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Water Quality Matters

MAINTAINING SAFE DOMESTIC WATER QUALITY WITH ON-FARM CISTERNS AND WATER TANKS

February 2006

TRE-120-2006-02

Background

This document provides information on how to maintain safe drinking water in rural homes, after storage in on-site water tanks and cisterns. The quality of potable water deteriorates during storage; if deterioration is significant, previously-safe water may become unsafe for domestic uses such as drinking, cooking, brushing teeth and personal hygiene. This fact sheet provides guidance for maintaining potable water after rural water storage systems.

Rural residents are responsible to ensure that water stored on farms and rural residences remains potable and safe for use. This can be done by adopting best management practices for water storage, and regularly testing the distributed water to ensure its safety. Should you have any concerns regarding the safety of your drinking water, consult your local public health office.

The use and storage of untreated raw water, or inadequately treated water, for rural households is not recommended. This fact sheet does not address issues related to the storage of raw water or inadequately treated water, whether the raw water is from a well, rain or surface water source, or from a communal untreated water source. Raw (untreated) water sources require special considerations and specific on-site water treatment to ensure the water is safe for domestic use. For general information on treating raw water, visit the PFRA website at http://www.agr.gc.ca/pfra/water/wqualite.htm and consult with your local public health office.

Introduction

Many people in rural Canada do not have access to reliable supplies of good quality potable water. In cities and towns, water is supplied to homes by a communal municipal water system. Water is treated at a water treatment plant, and delivered by pipelines to each house. The water system supplies the water needs on-demand, and no water storage in the houses is necessary. In Canada, these communal water delivery systems are most often owned and operated by the community's public works and utilities departments. The treatment, operation, maintenance and delivery of water are functions performed by a variety of technical staff. Larger municipalities utilize highly-specialized experts, scientists and engineers to ensure the delivery of safe water for human consumption. The water is monitored regularly and frequently. Water quality tests are conducted daily, to ensure delivery of safe potable water. Should problems be detected, immediate corrective action is taken, to reduce the risk to the population served. In Canada, all municipal water sources are required to adhere to

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strict legal regulations and standards set by provincial government authorities.

Most rural homes are not supplied water from a community system, and rural citizens must access their own water supply. These rural supplies are called private water supplies - water is obtained from an on-site well or a local surface water supply, and then treated by filtration and disinfection. Alternatively, some rural homes are supplied potable water delivered by pipelines from a water treatment plant. This fact sheet covers the storage of effectively-treated water deemed to be safe for domestic use prior to storage.

Rural Water Utilities - Storing Water On-Site For Short Durations Of Time (2 Days)

In parts of Canada, rural residents sometimes pool their resources to plan, construct and operate a rural water utility. Rural water utilities usually negotiate an agreement with a nearby community to supply a small quantity of water for the rural utility. In some cases, rural water utilities decide to construct their own water treatment plant and treat their own water source. In both cases, treatment systems are designed to filter the water and then disinfect the water with chlorination before it is distributed in pipelines. The treated water quality is regularly monitored to ensure safe domestic water quality is supplied to each consumer. *Rural water systems often differ from urban communal systems, because many rural systems only supply water at continuous low flow rates*. This means that on-site storage and re-pressurization is necessary in order to meet the household's on-demand water needs. **The ideal volume of an on-site water tank, supplied potable water from a rural pipeline, is enough water to supply the average house demand for about two days** (see Figure 1), usually about 700 to 1,500 Litres (150 to 330 Imperial gallons). Larger storage tanks are not recommended for several reasons:

1. large tanks take up too much space,
2. large tanks are too costly, and,
3. storage of large volumes of water is less safe because the potable water quality will deteriorate in storage, and could become unsafe for use and costly to correct.

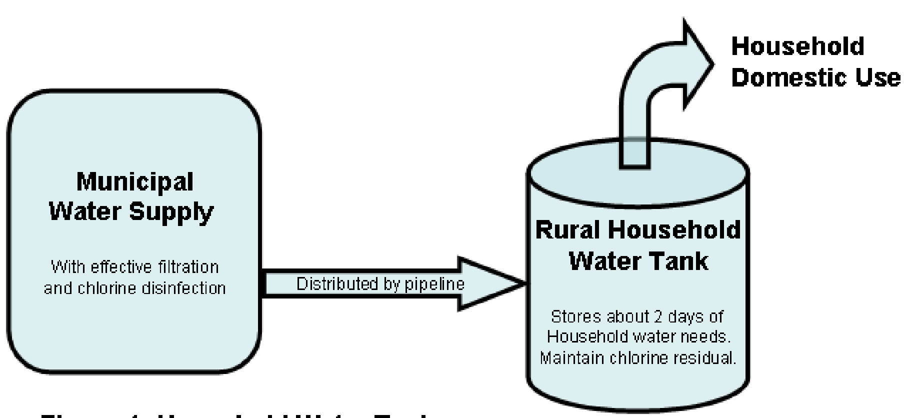

Figure 1: Household Water Tank

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Rural Water Cisterns - Storing Water For Long Durations Of Time (From Weeks To Several Months)

