AGRI-FACTS
Practical Information for Alberta's Agriculture Industry

Revised September 2012 Agdex 716 (D36)

Reverse Osmosis Water Treatment

Reverse osmosis is a water treatment process that forces water through an extremely fine membrane to remove dissolved minerals. Purified water passes through the membrane and collects in a storage container.

Most of the dissolved minerals in the water cannot pass through the membrane and are flushed away as waste. Small household reverse osmosis systems flush from three to twenty litres of water to waste for every litre of treated water. This flushing helps maintain treated water quality and prevent fouling of the membrane.

Reverse osmosis competes directly in the marketplace with distillation. Both can provide small amounts of high quality water for drinking, automatic humidifiers and watering plants. The diagram below shows the makeup of a typical household reverse osmosis unit.

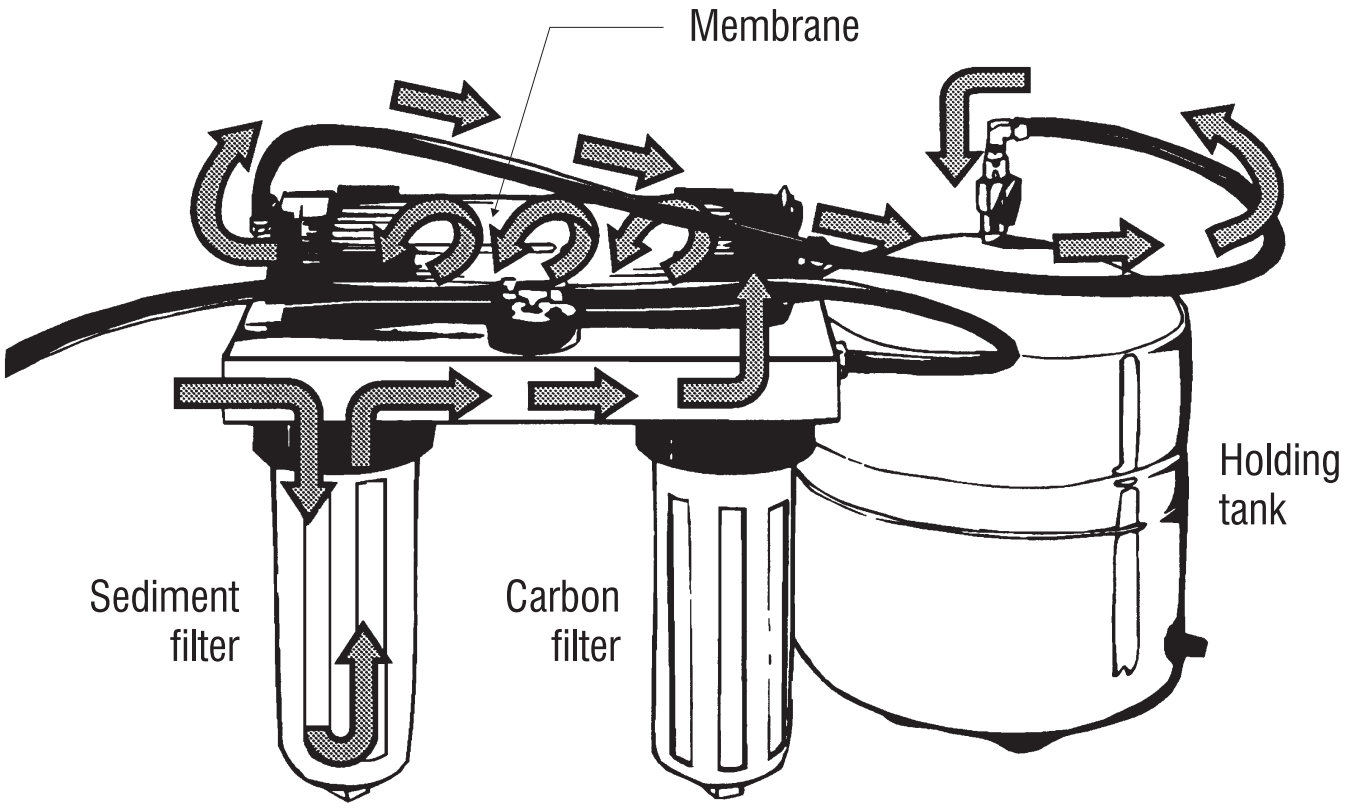

Figure 1. Reverse osmosis mechanics – water passes first through a sediment filter, which culls coarse solids that could plug up the reverse osmosis membrane. Water next follows the spiral winding of the membrane. Contaminated water leaves the system and goes down the drain; treated water moves on to a holding tank. When water is drawn from the tank, it flows through a carbon filter, which removes organic chemicals, then to a spigot.

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Types of reverse osmosis membranes

A variety of reverse osmosis membranes are on the market today. All the major types have limitations.

