



OOWA's Information Documents: Water Softener & Onsite Sewage Systems

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Water Softener & Onsite Sewage Systems Information Document

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1.0 Overview

A water softener is a water conditioning device that removes “hard” minerals, such as calcium and magnesium, from a water supply. Hardness, or high concentrations of dissolved calcium and magnesium, does not pose a public health threat, however it can cause issues such as scaling in pipes, water heaters and other water fixtures such as washing machines and dishwashers and can reduce the effectiveness of soaps and detergents. According to the Ontario Drinking Water Objectives, hardness is an aesthetic parameter, and not a health related parameter. Water softeners are ubiquitous in Ontario where the primary source of drinking water is groundwater, in both residential and non-residential applications, however it should be noted that the use of a water softener is only recommended if the raw water supply has a hardness greater than 120 mg/L.

A water softener works on the principle of ion exchange. Calcium and magnesium are positively charged ions. The water softener will replace the positively charged calcium and magnesium ions with negatively charged ions, usually sodium and/or potassium. The water softener has a conditioning tank or resin where ion exchange takes place. Exchange ions are added to the resin as sodium or potassium salts. As ion exchange takes place in the resin, the calcium and magnesium ions concentrate in the conditioning tank. As the surface of the resin becomes saturated with the calcium and magnesium, the ion exchange process will slow down. Therefore, the resin must be regenerated from time to time.

In order to regenerate the resin, it is immersed in a sodium or potassium rich solution (a brine), that dislodges the calcium, magnesium, sediment and accumulated residues. This solution then removed by backwashing the resin by successively applying a large volume of brine followed by rinsing with clear water. The frequency of this backwashing operation and the associated volumes of brine and clean water strongly depend on the use and quality of the water to be treated, but also on the model of softener used and its adjustment. It is this backwash water that can cause issues for onsite wastewater treatment systems, not the soft water itself. The following document will review the information available on the effects of water softener backwash on onsite sewage systems so that you can make an informed decision for yourself and your clients.

2.0 Possible Effects on Onsite Systems

As noted above, it is the backwash water from the regeneration process that may have adverse impacts on an onsite sewage system. The backwash water may contain, in addition to significant amounts of sodium or potassium and chloride present in the brine, calcium, manganese, iron, arsenic, and other residues. Its discharge into an onsite sewage system may produce undesirable effects on the onsite sewage system. There are two main issues of concern, the additional hydraulic load of the water softener on the onsite system, as well as the organic or chemical load associated with the chemical composition of the backwash water. The chemical composition of the backwash may affect the performance of the settling process in the septic tank, the concrete of the tank itself and may also have a negative influence on the infiltrative capacity of the leaching bed. These issues are discussed further below.

2.1 Hydraulic Load to the Sewage System

A water softener will contribute to the hydraulic load imposed on an onsite sewage system. This can be an issue if the sewage system is not large enough to handle the additional water discharged during a backwash cycle. A typical regeneration will discharge approximately 190 Litres (50 US gallons) per cycle, roughly equivalent to older clothes washing machines. For an older water softener that may regenerate once per week the quantity of backwash water for a typical household of 4 people using 250 liters per person would be approximately 2 % to 3 % of total weekly water usage. For older sewage systems that have not been designed in accordance with current code requirements this may pose a problem, however for most modern sewage systems this volume is likely easily accommodated in the code design flows for residential sewage systems, and may not require additional design flow capacity to accommodate the water softener. This should be reviewed by the designer on a case by case basis depending on the site specific details.

The frequency of regeneration, or backwash can either be programmed on a metered basis (i.e. based on how much water is used in the household), or on a timer or calendar basis. Older models of water softeners may only have a timer option, and for these units, regeneration is typically set for once per week. A challenge with timer based regeneration units is that the homeowner may choose to increase the frequency of the backwash cycle to ensure that water is always soft, increasing the potential for the hydraulic load to become problematic. Homeowners with timer based regeneration units should be advised on a reasonable frequency of regeneration.

Newer water softeners have the option to regenerate the resin on a metered basis. These units will regenerate the media after a certain amount of water has been softened, based on both the hardness of the incoming water, and the amount of softening preferred by the home owner. A metered regeneration is preferred as it can be set to optimize the effectiveness of the water softener, reducing the amount of wastewater generated as well as optimizing chemical (salt) use. Depending on the hardness of the incoming water and the water use in the household, water softeners operated on a metered basis may only regenerate once a month.

Generally speaking, whether the water softener is set on a calendar or a metered basis, hydraulic loading to the sewage system is typically not an issue for a properly operated and maintained water softener system. However, broken or leaking fixtures in a home can cause a water softener to operate improperly so proper maintenance is important.

2.2 Effects on Bacteria

There is a concern in the onsite wastewater industry that the chemical composition of water softener backwash may be affecting the bacterial population, and therefore the effectiveness of these organisms, in onsite systems, particularly in the septic tank. The main chemical contaminants of concern are sodium and chloride, which will be present in their ion forms in solution. Some studies have shown that salt toxicity from high sodium concentrations may be toxic to essential septic tank microbes. In addition, high levels of Calcium and Manganese can retard metabolic activity. However, studies have indicated that for a properly maintained water softener system the concentrations of these elements are below the threshold levels required to impact anaerobic digestion. Therefore, it is unlikely that water softener backwash will impact the necessary bacterial activity in a septic tank.