Sometimes rural residents choose to haul potable water from a community water supply, and store the water on-site, in a very large tank, called a cistern. The storage of large quantities of water (roughly 15,000 Litres or 3,300 Imperial gallons or more) may provide the household with one to two months of domestic water needs, depending on the occupancy and water use patterns. Large volume water tanks are utilized to minimize frequent water hauling, particularly when users pay for commercial water hauling. Water stored in a cistern should originate from a regulated community water supply to ensure the water was treated and processed as a potable water. This means the water will be filtered and disinfected with chlorine, and regularly tested by the community to ensure it is safe. (As earlier noted, the storage and use of raw untreated water, or inadequately treated water, is not recommended). Sometimes, rural homeowners have opted to use existing large cisterns to store potable water from a pipeline - this will lead to water quality degradation due to the length of time the water is left in storage (see Figure 2).

Cisterns may be concrete tanks located in the basement of older homes, or large fibreglass or plastic polyethylene tanks buried below ground outside of the home.

Because cisterns store water for long periods of time, the water safety cannot be maintained without additional water treatment. Figure 2 shows that potable water stored in cisterns requires additional treatment and disinfection to ensure it is safe for domestic use.

Responsibilities Of Rural Residents

When a rural water utility group is formed, the group will usually assume responsibility for water delivery to the rural household connection point. The rural water utility may not be responsible for the water quality. The rural homeowner always assumes responsibility for the on-site water quality

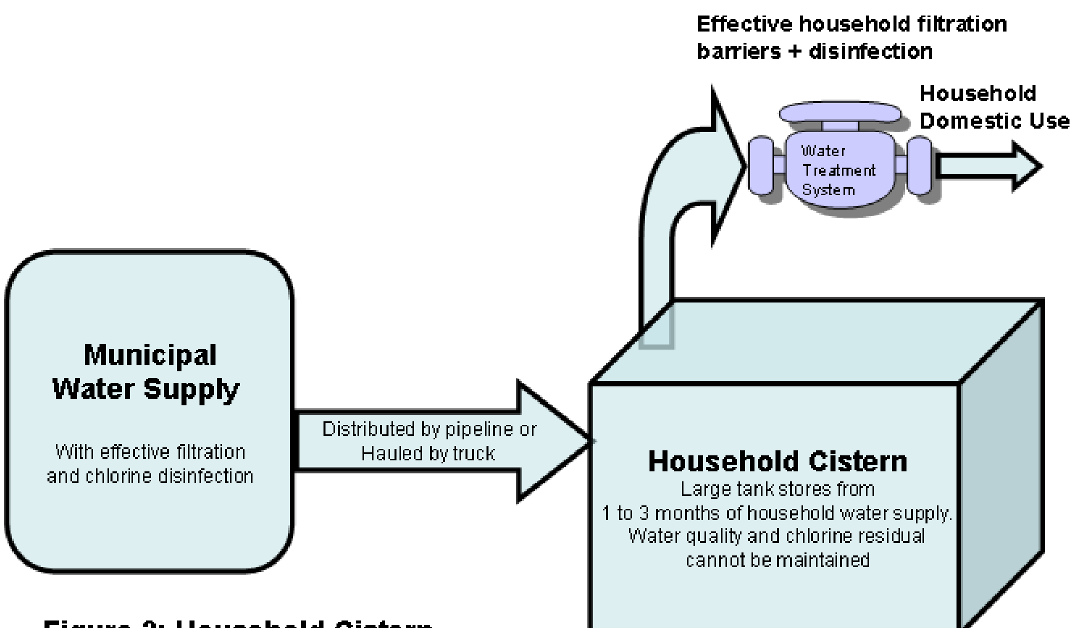

Figure 2: Household Cistern

and water distribution. The homeowner's responsibilities include:

- ensuring proper tank designs and materials are used to ensure the storage of potable water; select materials that are specifically designed to store potable water
- properly operating and maintaining on-site water storage and distribution (and water treatment, if any);
- ensuring the on-site water pipelines and distribution system meet the plumbing code and have no cross-connections with other on-site water or wastewater pipes; cross-connections pose serious risk to the household and to the other households connected to the large water distribution pipeline; and,
- conducting regular on-site water quality testing to determine the safety of the water for domestic use and other on-farm water uses.

