

Sodium and Chloride and Water Softeners

Introduction

Salt or sodium chloride is commonly used in water softeners to remove the hardness from water in homes and businesses. Softening of water is done to reduce the deposit of minerals in pipes, as well as on fixtures. It also allows soap to clean better in applications such as laundry and bathing.

When a softener is purchased it is equipped with a resin material or media coated with sodium ions. When water passes through this media "soft" sodium ions are exchanged for the "hard" calcium and magnesium ions resulting in softened water. When the softener media exhausts its sodium ions, the media is then regenerated. During regeneration of the softener media, a brine or sodium and chloride solution is discharged.

If this discharge is directed to a municipal wastewater sewer system Wastewater Treatment Plant (WWTP) the treated wastewater will be discharged to either the surface water or groundwater.

Two divisions of the Department of Environmental Quality (DEQ) have permitting responsibilities in regard to these discharges. The Surface Water Quality Division permits surface water discharges and the Waste Management Division (WMD) permits groundwater discharges. Both divisions require that permitted WWTPs monitor the treated effluent to ensure that the water discharged does not exceed maximum allowable limits for several different constituents.

The Problem

Several WWTPs permitted to discharge their treated wastewater to the ground by the WMD have been found to have excessively high levels of sodium and chloride in both their treated wastewater and in the groundwater adjacent to their discharge site. Once discharged to the ground, there is very little natural treatment or uptake by plants or other organisms and minimal soil adsorption of the sodium or chloride. Sampling results at several discharge sites have found that sodium and chloride levels in the adjacent groundwater greatly exceed federal drinking water limits. The maximum allowable level for sodium in groundwater is 120 m/l and for chloride 250 m/l. Samples of groundwater taken at affected facilities have often resulted in finding levels more than double allowable levels of both sodium and chloride.

Current conventional wastewater treatment technology removes very little sodium and chloride from the treated wastewater. WWTPs with high levels of sodium and chloride in their treated wastewater are usually located in largely residential communities, which have little or no municipally supplied drinking

water. The homes in these communities usually have individual drinking water wells, which require water softening to reduce water hardness. This results in high amounts of sodium and chloride being discharged into the sewer system.

Wastewater containing high levels of sodium and chloride discharged to the ground can result in excessively high levels of sodium and chloride in the groundwater surrounding the WWTP. The groundwater will flow away from the site and if the elevated levels of sodium and chloride in the discharge continue unabated, it is possible that sodium and chloride levels in drinking water in the area may eventually be impacted.

Potential Health Impacts

Studies have shown that when sodium in drinking water exceeds a certain level, it can contribute to certain heart ailments or high blood pressure particularly in susceptible individuals. Excessively high levels of chloride in exceedance of federal drinking water standards while not known to be detrimental to health, can make drinking water taste very unpleasant.

Results of Noncompliance

The DEQ has recently developed and put into effect, legal agreements or consent orders between the DEQ and several affected WWTPs whose treated wastewater is discharged to the ground. The consent orders require that within a specific timeframe the affected WWTPs reduce sodium and chloride in their treated wastewater, to less than maximum allowable levels. If the WWTPs fail to reduce these elements in the treated wastewater, in the agreed upon timeframe, significant fines may result.

Possible Solutions

The DEQ has been working with the affected WWTP operators to find solutions to this problem, which has so far been limited to a relatively small number of WWTPs in Michigan. Finding practical, cost effective solutions to this problem has been difficult. The affected WWTPs are in an area of very hard water with soil that does little to dilute or treat high levels of sodium and chloride in the treated wastewater. Several possible solutions to this problem have been considered they are as follows:

- First, a homeowner should determine if a softener is necessary. Some homeowners soften their water even when it is not necessary, because they believe that very soft water is of superior quality. Water with a measured hardness of less than 50mg/l is considered soft. Generally water of 50 to 150mg/l is suitable for use in most homes and it is not necessary to use a softener. Before investing in a water softener or to determine if water

requires softening, water hardness should be determined. (See water testing information at the end of this section)

- One possible solution has been to recommend that users of water softeners switch to potassium chloride in their water softener instead of sodium chloride. This substitution will indeed solve the problem of excess sodium, but it will not solve the problem of excess chloride. In addition potassium chloride is a more expensive product and as a result there has been reluctance on the part of consumers to purchase this alternative-softening agent.
- Another solution is to have individual homeowners install a dry well or underground discharge pit at their residence. The brine from the water softener is discharged to the drywell instead of into the sewer system. At least one municipality in Michigan has passed an ordinance that requires all homeowners install a dry well for this purpose. This solution is not allowed by all county health departments in the state of Michigan and therefore may not be a viable solution in every instance. In addition, adoption of local ordinances and/or aggressive enforcement of existing ordinances prohibiting the discharge of water softener backwash into the municipal sewer system may help alleviate the problem.
- Constructing or extending a public water supply system that provides WWTP customers with pre-softened water is another option. This eliminates the need for home water softeners and greatly reduces the amount of sodium and chloride that is directed into the sewer system. This option can be very expensive and is generally only feasible if the WWTP customers are in relatively high-density housing areas, which reduces the cost of providing and supplying softened water to individual homes at an affordable level.
- Another option, which may not solve, but can greatly reduce the problem, is to use less salt. Many homeowners use at least twice as much salt to soften their water as is necessary. Studies have shown that the average family of four which uses approximately 60 gallons of water per day, per person only requires 6 lbs. of salt per regeneration to adequately soften their water. It has been found that many softeners are set to use 12 pounds or more of salt per regeneration. To monitor how much water is used, a flow meter can be installed for about \$100.00. Knowing how much water is used will allow a family to further fine-tune how much salt is required to adequately soften their household water. Setting the softener to use the proper amount of salt per regeneration, depending on the size of the family, type of system and the hardness of the water may greatly reduce the amount of sodium and chloride being used and subsequently discharged to the sewer. If salt usage is reduced money will be saved, helping to offset and eventually pay for the flow meter installation.

- It has also been found that many softeners are set to recharge or backwash too frequently. Again based on a family's water usage, adjusting the backwash cycle to the appropriate time period between each backwash may significantly reduce the amount of sodium and chloride being discharged into a sewer system. Softeners have often been found that are programmed for a daily or every other day recharge. A softener, depending on water hardness may only require a recharge cycle be set for every five days to achieve the proper softening level.

Water Testing

- In order to determine water hardness an individual should collect a sample of their un-softened water and have the sample tested to determine the hardness. To have the water tested an individual may contact their local county health department or the DEQ, Drinking Water and Environmental Protection Division at: <http://www.deq.state.mi.us/dwr/Lab/H2O/H2O-lab.html> or phone 517-335-8184. The testing fee to determine water hardness is \$8.00. When hardness is determined, an individual should review the water softener manual or contact the manufacturer of the softener to determine the proper setting and backwash cycle for the softener.

Conclusion

In conclusion, the most practical solution for reducing sodium and chloride in wastewater is homeowner education with respect to the proper amount of salt use in home water softening. This would not only reduce the amount of sodium and chloride discharged to a sewer system but would save the homeowner money. While reduction of salt use is not a guarantee that a WWTP will achieve compliance with sodium and chloride limits in the facility's treated wastewater, the reduction of homeowner salt use in conjunction with one or more of the above alternatives, are currently the most practical approaches available to address this problem.