2.3 Stratification

There is conflicting evidence as to the potential effects on septic tank performance as a result of the high concentrations of salt in the brine that is discharged from water softeners. It has been theorized that the discharge of water softener backwash containing high concentrations of salt causes stratification in the septic tank and can affect the settleability of solids in the tank. The salty brine discharges into the tank and is denser than clear water, causing a layer of salty water at the bottom of the tank, with the fresh water resting above that layer. The typical function of a septic tank is to allow heavier solids to settle into a sludge layer in the bottom of the tank, with scum (fats, oils and greases) floating on the surface and clarified liquid in between the two layers. With a heavier salt water layer below the fresh water layer, it has been theorized that this can upset the normal settling processes in the tank, causing the sludge and scum layers to be undefined, and potentially leading to solids carry-over into the leaching bed.

The efficiency of a water softener is dependent on the level of hardness in the water, the volume of backwash, and the amount of excess sodium in the backwash. A 2013 study conducted by the Water Quality Research Foundation found that in the case of efficiently operated water softeners, the performance of the septic tank was actually improved, but in cases where softeners were running inefficiently, they may have a negative effect on tank performance in terms of solids discharge into the leaching bed.

2.4 Concrete Corrosion

There is a large body of anecdotal evidence that water softeners may cause increased corrosion of the concrete in septic tanks. Sulfuric acid is the principle cause of concrete corrosion in septic tanks. H₂S (hydrogen sulfide) is a waste product of the anaerobic bacterial decomposition of organic materials, that happens in the sludge layer of normally operating septic tanks. The H₂S converts to sulfuric acid (H₂SO₄) when it comes into contact with oxygen at the water surface causing corrosion of the of concrete in septic tanks. It is more likely that the corrosion that is observed in septic tanks and attributed to water softener use is in fact caused by a raw water source high in sulphur (not unusual in Ontario), which could be increasing the production of sulphuric acid in the septic tank, leading to increased signs of visible corrosion.

Chlorine has not been shown to accelerate the corrosion caused by sulfuric acid and therefore water softener backwash is not considered to be a contributing factor in septic tank corrosion. The presence of chlorine ions, from water softener backwash, could play a role in accelerating the corrosion of reinforced concrete tanks by contributing to the corrosion of rebar in the tanks, but is unlikely to do so as rebar should not be exposed.

2.5 Effects on Advanced Treatment Systems

Water softener backwash contains high amounts of sodium and chloride, which are known to inhibit bacterial activity at high concentrations. Some studies have demonstrated that there is no discernible effect on the performance of an aerobic treatment system receiving water softener backwash as compared to one that does not on the basis of organic and solids removal. However, it is important to

remember nitrification is affected by increased chloride levels, which could impact the performance of an aerobic treatment unit that is intended to provide nitrogen treatment. With increasingly stringent effluent targets being implemented in many jurisdictions, this could present operational challenges for a system receiving water softener backwash.

As noted previously in this document, the type of water softener, the volume of backwash, and the method of operation will be significant factors in whether or not the discharge would have a discernible impact on the performance of the treatment unit. It is recommended that the manufacturer of a treatment unit be consulted as to the compatibility of water softener backwash with their system, as requirements and warranty impacts can vary from one technology to the next.

3.0 Alternatives for Disposal of Water Softener Discharge

Property owners, installers and designers are strongly encouraged to consult the local permitting agency regarding the preferred discharge location for water softener backwash. If backwash is not permitted to be discharged to the onsite sewage system, an alternative means of disposal must be implemented.

Direct discharge into surface waters may be harmful to aquatic plants and animals due to the high chloride concentrations found in the backwash. Subsurface disposal is the recommended alternative to an onsite sewage system. The most common method of subsurface disposal of backwash involves stone and pipe installed horizontally (trench, French drain etc.) or vertically (dry well, soak away pit etc.) in the native soil for disposal. The following are recommendations for best management practices for subsurface discharge when discharge to the onsite sewage system is not permitted by your local permitting authority:

- Maximize the separation distance between the backwash discharge point and your well and any wells on neighboring properties, recommend 30 m or more.
- Maximize the separation distance between the backwash discharge point and surface water or wetlands, recommend 30 m or more.
- Maximize separation distance to high ground water and bedrock.
- Whenever possible, place the backwash discharge downgradient (generally downhill) of drinking water wells.
- When constructing the subsurface system, know the location of the other onsite wastewater system components in order to avoid damage to the system.
- Recommend constructing subsurface system in material with a low clay content (specifically montmorillonite) to reduce effects of sodium on the hydraulic conductivity of the soil. Imported sand fill may be required.
- Volume of drainage area (stone volume below the pipe) should be approximately equal to backwash volume to prevent break out to the surface of the ground.

4.0 References

4.1 List of references

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