Water Quality Problems With Tanks And Cisterns

All water, even high quality treated potable water, will deteriorate in water storage tanks and cisterns. The longer the time in storage, the greater the potential for change. Some types of changes are:

- loss of disinfection residual by chlorine depletion, resulting in microbial re-growth and contamination;
- increasing concentrations of oxidized minerals and organic matter; chlorine reacts with organic and inorganic matter (e.g. iron, manganese, calcium, magnesium, hydrogen sulphide, dissolved organic carbon, *etc*.);
- increasing concentrations of disinfection by-products such as trihalomethanes when chlorine reacts with organic matter;
- contamination and biodegradation from living organisms such as insects, rodents, reptiles, birds, etc. that crawl or fall into the water;
- internal contaminants added to the water from an improper, dirty or corroding cistern/tank;
- algal growth may form toxins from cyanobacteria, and will also cause problems with taste, odour, clogging of water treatment equipment, and increased organic content, and generally impair water quality and safety;
- microbial contamination and growth of microorganisms causing biofouling of the water tank and pipe walls;
- contamination from air borne particulate or living organisms or their waste products; and,
- chemical, physical or biological contaminants may be carried by rain or seepage into poorly-constructed, poorly-maintained, leaking tanks - *this is especially critical if buried cisterns/tanks are located in pervious or semi-pervious soils, or in locations where contamination may occur from septic fields, lagoons, leaking waste water pipes, fertilized or sprayed fields, corrals or barns, waste or refuse disposal sites, etc.*

Maintaining Water Quality During Storage

Maintaining water quality during storage requires several key steps:

- Cisterns and storage tanks must be properly sized, strategically located and well-constructed.
- On a regular frequency, cisterns and tanks must be visually inspected, properly operated and maintained, and periodically cleaned and disinfected.

- For water tanks, the water storage time should ideally, not exceed two days. For cisterns, the storage time should not be excessive, say, under 2 to 3 months.

- The stored water should always originate from an effective water treatment plant using chlorine disinfection after treatment.

- The owner of the water tank or cistern will attempt to maintain a residual chlorine concentration during storage such that the amount is not depleted below 1.0 mg/L Total Chlorine and 0.2 mg/L Free Chlorine. It is essential to maintain a free chlorine residual to achieve effective disinfection. Ideally, residual chlorine concentrations should be tested at least twice every seven days. Retain the test records for reference.

- Water quality should be regularly tested for microbial safety to ensure the water is safe for its intended use.

Caution: *If the above-noted steps are not possible, then the water quality after storage should not be considered as a safe drinking or household water supply. Water treatment systems may be utilized after storage to improve water quality, providing they are effective, and well operated and maintained. Regular testing is still required.*

Types Of Cisterns And Storage Tanks

Concrete Cisterns

Concrete cisterns are probably the most common on-farm cisterns. Some older cisterns were designed to collect rain water - this practice should be discontinued when storing potable water in a cistern. The information presented in this technical guide does not address current innovations for rainwater collection.

Older in-house concrete cisterns were generally constructed with open tops (with no lid or top enclosure) and therefore, are exposed to animals, insects, dust and airborne contamination. A cover may reduce the entry of some contaminants.

Buried concrete cisterns often have a capacity of about 5,000 to 15,000 L (1,100 to 3,300 Igal), or more. They are generally two-piece pre-fabricated or cast-in-place concrete construction. A potable grade plastic sealant is used to provide a water tight seal between the tank and lid. A groove is cast into the cistern lid for a 760 mm (30 inch) access manhole which is sealed with an appropriate sealant. They are generally buried with the top located a maximum of four feet below the surface of the ground. A 1300 gallon tank complete with top will weigh nearly 4,500 kilograms (10,000 pounds). Piping connections through the walls of a concrete cistern should be made using leak proof connections. Generally, the best method is to incorporate a no leak flange during concrete construction. An alternative approach is to bore a hole through the wall and install an appropriate potable grade sealant between the opening and pipe. Figure 3 shows the details of a typical concrete cistern.

Buried Fibreglass Water Tanks

Buried fibreglass tanks are often used as an alternative to concrete cisterns. Tank sizes for storing household water range from 3,500 to 7,000 L (750 to 1,500 Igal), or more. The tanks are circular with a 1500 mm (5 foot) diameter and come in two sections. The sections are bolted together using a butyl gasket. A 610 mm (24 inch) manway extension is bolted to a flanged collar (with gasket) and is fastened to the tank with self tapping screws and sealed with a butyl gasket. A 4,500 L (1000 Igal) tank weighs about 180 kilograms (400 pounds) which is much easier for the average homeowner to install. Fibreglass or other lightweight material tanks are not suitable in areas with a high water table (unless anchored), as the tanks will have a tendency to “float” caused by uplift from the water table. Piping connections through the walls of a fibreglass cistern are

