.

References

Carson, Rick, Stacy Itanrock, Megan Ricter. "Chloride Levels - Student Study." Introduction to Natural Science, Madison, WI. 2001.

National Weather Service. "National Weather Service Climate." National Weather Service Forecast Office. 27 Mar 2007. National Oceanic & Atmospheric Administration. 28 Mar 2007 <http://www.weather.gov/climate/index.php?wfo=mkx>.

Salt Use Subcommittee to The Commission on the Environment. "Report of the Salt Use Subcommittee to the Commission on the Environment on Road Salt Use and Recommendations." (2006)

United States. Transportation Research Board. Highway Deicing: Comparing Salt and Calcium Magnesium Acetate. Washington D.C.: 1991.