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Water Softeners and Wastewater Treatment Systems

Across North America, regulators are realizing that to protect water supplies, they must require high performance from onsite wastewater treatment systems. As a result, advanced treatment systems are becoming the standard in many areas.

Unfortunately, advanced treatment systems aren't always operated by advanced homeowners. Homeowners' awareness of their own role in the wastewater treatment process lags behind what advanced treatment systems require of them. Manufacturers of advanced treatment systems typically supply instructions describing what can and can't go down the drain. Yet when a system malfunctions, service providers often find that the users have abused it. Consequently, jurisdictions that require high levels of treatment for what comes *out* of onsite systems are realizing that they have to step in and regulate what goes *into* the systems.

In this context, many communities are deciding to regulate water softener backwash discharge. In normal operation, salt-type water softeners discharge a large volume of concentrated brine every few days when the ion-exchange column is recharged. In 20 years of practical real-life experience, Orenco has experienced the deleterious effect that water softener backwash can have on onsite treatment systems. Many other wastewater system designers, manufacturers, regulators and service providers have had these same experiences. In fact, water softener discharge causes problems in wastewater systems so commonly that it is one of the first items to investigate on every service provider's troubleshooting list. Numerous municipalities and counties, especially in California, even prohibit brine discharges into their centralized sewer systems.

For these reasons, Orenco advises homeowners not to plumb water softener backwash discharge into our AdvanTex® advanced treatment system. Moreover, failure to follow that advice voids Orenco's warranty. Other manufacturers of NSF Class I treatment systems have the same policy. The reasons why water softener backwash discharges do not belong in onsite wastewater treatment systems are explained in this fact sheet. Some water softening alternatives that can eliminate the need for brine discharge are also discussed.

How Brine Affects Onsite Systems

Brine has been reported as a primary cause of premature drainfield clogging**.** When you add salt to water, you increase its specific gravity. This increases its buoyancy and inhibits solids settling/stratification within the septic tank. The brine is heavier than water and quickly occupies the sludge zone — typically 250-300 gallons in a 1000-gallon tank, and 350-450 gallons in a 1500-gallon tank. At 50 gallons per water softener backwash cycle, it takes only 5 to 9 cycles to completely displace the sludge zone in the tank with heavy brine. As a result, solid particles are carried through the tank, above the dense concentrated brine, and out of the tank into the drainfield, packed bed filter, or other treatment system. As just one reference for this fact, see Winneberger, John H. Timothy, *Septic-Tank Systems, A Consultant's Toolkit, Volume II, The Septic Tank* (Butterworth Publishers/Ann Arbor Science, 1984), pp. 33–35. The American Water Works Association, Water Environment Federation, and the American Public Health Association, among other organizations, also have published numerous papers and articles on the degrading effect of sodium (cationic salts) on activated-sludge floc strength and settling characteristics, and degradation

of effluent suspended solids quality. This characteristic alone would seem sufficient to warrant the exclusion of brine discharges from wastewater treatment processes.

In addition to causing solids to spill into the drainfield, the salt itself has an effect on the drainfield soils. Soil science experts are still debating the deflocculating, permeability-reducing effect of replacing calcium and magnesium in soils with sodium. Regardless, we have plenty of experience showing that brine has a degrading effect on packed bed filters, as well as on other treatment processes. Until conclusive research is done, the conservative public health approach is to route backwash discharge somewhere other than the onsite wastewater treatment system, or to require the use of alternatives to salt-type water softeners. This avoids the need to speculate on which factor caused the drainfield or advanced treatment system to fail. It also avoids the need to develop and enforce regulations prohibiting "excessive" backwashing, a common problem with salt-type systems.

Brine degrades the performance of treatment systems. Inhibition of solids settling is just one of the deleterious effects that water softener brine has on wastewater treatment systems. Evidence is clear that water softener brine affects and degrades sensitive advanced treatment microorganisms, such as nitrifiers. Thousands of articles from the landscape and horticulture industry deal with the effects of salts on organisms growing in soil. It cannot be assumed that the microorganisms in a biological process tank are hardier and less susceptible to the effects of water softener chloride discharges than other organisms. Additionally, as salts accumulate within attached-growth or packed-bed treatment media, their effects on the microbial population become more dramatic.

Issues of Responsibility

Discharging water softener brine into many NSF Class I treatment systems violates and voids the manufacturer's warranty. Manufacturers of NSF Class I treatment systems, including Orenco, have not designed their systems to treat water softener brine. Also, the NSF Class I testing process does not include performance testing with softener brine. Consequently, discharging brine into these systems could cause treatment performance below that which the systems are designed to produce, especially in those systems expected to remove nutrients. It isn't surprising that a quick Web search of operation and maintenance manuals from NSF Class I treatment systems yielded 10 that prohibit water softener brine discharge into the systems. Disposal of water softener brine into these systems would violate and void these manufacturers' warranties, and anyone recommending such disposal would have to be prepared to accept liability for the consequences.