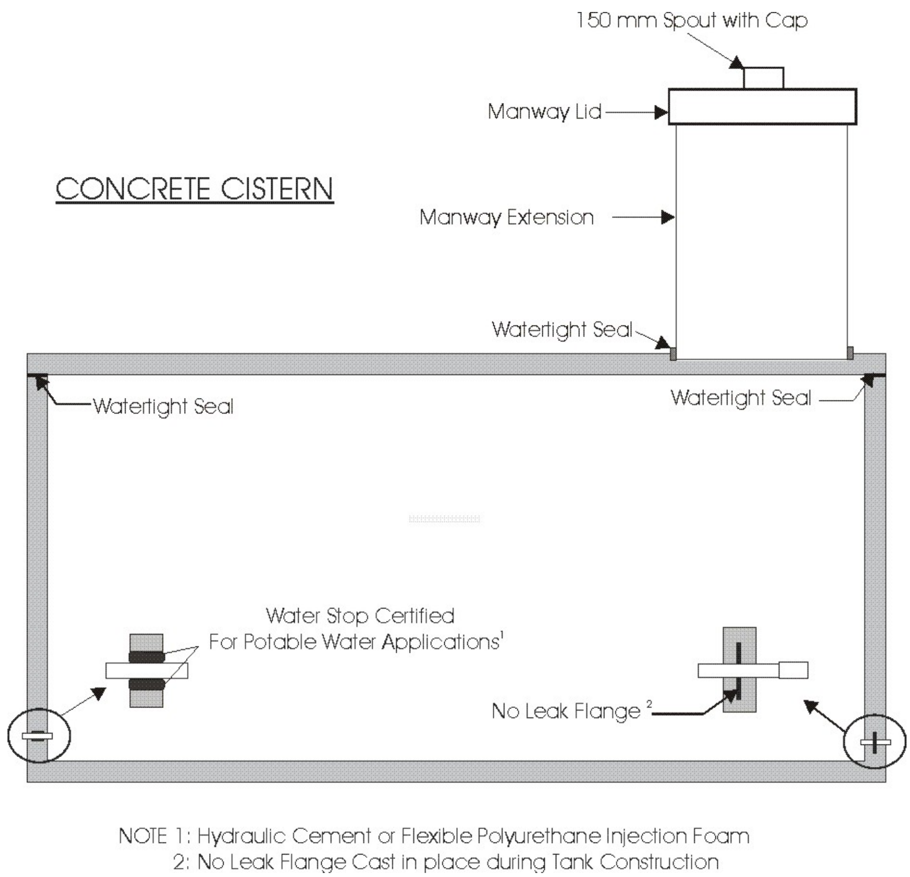

Figure 3: Typical Buried Concrete Cistern

generally made by imbedding a length of PVC pipe in the tank bottom during the fabrication process. Figure 4 shows the details of a typical fibreglass cistern.

Above-ground Tanks

Above ground storage tanks are available in both fibreglass or polyethylene materials. The fibreglass tanks come in sections that can be moved through a standard door and then are bolted together. Tank sizes range from 700 to 5,700 L (150 to 1250 Igal). Polyethylene tanks are normally installed above grade and suppliers carry various types and sizes of tanks. Oval shaped tanks can be moved through a standard 760 mm (30 inch) door and range in size from 450 to 1400 L (100 to 300 Igal). Some tank deformation usually occurs during water storage.

Smaller above-ground sealed cisterns sized to store a two-day supply will not experience the same degree of chlorine residual deterioration or water quality degradation as a larger cistern, since the water turnover will be greater. An above-ground cistern is also better protected from contamination and more easily inspected.

Of course, any above-ground water storage tank located outside a building must be designed to deal with environmental exposure, and must be functional during hot summers and cold winters. This may require incorporating insulation in the tank design, particularly for small storage systems that are at risk from freezing.

