High Quality Water at Home

A Collection of the Most Frequently Asked Questions about Water Quality and Contaminants

Presented by

WATER AIR
Wyckomar
UV PURIFICATION SYSTEMS

About this Guide

Wyckomar Canada is a manufacturer of UV Disinfection and integrated drinking water systems, and in the business of water treatment since over 40 years.

This educational brochure is focusing on the complex market of water treatment devices and systems and hopes to address most of the questions that arise when deciding to treat the water at the home.

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The Water We Use

Clean, fresh, and safe drinking water is a hallmark of good health, and its importance cannot be overstated in our busy everyday lives.

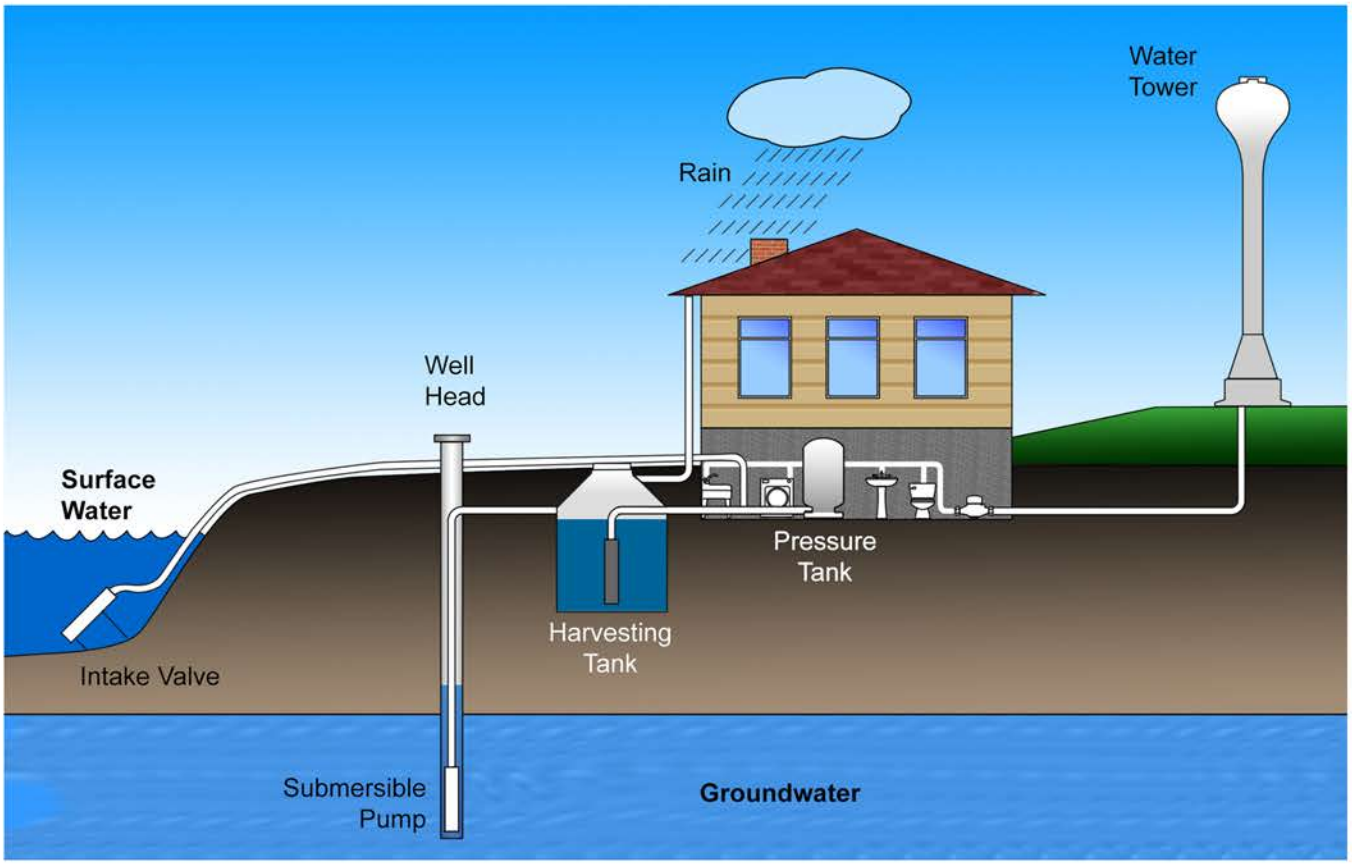
Safe and healthy water is not flowing from the taps in your home. It takes testing to analyze the physical and molecular contents of water because some contaminants can be invisible yet harmful and you want to make sure that the water is free from anything that makes its consumption unsafe.

