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Onsite Sewage Treatment Program

Communities Addressing Chloride Case Study: Lake Geneva, WI

The problem:

High chloride levels in wastewater infiltration basin that discharges to groundwater

The solution:

Water softener upgrade incentive program, implemented in 1997

Results:

Chloride concentrations frequently exceed the state standard and the city is beginning to pursue other strategies

Minnesota and Wisconsin municipalities are wrestling with high chloride levels in their wastewater. Chloride is one of the components of salt, which is used in forms such as sodium chloride (table salt), calcium chloride and magnesium chloride (road salts). Sodium chloride is commonly used in home water softeners and by water treatment plants to treat “hard” water. Wisconsin generally has groundwater with high levels of calcium and magnesium that must be removed through softening in order to improve taste and prevent lime scale buildup in appliances, pipes and water fixtures. The majority of home water softeners use sodium chloride (NaCl) in a softening process that replaces calcium and magnesium ions with sodium, while the chloride ions are discharged in the wastewater and eventually end up in the environment.

High chloride use can lead to environmental issues. Chloride released into local lakes and streams does not break down, and instead accumulates in the environment, potentially reaching levels that are toxic to aquatic wildlife and plants. Because salt water is more dense than fresh water, it settles at the bottom of lakes potentially preventing the natural mixing of oxygen and nutrients and in effect creating a “dead zone.”

The Minnesota Pollution Control Agency (MPCA) has authority to require discharges to comply with water quality standards using the Clean Water Act and National Pollutant Discharge Elimination System (NPDES) permits. This ensures the protection of aquatic plants, invertebrates and fish. Compliance schedules and variances can be used to assist in meeting permit requirements. Both permitting tools allow time to comply with the permit; however, the variance process considers economic factors that allow more flexible timelines, and offers the potential for renewal of a variance if the permit goal remains unachievable. The variance process may take longer than a compliance schedule and requires approval by the Environmental Protection Agency (EPA). Each community needs to determine which tool is appropriate for their situation.

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Lake Geneva background

The City of Lake Geneva is located in Walworth County, Wisconsin, and has 7,821 residents who receive unsoftened water from the City's water treatment plant. Most city residents use home water softeners to treat water hardness. The recommended water hardness level for taste and to prevent buildup of lime on pipes and home appliances is less than 5 grains, though many homeowners prefer levels closer to 0 grains. Lake Geneva's chloride issues are further complicated by the fact that local groundwater also contains naturally occurring levels of chloride at 59 mg/L

Lake Geneva discharges wastewater into a wastewater infiltration basin located approximately 1.5 miles east of the outfall of Geneva Lake, the adjacent body of water. The City discharges wastewater under a permit regulated by the Wisconsin Department of Natural Resources (WDNR). The water quality criteria for chloride in Wisconsin are 395 mg/L (chronic) and 757 mg/L (acute). In 1997, the WDNR asked Lake Geneva to lower their chloride levels, an effort that has continued ever since.



Lake Geneva, Wisconsin

City Demographics

Total Population	Number of Households	Median Income
7,821	3,210	\$43,587

Solutions

Some communities have been successful in meeting chloride standards through promoting upgrades to high-efficiency water softeners and use of on-demand settings rather than a set amount of salt, a change that can greatly reduce salt use. In 1997, Lake Geneva tested a pilot program to encourage residents to switch from timer-based water softeners to on-demand systems. The program was so successful that the City expanded it to all residents. Lake Geneva shared brochures, a website, and newspaper advertisements educating the public about the issue of chloride in Geneva Lake (see brochure in Appendix). The Lake Geneva Utility Commission (LGUC) currently offers a \$100 rebate for residents who switch to on-demand systems, and 80 lbs of solar water softener salt for those who agree to a free evaluation. The LGUC has partnered with Culligan to perform evaluations of water softener efficiency, and Culligan offers the added incentive of a \$100 discount off all metered on-demand water softeners.