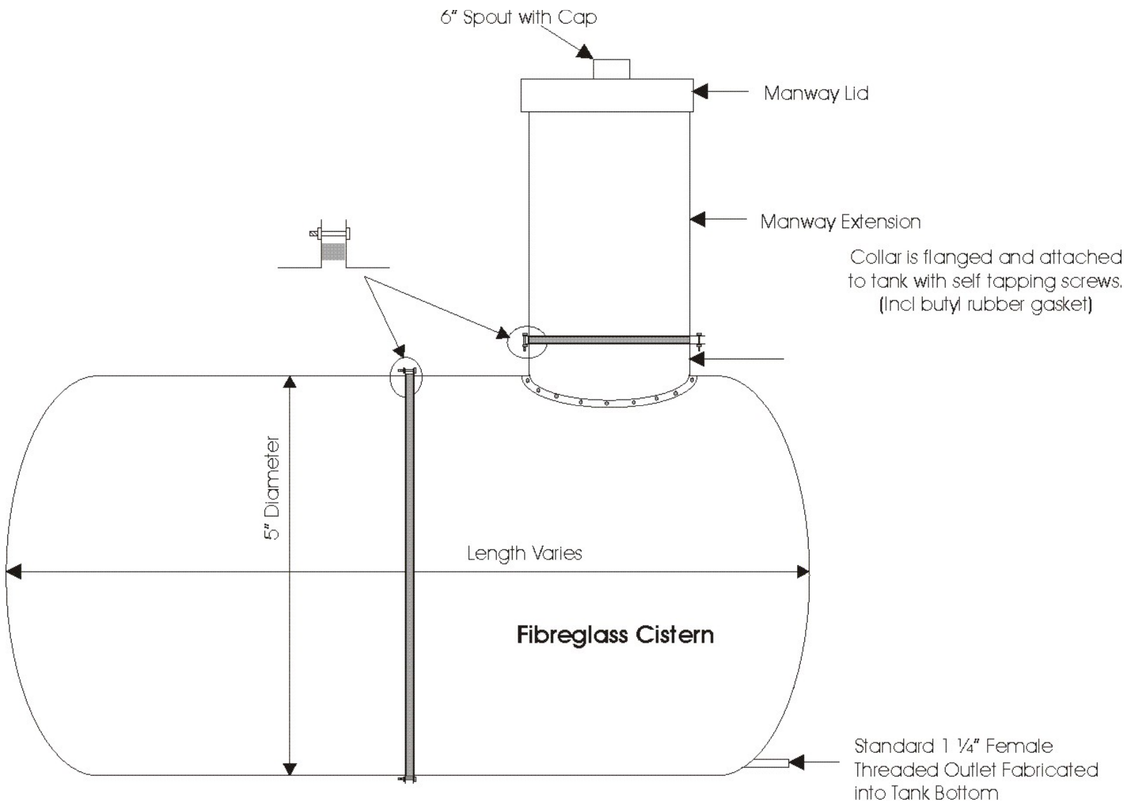

Figure 4: Typical Fibreglass Cistern

Installation Of Cisterns And Water Storage Tanks

Regardless of the type of tank, proper installation is required to ensure that it performs satisfactorily over the long term. This applies not only to the structural integrity of the cistern or tank, but also to the maintenance of the water quality.

Backfill Material for Buried Cisterns and Tanks

After excavation, unstable materials should be removed and backfilled with suitable compacted construction backfill material.

Concrete cisterns generally do not require special backfill materials. A 150 mm (six inch) layer of compacted pervious bedding material should be provided beneath a concrete cistern to ensure uniform support. Generally concrete tanks are backfilled with in-situ excavated material. The backfill should be placed and compacted in 150 mm layers around all sides of the cistern.

Proper installation of a fibreglass tank is critical to ensure that a solid envelop of granular backfill completely encompasses the tank. Fibreglass cisterns require a free flowing granular backfill material. The manufacturer's installation recommendations should be followed to ensure tank integrity and to avoid compromising the warranty.

All tanks or cisterns require a good foundation, proper support and backfill material that is consistent with the design, and/or the requirements specified by the tank or cistern manufacturer.

Locating Water Storage Tanks

Precautions have to be taken to prevent contaminants from entering the cistern. An improperly installed cistern can be the source of contaminated water even though safe water is being delivered to the cistern.

Cisterns should be located in an area that is not subject to contamination from the land or from below-ground. Cisterns should be located safely away from lagoons, septic fields, waste landfill, corrals, barns, fertilized/sprayed fields, etc. Sources of contamination from ground water should also be considered. Drainage from the land should be away from the buried tank.

The tank should be located in an area that is free draining (*i.e.* the site should not have standing water). The ground surface over the cistern should be raised to ensure positive drainage away from the cistern. Ponded water could overflow into the cistern through the manhole and contaminate the cistern. The cistern air vent should be screened to keep out insects and rodents and the opening should face down to keep air borne contaminants out. The manhole lid should fit tightly and have a lock. Both the manway and air vents should extend at least 30 cm above grade.

Above ground cisterns are normally located in the basement and are generally smaller to be able to fit through doorways. If the tank is located in another building, be sure it is not exposed to contaminants, including airborne contaminants. Dedicated buildings or rooms for storage are sometimes desirable.

Similar to an underground installation, an above ground cistern should be properly vented and have a tight fitting lid. One issue that has to be considered when installing a tank or a cistern in a basement is moisture accumulating on tank sides. To counteract this problem, a reflective insulation material may be used on the tank with the tank located close to a drain to dispose of any moisture that collects. The insulation will also act as a barrier preventing light from contacting the water and reduce the risk of algae growth problems.

Storage Tank And Cistern Maintenance

Water infrastructure, including water storage systems, require regular maintenance, specifically suited to the on-site water system. The frequency will vary depending on the system. **In general, water tanks and cisterns should likely be cleaned out and shock chlorinated at least once per year.** This frequency will increase if water quality problems occur.

Washing and Sludge Clean-out

Cisterns and storage tanks should be regularly inspected, cleaned and periodically shock chlorinated to disinfect the tank (Shock chlorination is a term used when applying high concentrations of chlorine disinfectant for maintenance purposes - this water should not be consumed.)

