

SULFATE IN WELL WATER

Sulfate (SO₄) occurs naturally in most of Minnesota’s groundwater, with higher levels common in the western part of the state. At high levels, sulfate can give water a bitter or astringent taste and can have laxative effects. This brochure provides a basic discussion of sulfate in well water and discusses actions you can take to minimize its effects.

How does sulfate get into the groundwater?

As water moves through soil and rock formations that contain sulfate minerals, some of the sulfate dissolves into the groundwater. Minerals that contain sulfate include magnesium sulfate (Epsom salt), sodium sulfate (Glauber’s salt), and calcium sulfate (gypsum). The level of sulfate in most groundwater in Minnesota is low, less than 250 milligrams per liter (mg/L).* Sulfate occurs at higher levels, which sometimes can exceed 1000 mg/L, in certain areas of the state, particularly in the southwest and along the western boundary. High levels of sulfate also occur, though less commonly, in some wells in the northeastern and southeastern parts of the state.

* One mg/L is one thousandth of a gram in a liter of water, which is approximately equal to 1 part per million (ppm). One ppm is approximately equal to one drop of the substance in 10 gallons of water.

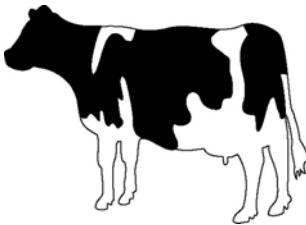
Are there health risks for humans who drink water containing sulfate?

People unaccustomed to drinking water with elevated levels of sulfate can experience diarrhea and dehydration. Infants are often more sensitive to sulfate than adults. **As a precaution, water with a sulfate level exceeding 400 mg/L should not be used in the preparation of infant formula.** Older children and adults become accustomed to high sulfate levels after a few days.



Can sulfate harm animals?

Animals are also sensitive to high levels of sulfate. In young animals, high levels may be associated with severe, chronic diarrhea, and in a few instances, death. As with humans, animals tend to become accustomed to sulfate over time. **Diluting water high in sulfate with water low in sulfate can help avoid problems of diarrhea and dehydration in young animals and animals not accustomed to drinking high sulfate water.** The ratio of water high in sulfate to water low in sulfate can be gradually increased until the animals can tolerate the high sulfate water. Contact a veterinarian or your county office of the Minnesota Extension Service for more information.



Can sulfate cause other problems?

If sulfate in water exceeds 250 mg/L, a bitter or medicinal taste may render the water unpleasant to drink. High sulfate levels may also corrode plumbing, particularly copper piping. In areas with high sulfate levels, plumbing materials more resistant to corrosion, such as plastic pipe, are commonly used.

How can sulfate be removed from water?

Three types of treatment systems will remove sulfate from drinking water: reverse osmosis, distillation, or ion exchange. Water softeners, carbon filters, and sediment filters do **not** remove sulfate. Water softeners merely change magnesium or calcium sulfate into sodium sulfate, which is somewhat more laxative.

Reverse osmosis (RO) is a water treatment system that removes most dissolved substances, such as sulfate, from water by forcing the water through a cellophane-like plastic sheet known as a “semipermeable membrane.” It can typically remove between 93 and 99 percent of the sulfate in drinking water depending on the type of unit. A small counter top RO unit will produce about 3 gallons per day. Slightly larger units that are usually installed under the sink will produce 5 to 20 gallons per day. RO units typically produce only 1 gallon of water for every 4 to 10 gallons of water treated. The remaining water goes to waste.

Distillation is a water treatment system that boils water, then cools the steam until it condenses into a separate container. The dissolved substances, such as sulfate, are left behind in the boiling pot. With proper operation, distillation units can remove nearly 100 percent of sulfate. Distillation units require about four hours to produce 1 gallon of water, so this type of treatment uses a considerable amount of energy in its operation.

Ion Exchange is the most common method of removing large quantities of sulfate from water for commercial, livestock, and public supplies, but is not commonly used for individual household water treatment. It is a process where one element or chemical is switched for another. Many people are familiar with water softening, one common type of ion exchange system. Water softening works by passing “hard” water - water with calcium and magnesium - through a tank filled with a special resin saturated with sodium ions. The hardness minerals stick to the resin, and the sodium is dissolved in the water. Ion exchange systems for removal of sulfate work in a similar manner, but use a different type of resin. Sulfate ions in the water exchange places with other ions, usually chloride, which is on the resin. When the resin is full to capacity with sulfate, it must be “regenerated” with a salt solution. Water softeners for removal of hardness do not remove sulfate, and sulfate removal systems do not remove hardness, although some commercial units contain both resins and can remove both hardness and sulfate.

If both a water softener and a sulfate removal system are used, the water softener is usually placed before the sulfate removal system.

Any water treatment system requires proper operation and maintenance to ensure that it continues to function properly. It is important to follow the recommendations of the manufacturer and installer for the maintenance of the water treatment system.

Other related references that are available from the Minnesota Department of Health (MDH) are:

- Well Disinfection**
- Iron Bacteria in Well Water**
- Why Does My Water Smell Like Rotten Eggs? - Hydrogen Sulfide and Sulfur Bacteria in Well Water**
- Well Owner’s Handbook**

If you have any questions, please contact a licensed well contractor, a reputable water treatment company, or a well specialist at one of the following offices of the MDH:

MDH District Offices

625 North Robert Street
P.O. Box 64975
St. Paul, Minnesota 55164-0975
651/201-4600 or 800/383-9808

705 Fifth Street Northwest
Bemidji, Minnesota 56601
218/308-2100

320 West Second Street
Duluth, Minnesota 55802
218/723-4642

1505 Pebble Lake Road
Fergus Falls, Minnesota 56537
218/332-5150

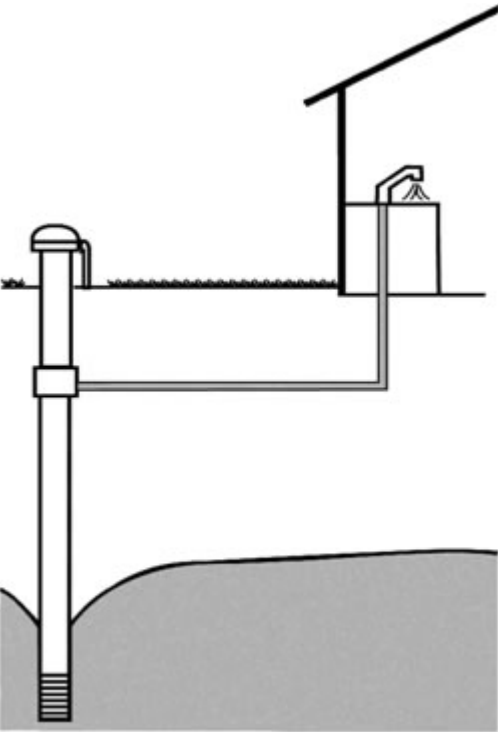
3333 West Division Street
St. Cloud, Minnesota 56301
320/223-7300

1400 East Lyon Street
Marshall, Minnesota 56258
507/537-7151

18 Wood Lake Drive Southeast
Rochester, Minnesota 55904
507/285-7289

Visit the MDH Well Management Section web site at: www.health.state.mn.us/divs/eh/wells

To request this document in another format, call 651/201-4600.
Deaf and hard-of-hearing: TTY 651/201-5797.



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**Well Management Section
Environmental Health Division**