What's the Big Stink on Septic Discharge?

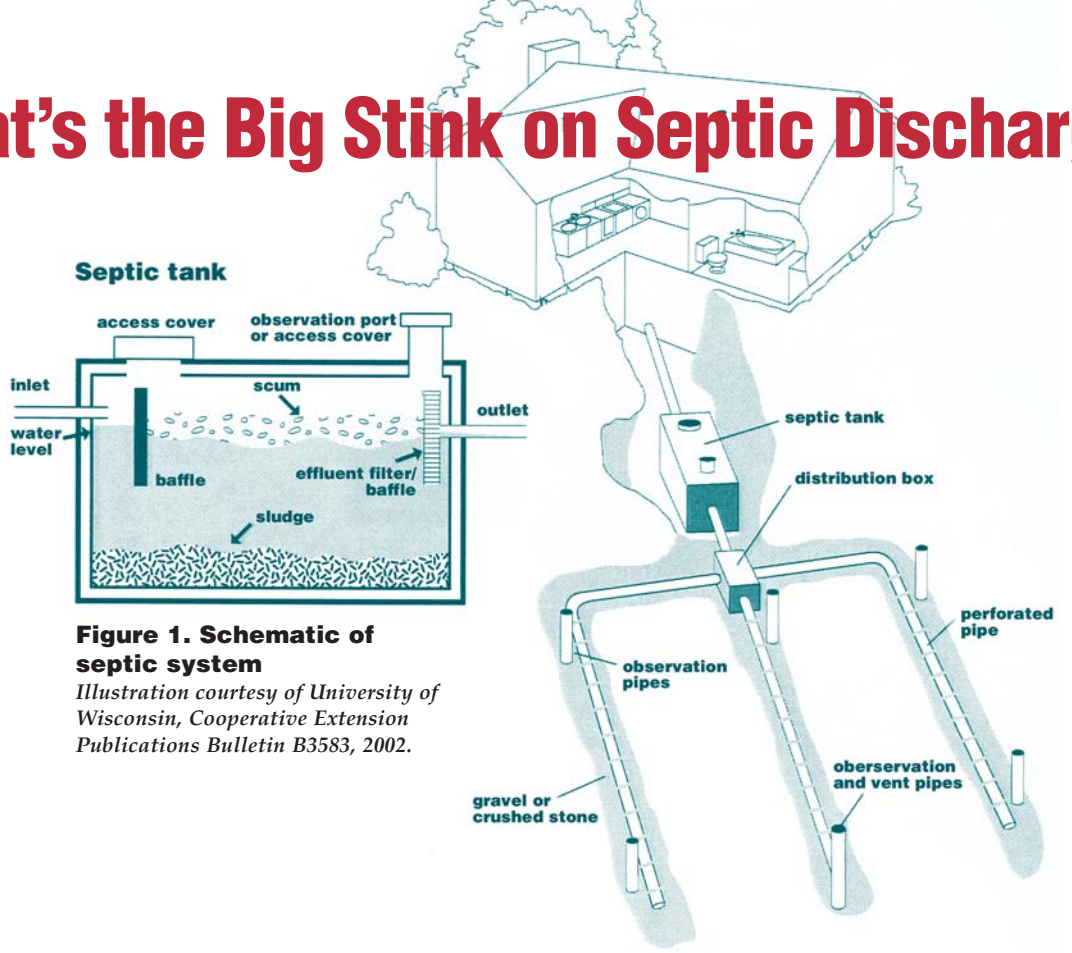

Figure 1. Schematic of septic system
Illustration courtesy of University of Wisconsin, Cooperative Extension Publications Bulletin B3583, 2002.

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Ask the average city dweller to define the word *septic* and they might respond with *infectious* or *diseased*. Ask a country dweller the same question and they may answer that it is part of a water purification system (referring to a septic tank). Difficult as it may seem, a septic system is, indeed, an infectious container where household waste water purification begins.