For safety reasons, do not enter any cistern or tank as there may be dangerous concentrations of hazardous gases or insufficient oxygen, that could result in death. All cisterns or tanks are considered and regulated as a "confined space," which poses severe dangers to human or animal life. Improper entry into confined spaces have resulted in human fatalities from hazardous gases or low oxygen levels. No one should enter a cistern to perform maintenance unless they are properly trained in confined space entry and properly equipped with the air testing, ventilation and rescue equipment. Proper confined space entry procedures should be used at all times. No matter how clean the cistern or tank may appear, these dangers are not able to be detected by human sight or smell.

The homeowner should only undertake those activities that do not require entry into the cistern or tank. For example, after emptying, the walls may be washed down with a garden hose, wand or a pressure washer, while working from outside the tank. The wash water can be removed using a submersible pump and discharged into an open outside area. This may have to be done more than once to adequately remove material that has settled in the cistern.

Shock Chlorination

After washing and pumping out the sludge, the cistern can be shock chlorinated. Re-fill the cistern or tank to normal operating level or slightly higher. **During the filling add additional bleach to obtain a Free Chlorine concentration of at least 50 mg/L (50 ppm) for a six (6) hour minimum contact time (AWWA, 1973).** If lower shock chlorination doses are used, longer contact times are required.

This concentration is achieved by adding 1 L of new unscented household bleach for each 1,000 L of treated water (one gallon of bleach for each 1,000 gallons). If chlorine-consuming contaminants such as organic matter, iron, *etc*. are present in the water, doses may need to be higher.

After a minimum of six (6) hours shock disinfection contact time, the highly-chlorinated water in the cistern can be dumped to waste in accordance with safe practices . (If lower shock chlorination doses are used, longer contact time is required.) The cistern should be flushed and re-filled with potable water. Highly-chlorinated water is unsafe for drinking, unsuitable for domestic or livestock use, and will cause problems if discarded into septic fields. Furthermore, environmental regulations exist which prohibit the disposal of highly-chlorinated water into streams and ditches, in order to protect the environment.

Dealing With Water Quality Problems In Water Tanks And Cisterns

Restoring Lost Chlorine Residuals

Regardless of the type or size of cistern, storing water for extended periods of time will result in a loss of chlorine residual. When this happens the water is not safely disinfected and is not suitable for household use. Before any water is used it should be tested to ensure that there is adequate disinfection residual.

When chlorine residuals are tested and there is little or no residual chlorine concentration, the water in storage can be dumped to waste and replaced with treated and safely disinfected water. Alternately, the water in storage can be re-chlorinated by batch chlorination. Add about 20 mL of 5 percent bleach for each 1,000 L of stored water (about 2 ounces of bleach for each 1,000 Imperial gallons). The entire water volume of the cistern should be thoroughly mixed and not used for at least 20 minutes. The cistern can be mixed by running a thoroughly cleaned and disinfected hose from an inside tap back to the cistern.

When water is flushed and replaced, and re-chlorinated by batch chlorination, it should be re-tested to ensure that the minimum 1.0 mg/L Total Chlorine and 0.2 mg/L Free Chlorine residual is present. The maintenance of a Free Chlorine residual is essential to ensure proper disinfection. The owner should also test the chlorine residual of the supply water to the cistern to ensure that the lost residual is not related to a failure in the distribution pipeline system or the central water treatment plant.

After restoring lost chlorine residuals, it is a good idea to re-test the water for microbial contamination and disinfection by-products such as trihalomethanes.

Water Treatment After Short-Term Storage (2 Days)

When properly-treated and disinfected drinking water is stored for 2 days, very little deterioration of water quality results, and there is normally no need for additional water treatment. Sometimes individuals will add-on a polishing treatment device (e.g. Ultraviolet filter, reverse osmosis membrane, etc.). It is best to select only tested and certified water treatment devices. Health Canada recommends equipment to meet NSF International (NSF)/American National Standards Institute (ANSI) standards. If polishing treatment devices are used, the equipment should be properly operated and maintained to ensure the device does not become a source of water quality problems.

Water Treatment After Long-Term Storage (>2 Days To Several Months)

Post Storage Disinfection

Safe drinking water must always be effectively treated and disinfected. Since safely treated and disinfected water will deteriorate during storage, disinfection after long-term storage is required. As noted above, it is best to select only tested and certified water treatment equipment (NSF International/ANSI standards.)

Three processes are ideal for disinfecting rural household water after storage: *chlorination, ozonation or ultraviolet light (UV)*. Other processes such as distillation, reverse osmosis and boiling may also be used but are suited to treating drinking water only, at one dedicated tap.