Limitations	Cellulose acetate membranes	Cellulose triacetate membranes	Thin film composite membranes
pH	pH 2 - 8	pH 4 - 9	pH 2 - 11
Temperature	5°C - 30°C	5°C - 35°C	5°C - 50°C
Resistance to bacterial attack	poor	fair/good	excellent
Resistance to damage by chlorine	fair 0 - 1 ppm	good 0 - 3 ppm	poor 0 - 0.1 ppm
Typical rejection of salts at 60 psi	85% - 92%	92% - 96%	94% - 98%
Typical rejection of nitrate at 60 psi	30% - 50%	40% - 60%	70% - 90%
Typical treated water production at 60 psi	1 gal/ft^2 of membrane/day	1 gal/ft^2 of membrane/day	2 gal/ft^2 of membrane/day
Turbidity allowed in feed water	none	none	none
Iron allowed in feed water	1ppm	1ppm	0.1ppm
Hydrogen sulfide allowed in feed water	none	none	none pH
Relative water production	1	1	2
Relative cost	low	medium	high

Note: Several manufacturers produce reverse osmosis membranes, and technology is continually improving. Specifications may differ for individual units. 1 ppm = 1 mg/L.

Factors that affect treated water quality and quantity

Small household reverse osmosis units operating on household water pressure will produce 1 to 5 gallons per day. Many reverse osmosis units are manufacturer rated at 80 psi supply pressure. Typical private water system pressure is closer to 30 to 40 psi, so water production will often be about half the manufacturer's rated capacity.

Total dissolved solids in the water

Higher pressure is required for reverse osmosis to remove higher levels of total dissolved solids. Many household reverse osmosis units operate on 25 to 50 psi pressure. These are only suitable for a maximum of 1,500 to 2,000 ppm total dissolved solids. If reverse osmosis is to be used to treat water that is higher in total dissolved solids than this, a booster pump will be required.

Pressure

Water pressure affects both quality and quantity of the treated water produced. Basically, the higher the pressure, the more treated water produced and the better the quality will be.

Temperature

The optimum water temperature for most reverse osmosis membranes is 25°C. As the temperature drops to 5°C, the capacity of the reverse osmosis unit will be reduced to less than one half. Long, small diameter water feed lines will allow the water to warm up to room temperature (20°C) before reaching the membrane, which will increase treated water production.

Membrane fouling

Reverse osmosis membranes can be fouled and clogged by bacterial slimes, hard water scale, iron and silt. Avoid or treat bacteria-contaminated water. Soften water that is harder than 50 ppm (3 grains per U.S. gallon). Filter any iron or sediment from the water. Some membranes can be disinfected using chlorine, formaldehyde, iodine or peracetic acid. Check with the supplier about the recommended disinfection products and procedures for a particular unit.

Maintenance of reverse osmosis units

Where pretreatment is required, this pretreatment equipment is critical. Ensure that pretreatment equipment is working properly.

Change prefilter and postfilter cartridges regularly. These filters can become “bacteria farms” and contaminate the water.

Check the product water quality regularly. Dealers have test equipment; a total dissolved solids check only takes a few seconds. Some units have built in testers.

If the proper membrane is used and pretreatment is adequate, a good quality reverse osmosis membrane should be expected to last from two to five years.

Keep chlorinated water out of most reverse osmosis units, particularly those with thin film composite (TFC) and polyamide membranes. Activated carbon prefilters are used to remove chlorine from the water before it hits the membrane.

An increase or decrease in the amount of water produced usually indicates trouble with the membrane. Have the product water quality checked by the equipment supplier.

Substances that will go through a reverse osmosis membrane

Volatile gases such as oxygen and hydrogen sulfide will pass through reverse osmosis membranes. Some organic substances with low molecular weight can also pass through the membrane. Some of these organic substances are suspected of being cancer causing; fortunately, these substances are rarely found in Alberta water. The activated carbon filters used in most reverse osmosis units can remove most organic substances anyway.

Bacteria can also “grow through” reverse osmosis membranes leading to possible bacterial growth in the postfilter and water storage tank.

Summary

Small household reverse osmosis systems will produce 1 to 5 gallons of water per day.

If total dissolved solids is greater than 2,000 ppm, or more than 5 gallons of water per day is required, a booster pump will be required.

- Reverse osmosis will remove 85 to 98 per cent of total dissolved solids from water.
- Raw water quality must be within the limits specified for the membrane used for a particular unit.
- Many reverse osmosis membranes do not remove nitrates very well.
- Thin film composite membranes are usually the best alternative for rural water in Alberta.
- Thin film composite membranes are durable but cannot tolerate chlorine.
- Gases, such as hydrogen sulfide (rotten egg odour), will pass through reverse osmosis membranes.
- Maintenance of pretreatment equipment is critical.
- Manufacturer’s water production ratings are based on ideal conditions of temperature, pressure and low total dissolved solids. Under private water system conditions, expect approximately half the production that the sales literature states.
- Small reverse osmosis units waste from 3 to 20 litres of water for each 1 litre of water produced. Many units are now available with a shutoff to turn off the inlet water supply when the storage tank is full.

More information

Additional information is available through health inspectors, agricultural water specialists or on the Alberta Agriculture and Forestry website.

Alberta Agriculture and Forestry Agricultural Water Specialists can be contacted through the **Alberta Ag-Info Centre** at **310- FARM** (3276)

The Rural Water Quality Information Tool on the Alberta Agriculture and Forestry website (http://www.agric.gov.ab.ca/app84/rwqit) can help assess water test results and provide links to additional factsheets and websites regarding water treatment.

Prepared by

Alberta Agriculture and Forestry

For more information

Call Alberta Ag-Info Centre
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Website: www.agriculture.alberta.ca

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