Approximately 25 percent of American homes use some type of on-site waste treatment (septic) system rather than direct city sewer hookups. Residents seem largely unaware of their systems and many have no clue how they work or how to maintain them. Some unfortunate souls have learned the hard way that replacing a septic system may cost more than the room addition (or swimming pool!) they have been dreaming about. Concerns about the proper operation of septic systems have risen the level of state legislators who are now trying to regulate what you dump down your toilet. There is a vast quantity of misinformation out there. This article addresses the technical aspects of how these systems work, including what you should and should not introduce to them and why. Specifically, we will discuss the technical issues regarding the discharge of brine waste from an automatic softener into a septic system.

Misinformation has risen to the ranks of the regulatory agencies, which are trying to regulate what you dump down your toilet.

What is the purpose of a septic system?

Man learned early on that it was best to bury his household waste, rather than run the risk of stepping in something ugly and tracking it back into the cave. Modern septic systems have evolved little in principle since the Stone Age: they are still basically holes in the ground into which we discharge our household waste water and sewage and then allow it to seep into the ground.

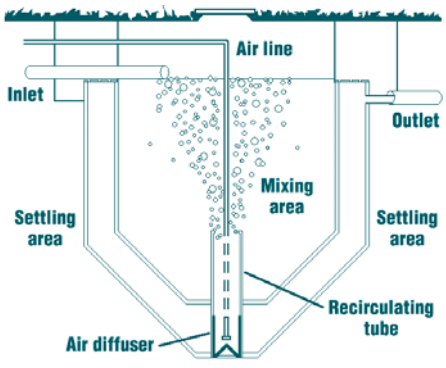
What are the different types of septic systems?

Those living in rural areas, or other low-density residential regions, not connected directly to city sewer hookups, are familiar with septic systems or other on-site waste disposal systems. There are two basic types of systems: *anaerobic* and *aerobic*. The *anaerobic* system is older, simpler and more common. It consists of a *septic tank* (which receives household waste and gives it "primary" treatment) and a leach field or *drain field* (that does further treatment before allowing the liquid byproducts to seep back into the soil…and the groundwater table). *Aerobic* systems require aeration (and therefore have moving parts) but are more compact with smaller drain fields. Aerobic systems do a better job in the digestion of waste and release a higher quality of water but they require more maintenance and can be a little touchy with respect to what gets dumped into them and how fast. Both systems prefer steady state operations.

How do they work?

The anaerobic septic tank system is actually alive with both aerobic and

Figure 2. Aerobic system
Illustration courtesy of the author



anaerobic bacteria. Its main purpose is to separate the *floaties* (fats, oils, grease) from the *sinkies* (waste matter, food scraps, whatever). Aerobes work on the *floaties*, helping to digest and breakdown fats and oils to liquids and gases. The gases are vented back through the household vents and the liquids sink down and flow out with the normal effluent of the tank. Anaerobic bacteria work on the *sinkies*, helping to digest the remaining nutrients, converting them into a liquid rich in nitrates, phosphates, sulfates, minerals (ashes to ashes, dust to dust) and gases. The nutrient-rich (and bacteria laden) effluent passes quietly though the septic tank and the liquid portion is allowed to outflow into the leach field by being siphoned off under the surface so as not to pick up either the *floaties* or other *sinkies* (which may have ridden up on a gas bubble). Indigestible solids such as fibers and plastic, accumulate in the septic tank and eventually have to be pumped out. The typical design of a septic system is to provide five years between "refills" but depending on usage (or mis-usage), this may come sooner and quite unexpectedly.

The leach field consists of a distribution system of pipes buried in shallow trenches where the liquid is released. Here, aerobic bacteria in the soil, with the aid of oxygen from the atmosphere (assumes unsaturated and aerated soil) finish the job before allowing the waste water to seep back into the soil.

In a typical design, septic tanks are sized to contain about three days worth of household waste and liquid. For the average family of four, this is about a 1,000-gallon septic tank. Designers project that by the time the septic tank is about half to two thirds full of *sinkies* (sludge) and *floaties* (scum), it is time to pump it out. A 1,000-gallon septic tank serving a family of four should be pumped out every 2.6 years (more frequently if you use a garbage disposal).[1] The cost of pumping may run $100 to $200. Replacing a drain field because you forgot to pump may run $5,000 to $10,000.