Post-Storage Chlorine Disinfection

Chlorine is added as the water is drawn from storage and distributed throughout the in-house plumbing. This may be done by incorporating a small chlorine batch tank and regulating valve on the suction line of the pressure pump, or by using a chemical feed pump on the discharge side of the pressure pump. (Adding the chlorine on the suction side of the pressure pump is not recommended since it could cause the pump to lose its prime should the chlorine tank be emptied.) The chemical feed pump should be wired into the pump pressure switch so that both pumps run at the same time. The pressure tank should be sized such that the tank draw down provides at least two minutes run time.

After chlorine is added to the water, a chlorine contact tank is necessary. It is usually located after the in-house pressure tank. The contact tank is sized to ensure sufficient contact time for adequate disinfection prior to discharge into the distribution system. Contact tanks should be sized for about 10 to 20 minutes of contact time.

- Advantages
  - Low capital and maintenance costs
  - Provides residual disinfection
  - Chlorine residual can be easily tested
- Disadvantages
  - Adjustment of chlorine feed is required to maintain correct residual
  - Chemical feed pump and lines have to be cleaned periodically
  - Forms disinfection by-products when organic matter is present in water
  - Chlorine is not capable of disinfecting protozoan parasites such as Cryptosporidium and Giardia and must therefore be used as a post-disinfectant after other treatment barriers

Post-storage Ozonation Disinfection

Ozone is similar to chlorine but is a stronger disinfectant. Unfortunately, ozone does not provide any residual disinfection as it rapidly decomposes to ordinary oxygen. Effective ozonation systems may be available for farm applications. Materials must be very high quality and vendors should provide detailed information for sizing, installation and maintenance.

- Advantages
  - Very effective disinfection
- Disadvantages
  - No residual disinfection is provided
  - Requires microbiological testing to verify disinfection
  - Forms disinfection by-products when bromine is present in the water
  - Maintenance is more difficult than with chlorination
  - Requires on-site ozone generation, which is highly corrosive and must also be vented to prevent build-up of ozone gas
  - Should incorporate an ozone gas alarm to safeguard from unsafe ozone levels

Post-storage Ultraviolet Light (UV) Disinfection

UV disinfection of treated water is reliable and poses relatively low maintenance requirements. A depth cartridge filter (5 micron or smaller) may be used prior to the UV unit to remove sediment. The capacity of the unit should be about double the maximum pump discharge of the in-house pressure system to ensure adequate disinfection. A normally closed solenoid valve should also be installed after the pressure tank to stop flow in the distribution system in the event of a power failure. The light should also be equipped with an alarm system that monitors the output of the UV light.

UV systems for farm use are usually designed for annual bulb replacement. Quartz glass sleeves inside the unit must be cleaned on a regular basis to ensure adequate light transmission. The frequency of cleaning of the quartz sleeve will depend on the quality of the water.

- Advantages
  - Low capital cost
  - Little routine maintenance
  - No disinfection by-products are formed
- Disadvantages
  - No residual disinfection is maintained
  - Requires microbiological testing to verify disinfection
  - Requires additional features (e.g. warning lamps, alarms) to ensure UV transmission is functioning
  - Replacement cost of UV light bulb is approximately $100 per year

Post-storage Treatment using Reverse Osmosis (RO)

Reverse osmosis is a membrane treatment process that removes most minerals, biological organisms, organic matter and suspended matter from water. This physical removal of biological contaminants is **not** a disinfection process. Reverse osmosis treatment should not be used as the sole method of treatment when the water is microbiologically contaminated. Units treating water for the whole house are available but are fairly costly. Dedicated units treating water at one tap (under-the-sink) are advantageous as a secondary level of protection for drinking water at one location, and should only be used in combination with pre-treated and safely disinfected water. For example, a dedicated reverse osmosis unit will ensure the removal of protozoan parasites, along with other contaminants in the water.

- Advantages
  - Low capital and maintenance cost (tap units)
  - No disinfection by-products are formed
- Disadvantages
  - Should not be considered as a stand alone disinfection process
  - Requires microbiological testing to verify water is free of microorganisms
  - Membrane plugging and fouling will occur from minerals (hardness) and organic matter or waste products from microorganisms
  - Water is ultra-pure and corrosive
  - Produces 15% volume as product water and wastes 85% as reject water which

must be disposed of; depending on the design, the reject water may be recovered by recycling

Post-storage Treatment using Distillation

Distillers may be used to provide a secondary level of drinking water protection. Water is heated into steam and then re-condensed.

- Advantages
  - No disinfection by-products are formed
- Disadvantages
  - High energy consumer
  - Requires frequent cleaning

Post-Storage Water Quality Monitoring

Water testing is required to determine the safety of domestic water supplies. Municipal systems perform a variety of tests on an established frequency. Some tests are performed many times during the day, while others are more periodic. Of course this is not possible for rural homeowners.