Users operate water softeners improperly. Although it's true that water softeners would discharge much less brine if users followed the water softener manufacturers' recommendations, there is no way to ensure that users will do so. Water softener manufacturers could help by designing controls so that users cannot turn up the regeneration rate excessively. In many cases, when a drainfield fails prematurely, service providers often find that the user has tweaked the water softener discharge and recharge rate way up — typically to every other day or every third day, which is much more frequent than water softener manufacturers recommend. For example, Orenco engineers studied a retirement community where two-person households using 100 gallons (379 L) of water a day typically were recharging their softeners every other day and going through about 80 lb (36 kg) of salt every three to four weeks. The filters in this community were clogged with grease and solids and cemented with a salty deposit. Brine discharges at this level would result in chloride concentrations almost twice the 10,000 mg/L level that has been identified (in various WEF and AWWA publications) as destructive

to microbial processes. An investigation of a community system with more than 500 homes in Michigan found chloride concentrations of 3,000 mg/L in the tank effluent where softener brine was discharged, and discharge concentrations in Virginia were as high as 4,600 mg/L. In both of these situations, the normal scum accumulation was not occurring. Additionally, observations such as Winneberger published indicate that the brine concentrations at one to two feet below the tank discharge level are about three times greater than the discharge concentration. Process designs must also consider and address salt buildup due to evaporation.

Water softener manufacturers must step up to the responsibility of helping their customers deal properly with the residual product that their appliance generates. This waste product is not the result of a biological process, nor does it contain coliforms or other microbial contaminants. For these reasons, it does not belong in a biological wastewater treatment system, whether onsite or municipal. Just as homeowners accept that other wastes such as motor oil, paint, and excessive quantities of grease can't go down the drain, they must accept that their water softener brine must not be channeled through the home's wastewater treatment system.

Softeners that Do Not Discharge Brine

Salt-type softeners have numerous disadvantages besides their effect on onsite systems. Many users cannot drink salt-softened water because of the high level of sodium it contains. The Journal of the American Dietetic Association has reported that the sodium content of water can increase to as much as 100 mg/L after softening. It's also reported that salt-softened water can be harmful to people who have heart or kidney disease, or who are on a sodium-restricted diet. The American Heart Association states, "people on salt restricted diets should avoid home softeners or make sure the ones they install don't use sodium." Other people simply find the taste of salt-softened water objectionable for applications such as making coffee. In addition, replenishing salt in the softener involves expense and effort. Where sodium is a health concern, a separate line should be plumbed to supply non-softened water for drinking.

Several types of devices on the market remove minerals from household water without generating brine or adding salt to the drinking water. Carbon filtration units such as LifeSource (www.lifesourcewater.com) and catalytic devices such as Aquantum (www.aquantum.com) remove hardness minerals from water without introducing salts. The Los Angeles County Sanitation Department has a Web page (www.lacsd.org/chloride/default.asp?cid=12) that describes several units of this type, including comments and ratings from county residents who use them.

Those who prefer salt-type softeners can use exchange-tank (canister-type) water softeners rather than units that regenerate automatically. In these softeners, a service provider periodically changes a removable resin canister and brings it back to a plant where it is recharged and the brine is disposed of in some way that does not involve the municipal sewer system.

Finally, in some communities, salt-type softeners may be plumbed so that their backwash is discharged into a dry well or French drain, or into properly sized and designed distribution beds or a chamber system.

What Is the Next Step?

When regulators consider whether to allow discharge of water softener brine to wastewater treatment systems, the burden of proof should be on the party that stands to profit from its position. Sales of

wastewater systems will not change based on whether softener brine is allowed in them, but water softener sales may. Rather than asking wastewater system manufacturers to prove harm to the treatment system, water softener manufacturers should have to prove that the addition of their brine discharge to the waste stream does no harm. Although the Water Quality Association has advocated for the discharge of softener brine to wastewater treatment systems, its references are limited to *two* specific and *limited* studies. These should be carefully reviewed and their conclusions considered in context.

Need for Future Research

One thing that all parties to this controversy agree upon is that more research is needed. This research should include not only standard septic tanks, but also secondary and advanced treatment processes that are required to maintain high levels of treatment. Until that research is in hand, the onus is on the Water Quality Association to prove, in a manner consistent with protection of public health, that adding water softener brine to wastewater treatment systems, and accumulation of salts within the process, will not jeopardize the long-term performance or degrade any part of the primary or secondary treatment processes, or the final effluent quality.