ASK THE
INSPECTOR

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What type of water treatment systems are available to me and for what conditions might they be required?

Water quality has become a major issue in recent years for homeowners living in both rural and urban areas because of the publicity surrounding contaminated water supplies with fatal consequences, in Walkerton, Ontario and North Battleford, Saskatchewan, among other places. These concerns have lead to a number of different residential water treatment systems becoming available to the public. There are basically four different types of systems available to consumers that are either point of use (installed at drinking water and/or cooking taps) or point of entry (installed to treat all of the water in the home.). Filters, reverse osmosis systems, water softeners, and ultraviolet (UV) light systems can all be used either alone or in conjunction with each other to remove harmful or cosmetic contaminants from water. These contaminants include harmful bacteria (such as E. Coli), harmful parasites (such as cryptosporidium and giardia oocysts), and unpleasant but not harmful characteristics such as chlorine odours, hardness, sulphur odours, and elevated iron levels.

Filters

- The two main types of filters are ceramic and activated carbon
- Ceramic filters have small pores that allow water to flow through, but that trap particles (including some bacteria and parasites) in the pores of the ceramic. They are cylindrical shaped filters that are typically encased in a clear plastic housing. Depending on the size of the pores, different particles are removed. For example, ceramic filters with an absolute pore size of 1 micron, or 0.001 mm, will remove harmful cysts such as cryptosporidium or giardia (3 to 5 microns). To remove harmful bacteria such as E. Coli (0.5 to 1 microns), however, the pore size would have to be much smaller and there are more effective methods of removing this type of bacteria (read on for more information). Ceramic filters generally do not remove adequate amounts of harmful contaminants to purify the water and they also do not remove unpleasant organic odours from the water.
- Activated Carbon (AC) filters are effective at removing organic or 'earthy' odours, and organic and inorganic chemicals such as chlorine, gasoline, pesticides, radon, etc. The AC filter consists of a container of solid AC that water passes through. Some materials, such as the above-noted contaminants, are attracted to the porous AC and are adsorbed onto its surface. Other materials, such as calcium, magnesium, floride, etc., pass through the filter because they are not attracted by the AC. Small particles like bacteria and cysts are not removed because of the AC filter size (0.5-5 mm or 500 to 5000 microns).
- Filters are usually installed in conjunction with other systems since they work well at removing 'cosmetic' water problems but are not effective at removing all contaminants.
- Filters require cleaning and changing according to manufacturer's instructions. Once a filter has been in use for an extended period of time, its surface becomes coated with the filtered materials and the water pressure downstream of the filter drops. As well, the surface of the filter can become a breeding ground for bacteria, leading to significantly worse water quality downstream of the filter.

- A filter may be installed at the Point of Entry (POE) of the home's water supply, or at the Point of Use (POU), depending on the intent of the filter. A filter that will be used to remove cosmetic characteristics to improve the taste for drinking water may be installed at the POU since it is not necessary to make all of the water in the house pleasant to drink. A filter that will be used to remove harmful contaminants would be installed at the POE, since water that is used for showers or for tooth brushing may be ingested and should be safe to drink.

Reverse Osmosis (RO) Filters

- This type of system involves a semi-permeable membrane that allows water to pass through but blocks contaminants such as metals, sodium, and cysts. Osmosis is a process where, under certain conditions, if two containers of water that have different contamination levels are separated by a semi-permeable membrane (that does not allow the contaminants to pass), the water molecules will flow from the less contaminated water through the membrane towards the more contaminated water. Reverse osmosis involves the use of pressure to force water through a semi-permeable membrane in the opposite direction than what osmosis dictates, towards the water that has less contaminant. The pressure to force the water through the membrane is either provided from the city water supply (in an urban setting) or from a pump (in a private well situation).
- Some RO systems have one or more pre-filters (i.e. activated carbon or sediment filter) to remove chlorine odours or suspended particles that the RO filter would not remove, or that would block the RO filter.
- The filters associated with this system require replacement periodically to prevent the growth of harmful bacteria on the filter media.
- Reverse osmosis filters are typically installed at the POU (i.e. under the kitchen sink) because the size and cost of providing a unit to treat all of the home's water would be prohibitive.

Ultraviolet Lights

- Water is passed over an ultraviolet light, which damages the DNA of living cells (including those of bacteria, cysts, viruses, moulds, etc.) and renders them harmless.
- The water should be filtered prior to passing through the light. If there are particles in the water, the living organisms may be shielded from the light.
- Bulbs should be replaced annually since their intensity eventually diminishes, as with any other light bulb.
- These systems are typically installed only if the water quality is poor, and therefore are installed at the POE for similar reasons discussed in the Filters section.

Water Softeners

- Use ion exchange technology to remove minerals (including calcium, magnesium, iron, etc.) from water. Ion exchange is simply the transfer of ions from the water onto the surface of the exchange media, which in most softeners is a series of plastic beads or a chemical matrix called Zeolite. Ions are minerals that have a positive or negative charge and are attracted to areas that have the opposite charge. Calcium and magnesium have a positive charge so the ion exchange medium in a water softener is given a negative charge to attract the minerals to their surface. The medium is covered with positively charged sodium ions that trade places with the calcium and magnesium when hard water passes through the softener.
- Water travels through the portion of the softener containing the ion exchange medium, and comes out as mineral-reduced, softer water. The medium will eventually become covered with the calcium and magnesium minerals, reducing their effectiveness at softening the water. The second component of a water softener is a tank that contains salt and water. After a certain amount of water has passed over the beads (this amount depends on the hardness of the water), the salty water 'washes' the beads. The water from the salt compartment is run over the beads and the sodium ions displace all of the calcium and magnesium from the medium to be washed down the drain. This is typically done during the night or at a time of day when nobody in the house is using water.
- Some softeners go through the cleaning or backwash cycle daily, while other more advanced units, detect when cleaning is necessary and only backwash when necessary.
- In no way do they make water 'safer' to drink. In fact, the sodium that is used to remove the minerals results in a sodium residual in the water after the softener. Soft water should therefore not be used for drinking water by people on sodium reduced diets or for watering plants, since the sodium is harmful to them. Softeners are mainly installed at the POE, however a separate water line is often installed before the water softener to be connected to the drinking water and outside hosebibs for this reason.

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