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Onsite Sewage Treatment Program

Communities Addressing Chloride Case Study: Pipestone, MN

The problem: High chloride levels in wastewater that discharges to Pipestone Creek

Chloride reduction strategy: Centralized lime softening water treatment plant in combination with a city ordinance to restrict individual water softener use

Challenges to implementation: Funding

Minnesota 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. Minnesota 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 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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Pipestone historic water tower

Pipestone background

The City of Pipestone discharges wastewater into the Pipestone Creek under a permit regulated by the Minnesota Pollution Control Agency (MPCA). The wastewater discharge permit (NPDES) is set to expire in 2023, at which time the City of Pipestone must lower its chloride discharge levels to within the federal limit. Minnesota Rule 7050.0222 Subp. 2 sets discharge levels into lakes and streams at 230 mg/L. Under the current permit Pipestone must lower chloride levels in wastewater discharge from approximately 600 mg/L to less than 297 mg/L.

City Demographics

Total Population	Number of Households	Median Income
4,156	1,906	\$41,539

Pipestone is in Pipestone County and has 4,156 residents served by the city’s water treatment plant. Four city wells draw from the Sioux Quartz aquifer, located between layers of limestone bedrock that deposit minerals in the groundwater. Pipestone residents’ water hardness is 30 to 38 grains. 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. The majority of Pipestone residents use home water softeners to treat water hardness, and according to Pipestone’s city water and wastewater manager, individual home water softeners contribute 80% of chloride in processed by the wastewater treatment facility.

Chloride is not the only issue facing Pipestone. The city’s water storage reservoir, water treatment plant, and wells are aging and need to be updated or replaced. Water from the Sioux Quartz aquifer also has high levels of naturally occurring radium and gross alpha emitters, which can cause cancer. Pipestone has been working with the Minnesota Department of Health to address this drinking water health concern. The MPCA requires Pipestone to meet chloride standards in 2023, and so the city is looking for a solution to jointly address their aging water treatment infrastructure, high chloride levels, and high radium and gross alpha emitter levels.

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Pipestone's current water treatment plant

In 2015, the City of Pipestone hired the engineering firm Bolton and Menk, to look into water treatment alternatives and propose a design for a new water treatment plant. Some communities have been successful in meeting chloride standards through local ordinances that require residents to upgrade to high-efficiency water softeners and use on-demand settings rather than a set amount of salt, a change that can reduce salt use by as much as 80% according to EcoWater Systems. A city ordinance and a ban on water softeners will be considered after a new water treatment facility is built, but these strategies alone will not address the aging infrastructure and the other contaminants in Pipestone's water supply.

Ignoring the new chloride standard is not an option for Pipestone. Communities that fail to meet the chloride standard by the permit deadline will face consequences such as reduced state funding and a moratorium on issued permits. Five years ago, Pipestone faced a moratorium on new sewer hookups within the city due to compliance issues. Pipestone would like to avoid these types of actions by working with the MPCA to address their water quality issues.

Lime or soda ash softening is a common method of water treatment used by Minnesota municipalities to reduce total dissolved solids, and remove iron and other contaminants. Through lime softening the water hardness level is greatly reduced, but usually not to zero. Residents might continue to use home water softeners, but would only need a fraction of the salt. A disadvantage of lime softening is the plant maintenance cost, however the solid waste byproduct can be used in agricultural settings as a liming agent, an advantage over reverse osmosis.

Project Description

Bolton and Menk determined that lime softening was the best and most cost-effective option to address Pipestone's chloride levels and other issues, and developed a design for a new estimated \$10.5 million lime and soda ash softening water treatment plant. Pipestone was eligible for a \$7 million grant through the Minnesota Public Facilities Authority (PFA) Point Source Implementation Grant Program (PSIGP) as well as a low interest loan program through the PFA's Drinking Water Revolving Fund. The project is currently in the process of receiving construction bids.

Conclusion

The average median household income in Pipestone is \$41,539 per year. The residents of Pipestone currently pay an average of \$22 per month for water. The average price for water will increase to \$47 per month based on the current estimated cost of the new lime softening water treatment facility. According to Bolton and Menk, the savings in salt used for water softening every month should help offset the water rate increase.

Moving forward, the city is in discussions with the MPCA about the possibility of obtaining a permit that calculates chloride standards for the plant differently, allowing for slightly higher concentrations of chloride in wastewater discharge. The city is seeking a moratorium on new contamination standards during the 20 to 30 year loan repayment period for the water treatment facility. Construction of the new water treatment facility will begin after funding has been secured, after which point the city may examine chloride strategies such as ordinances on salt and water softener use.

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