Chlorine Residual Testing

The chlorine disinfection process can be easily monitored on a regular basis by the homeowner. Chlorine residuals can be measured using test strips or chlorine test kits available from chemical supply companies. The test strips are inexpensive and easy to use. Test kits are more costly but provide more reliable and accurate results when used properly.

The chlorine feed rate on a chlorination system should always be adjusted to maintain a residual of 1.0 mg/L Total Chlorine and 0.2 mg/L Free Chlorine at the tap where the water is used (Health Canada 2005). Chlorine residual testing is an inexpensive way of monitoring the disinfection process, and should be done two to three times per week. Chlorine concentrations will decay over time, and chlorine demand occurs from a variety of parameters (e.g. disease-causing organisms, dissolved iron, manganese, organic matter, ammonia, etc.) If an insufficient chlorine dose and/or contact time occurs, the chlorine residuals will be too low and effective disinfection will not occur, potentially leaving disease-causing organisms in the water. Chlorine residuals should not exceed 4.0 mg/L (US EPA, 2003).

Testing for Microbiological Contaminants

The safety of drinking water supplied from an effective municipal water treatment plant is assessed by frequently testing for microbial contamination of the treated water. Common types of microbial tests are: *Total Coliforms, Faecal Coliforms, E. Coli and Heterotrophic Plate Count*. Commercial laboratories, or a provincial government health laboratory, will conduct these analyses for a fee of about $20 for each type of test. Consult with local provincial agencies (e.g. public health or water agencies), as some provinces provide subsidies for selected water quality tests.

The presence of Total Coliforms and other microorganisms indicates that either the disinfection process is not functioning properly or that the water has become contaminated. The storage system and distribution pipes may require shock chlorination, flushing and re-testing before the water can be considered to be safe.

A private drinking water supply using water from an effective drinking water treatment plant, should be tested at least once or twice annually for Total Coliforms. Ideally, a Free Chlorine residual of 0.2 mg/L will be maintained continuously, and confirmed by testing twice weekly. If UV or ozone disinfection is used instead of chlorine, more frequent Total Coliform testing will be required because there is no other way of testing for disinfection effectiveness (i.e. there is no residual disinfectant that can be monitored as with chlorination). Additional bacteriological testing is also required when water quality deterioration or equipment failures occur.

Bacteriological testing requires the use of sterile sample bottles. Bottles and sampling instructions are available from commercial laboratories or possibly from local public health offices. Samples should be shipped cool (e.g. in a cooler with ice packs) to the lab within 24 hours of collection.

Summary

Water tanks should always store disinfected water from a source that is known to be properly treated by filtration and subsequently disinfected and monitored. Water tanks should store water for no more than about 2 days. This will ensure that there is little reduction in the safety of the water. Figure 5 shows a household water tank.

Figure 5 - Household Water Tank - 2 day water storage

Cisterns should always store disinfected water from a source that is known to be properly treated by filtration and subsequently disinfected and monitored. Since cisterns store very large volumes of water (usually several weeks or months), the water quality will deteriorate in storage and can no longer be viewed as safe for domestic use. At a minimum, the water after storage in a cistern should be re-treated with appropriate disinfection to ensure the water is safe for domestic use. Cisterns require regular cleaning and maintenance to ensure the water quality deterioration is not severe. Figure 6 shows two fibreglass tanks storing a large volume of water.

Figure 6 - Cisterns: Large volume water storage tanks

Water storage tanks or cisterns are necessary for many rural households. While water quality problems may result during storage, the methods in this fact sheet can help deal with the key concerns. Remember to follow good construction practices, effective operation and maintenance of the storage tank or cistern, and regularly test for the safety of the water.

Should untreated raw water ever be stored in a cistern, the water is considered to be unsafe for domestic use and requires effective and much more extensive water treatment processes than described in this fact sheet. The storage of untreated raw water, even from a well, is not recommended.

The use of safe domestic water quality in households is important for drinking, cooking, brushing teeth, washing dishes and general hygiene. If there are any concerns about the safety of your water, contact your local public health office, and be sure to use an alternate source that is known to be safe.

For further information on protecting and improving rural water supplies, contact your nearest Agriculture and Agri-Food Canada - PFRA office or visit the Prairie Farm Rehabilitation Administration website at www.agr.gc.ca/pfra.

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- Water Treatment Devices for Disinfection of Drinking Water
  http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/disinfect-desinfection_e.html
- Water Treatment Devices for Removal of Taste, Odour and Chemicals
  http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/devices-dispositifs_e.html

- Guidance for Providing Safe Drinking Water in Areas of Federal Jurisdiction Version 1 Section 3 Chlorine/Chloramine Residuals
  http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/guidance-federal-conseils/framework-app-cadre-4_e.html#residuals

United States Environmental Protection Agency
National Primary Drinking Water Regulations; List of Drinking Water Contaminants & MCLs
http://www.epa.gov/OGWDW/mcl.html#mcls
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Author: E. Scott, D. Corkal, PFRA