Aerobic systems fluidize the incoming waste water solids and circulate it while pumping air bubbles into it, allowing for a much more rapid and complete digestion of the solids. Aerobic systems convert ammonia to nitrate and because of the more active bacteria levels, generally have to be disinfected before discharging clarified water to a drain field. Aerobic systems are more compact and are often employed where the homeowner does not have enough space for a large drain field or the soil is not suitable. They are also used to replace anaerobic systems that have failed. System failures are generally due to misuse and drain field plugging. One of the leading causes of plugging is lint from unfiltered laundry discharge. A system failure is very serious and essentially shuts down the home. Repairs are expensive. Both types of systems require regular maintenance. Septic systems shouldn't smell. Detecting foul odors in the home or around the drainfield should tell you that your system is not working well.[1]

What is the purpose of the leach field?

Most leach fields consist of several relatively narrow, shallow trenches filled with gravel. Water from the septic tank passes through perforated pipe near the top of the gravel and is distributed throughout the length of each trench. The purpose of the field is to provide additional treatment and disposal of the tank effluent. Here, the water seeps into the soil beneath and along side the trench where a *biomat* (biological mat) is formed and anaerobic bacteria work to purify the water as it percolates through the soil. The biomat is a layer of microorganisms and their byproducts that feed on the organic material and form a jelly-like filtration barrier along the bottom and sides of the trenches. It is capable of filtering out viruses, pathogenic bacteria and parasites. This is the *purification* part of the system process. Aerobic bacteria in the soil feed on and, in turn, help to break down the biomat, keeping the system in equilibrium. Eventually, the water is taken up by plants, evaporates or seeps into the groundwater.

What can go wrong: and what is to blame when it does?

Septic systems are designed with a normal life expectancy of 20 to 30 years. However, if their equilibrium is upset by poor maintenance, or infrequent cleaning out of the septic tank, excess nutrient can carry over to the drainage trenches and the biomat will increase and eventually plug the drain field. The result is system failure. Failure can result in the ponding of water at or above ground level, backup into the house and runoff to nearby waterways creating dangerous biological pollution of beaches and rivers. System failure is all too common. Studies have shown that in any given area, as many as 85 percent of the systems are not properly functioning due to poor maintenance. Those responsible for paying the costs of fixing the problem often point fingers at anything that may have contributed to the failure—including the discharge of water softeners into the receiving tank. This has led to a rash of actions to ban the discharge of softener waste into these systems. But are the allegations leveled against the use of softeners supported technically?

Regulatory agencies think (or have been led to believe) that high concentrations of salt have a deleterious effect on the biological functions occurring in the septic tank. Fact: The discharge waste from softener regeneration contains high calcium and magnesium and some excess sodium salts. The optimal osmotic potential for most bacteria is between -5 and -20 bars. Many bacteria divide and grow most rapidly at -14 bars. This osmotic potential corresponds to a sodium chloride concentration of 15,000 ppm as $CaCO_3$. Typical osmotic potential of septic tank effluents on systems without softeners is 0.36 bars. The osmotic potential on systems with softeners ranges from -0.51 to -10 bars. The salts added by a water softener regeneration actually reduce the stress on the bacteria by decreasing osmotic potential differences. According to this information, the softener discharge will not retard sludge digestion and may even stimulate the essential bacteria growth.[2]

There is considerable debate on this issue. Observations made by experts in the field have proposed that septic systems operate differently when there is a softener in the system.[2] Nonetheless, these systems did not fail and there are tens of thousands of homeowners out there with softeners on septic systems who do not have problems.