Despite a reduction in chloride loading at the Lake Geneva wastewater treatment plant, chloride levels in the infiltration basin continue to test at levels above the chloride standard and have slowly risen over the last 10 years. Some stormwater runoff from a nearby highway also flows into the basin, and though chloride loading from road salt is likely at peak times, a lack of seasonal variation in chloride levels indicate that the majority of chloride is from wastewater effluent.

Conclusion

At this time, Lake Geneva has started to discuss other strategies for reducing chloride levels in their wastewater effluent. The water softener program has not completely reduced point source chlorides, but there may be ways to make it and similar programs more successful in the future.

MONTHLY WWTF EFFLUENT CHLORIDE MONITORING											
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	AVERAGE
JAN		300	300	380	350	400	380	320	320	340	343.3333
FEB		270	310	310	360	390	400	340	340	370	343.3333
MARCH		280	330	320	300	290	410	360	330	320	326.6667
APRIL		200	310	290	320	270	320	340	300	290	293.3333
MAY		270	270	330	340		340	290	300		305.7143
JUNE	220	240		350	350	320	350	350	360		317.5
JULY	270	310	280	290	360	290	300	340	340		308.8889
AUG	280	310	290	300		320	330	340	360		316.25
SEPT	300	300	330	350	360	340	340	340	360		335.5556
OCT	270	280	310	260	360	340	350	350	340		317.7778
NOV	240	290	340	350	380	340		340	330		326.25
DEC	230		360	340	350	430	330	260	360		332.5
AVG.	258.57	277.27	311.82	322.50	348.18	339.09	350.00	330.83	336.67	330.00	

References

"About Us - Lake Geneva Utility Commission." Accessed April 24, 2017. <http://www.lgutilitycommission.com/about-us>.

"Brochure-LifeOfChloridesPuzzle.pdf." Google Docs. Accessed April 24, 2017. https://drive.google.com/file/d/0B-877Fe5oHxlX3dyZUtHS2FSY2c/view?usp=drive_web&usp=embed_facebook.

Dugan, Hilary A., Sarah L. Bartlett, Samantha M. Burke, Jonathan P. Doubek, Flora E. Krivak-Tetley, Nicholas K. Skaff, Jamie C. Summers, et al. "Salting Our Freshwater Lakes." *Proceedings of the National Academy of Sciences*, April 10, 2017, 201620211. doi:10.1073/pnas.1620211114.

Gajewski, Josh. "Lake Geneva." E-mail message to author. May 15, 2017. Correspondence with Lake Geneva Utility Director. "Geneva Lake Environmental Agency - Home." Accessed April 24, 2017. <http://www.genevaonline.com/~glea/index.php>.

Kyser, Scott. *Alternatives for Addressing Chloride in Wastewater Effluent*. Report. Edited by Sherry Mottonen. Minnesota Pollution Control Agency. April 2017.

"Lake Geneva, Wisconsin (WI 53147) Profile: Population, Maps, Real Estate, Averages,.." Accessed April 24, 2017. <http://www.city-data.com/city/Lake-Geneva-Wisconsin.html>.

"Lake Geneva, Wisconsin." Accessed April 24, 2017. <http://www.cityoflakegeneva.com/>.

"Living Here, November 16, 2016." *Geneva Shore Report*, November 16, 2016. <https://genevashorereport.com/living-here-november-16-2016/>.

Thornton, Jeffrey A., Thomas M. Slawski, and Hebin Lin. "Salinization: The Ultimate Threat to Temperate Lakes, with Particular Reference to Southeastern Wisconsin (USA)." *Chinese Journal of Oceanology and Limnology* 33, no. 6 (November 1, 2015): 1461-75. doi:10.1007/s00343-015-4368-3.

Ward, Xavier. "Study: Geneva Lake Shows Elevated Levels of Salt," 20170417060000. http://www.gazettextra.com/20170417/study_geneva_lake_shows_elevated_levels_of_salt.

"2015 Consumer Confidence Report." Google Docs. 2015. Accessed April 24, 2017. https://drive.google.com/file/d/0B-877Fe5oHxLYmxFNmNmaWxreXM/view?usp=drive_web&usp=embed_facebook.

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