It is also speculated that the additional volume of waste water will overwork the septic system. Fact: The additional volume of water from softener regeneration is 30 to 50 gallons per cycle and it is added to the waste water stream over a period of about two hours. This is a lesser rate than draining a bathtub or doing a few loads of laundry. There is no hydraulic overload.[3]

A third area of concern is that the soil structure and drainage properties of the leach field would be adversely affected by the high sodium concentrations. Fact: It is well known that high sodium irrigation water cause compacting of clay soils. However, the discharge of a water softener is not a pure salt or sodium discharge. It contains high levels of calcium and magnesium which are preferably adsorbed by the soil. This will actually help maintain drainage.[4]

The high density of the brine from

the softener regeneration will cause solids to float and damage the system by causing excess solids to flow into the drain field. Fact: This was one of the observations made by Terry Bounds, an engineer with Orenco Systems, Inc. Field tests (Winneberger, 1984) can confirm that the heavier salt brine tends to sink deeper in the liquid portion of the septic system while lower total dissolved solids (TDS) waste water flows that are subsequently introduced tend not to penetrate it.[5] On average, the TDS increase in a septic system brought about by softener regeneration adds less than 500 ppm of TDS and a miniscule difference in density. However, there has not been sufficient research conducted to determine whether this stratification affects the long term performance of septic tanks and there is no evidence to show that it causes additional buoyancy for solids that would otherwise sink.

Salt is detrimental to the concrete tanks in septic systems. Fact: Perhaps, but the few hundred ppm of increased TDS would not be significant, especially when it is balanced by calcium and magnesium in the waste stream.

Salts in the softener system discharge are more detrimental to aerobic systems. Fact: This was thoroughly tested and reported by NSF in 1978. Their conclusion was that water softener wastes had no adverse effect on on-site aerobic waste water treatment systems.[6]

Avoiding septic system failures

The primary reason for septic system failures is the plugging of the drain field. All of the issues above can theoretically lead to problems with drainage by either changing the soil structure or causing excess solids to carry over. Septic systems are not waste baskets. Minimize the use of your garbage disposal. Things like dental floss, disposable diapers, sanitary napkins, cigarette butts, gauze bandages, coffee grounds and kitty litter will not digest and only speed the filling of your septic tank. Use a lint filter on your clothes washer. Use a filter on the liquid discharge of your tank to your leach field. Don't dump chemicals, paints, solvents, grease and cooking oil, bleach or garden sprays down the drain.

Look for signs of septic system failure: foul odors in your home or yard, slow or backed-up drains, wet spongy ground or lush plant growth may appear near a leaky tank or failing drain field. Repeated outbreaks of intestinal illnesses in your family may occur if your well water gets contaminated by your (or someone else's) poorly operating septic system.

Do not drive across your drain field or pave over it. Do not pile logs or other heavy objects over the drain filed. Soil microbes need oxygen. Do not plant trees over your leach field and don't install your swimming pool above it.

Do divert your roof runoff, pool drains, basement pumps away from your drain field. Fix those leaky faucets. Divert household gray water (filtered) directly to the drain field to reduce the load on your septic tank, or use it for irrigation. Only 28 percent of your total discharge comes from the toilet.[7] Adjust your softener to minimal salt settings and use a demand-initiated regeneration valve to minimize water and salt usage. Consider using potassium chloride if you intend to use your softener discharge for irrigation. Conserve water.

Sound technical facts prevail

Over the past three years, legislation has been passed that limited or banned altogether the sale and use of water softeners that discharge to septic systems in the states of Texas, Montana and New Mexico. In all instances, local members and the national resources of WQA came to tackle the problem with positive results. The winning edge was our sound technical approach with good studies and hard facts. A catalog of documents has been put together by WQA experts to help members in case a similar issue pops up in other states. This catalog includes industry-supportive documents from the EPA, useful letters, brochures and numerous other scientific study reports.[8]

Should softener discharge issues arise, get in touch with your local or regional WQA representatives or call WQA and talk with Technical Director Joe Harrison or Government Relations Consultant Carlyn Meyer. Make sure you have all the facts.

Conclusions

Septic systems or on-site waste treatment systems present a delicate balance of bacterial action and nutrient supply. They are designed for but never operated in a steady-state mode. Although it is theoretically possible that a sudden flow of high TDS brine from a softener regeneration could upset this balance, there is absolutely no scientific evidence to support these claims. If fact, the use of water softeners in conjunction with septic systems is supported by the U.S. EPA, NSF, several notable universities and WQA.

To keep your septic system operating troublefree, it needs to be paid attention to with regular maintenance and an awareness of what it can and cannot do. In addition, keep your softener tuned to high efficiency so as not to waste salt or water.

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