In the following we will discuss the various sources of the water that reaches your tap, show problems that come along with the water source and finally we will lay out the treatment applications for the different sources of drinking water.

Water that looks clear can still be contaminated

There are many sources of drinking water – are you confident in the source of yours?

-- Bottled / Purchased Water
-- City / Municipally Sourced Water
-- Surface Water, Rainwater
-- Aquifer Sourced Groundwater, Drilled Well



Sources of Drinking Water

This overview of water sources shows the features and challenges that come along with the specific source water for household usage.

Bottled Water

When water is purchased, the Food and Drug Administration (FDA) makes sure that whatever hits the shelves of vendors does meet basic quality parameters regarding the chemical composition, and bottling companies are under rigid regulations when it comes to producing water for the general public. The ingredients are printed on each bottle and there are only slight differences possible in the range of content.

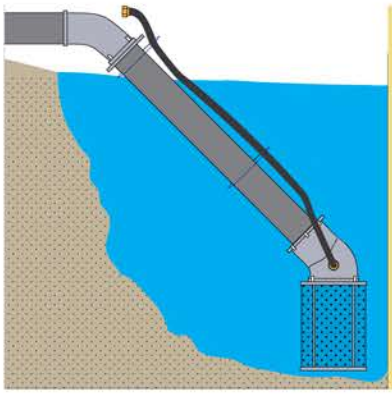
All purchased water must have minerals in them, otherwise it would be corrosive.

Distilled water can be purchased but has no minerals, so it is not recommended for drinking.

City / Municipally Sourced Water

The sources of city water can be from rivers, lakes, from water reservoirs, but also from drilled and dug wells and each of these sources presents a different challenge regarding the contami-nants that come along with it. The source water is treated in water works, which are big expensive plants to produce drinking water of high quality for the population. The United States Environmental Protection Agency (EPA) regulates drinking water provided by public water systems, and sets enforceable standards.

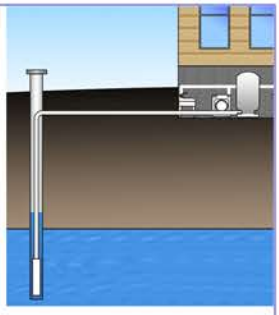
Surface Water from Dug Wells, Cisterns, Lakes and Rivers, Rainwater Catchment



Water that is sourced from surfaces like lakes, creeks, rainwater catchment or from cisterns and dug wells is a great way of providing the water needed for a household in areas where there is sufficient rain and surface water present. This water has everything in it that comes with the rain and that is in the surface source. It can contain pollutants from the environment, herbicides used in agriculture, and micro-organisms, such as bacteria, viruses and parasites.

Aquifer Sourced Groundwater from Drilled Wells

Water that comes from a drilled well that is fed by a subterranean aquifer is called Groundwater. It occurs in the saturated soil and rock below the water table. Wells that reach the groundwater are dozens to hundreds of feet deep



Problems of the Different Water Sources

All highlighted water sources do have their own unique challenges which can affect the water quality at the tap,.

Problems of Bottled Water:
- Variable quality and contents. Environmental issues most notably from plastic bottles.
- Potential source of chemical leaching from plastic (Most plastic water bottles are made of PET polyethylene terephthalate plastic. At least 150 chemicals are known to leach from PET plastic beverage bottles, including heavy metals like antimony, lead, and hormone-disruptors like BPA.)[1]

Problems of City Water:
- can be soft / hard / very hard, depending on the city water source
- typically, there are dissolved metals like iron and manganese and minerals like calcium in water that is pulled from an aquifer (below the max. EPA allowed levels)
- typically contains lots of chlorine added by the water works
- can become contaminated if there are problems at the plant (Reference: Walkerton, ON 2002)[2]

Problems of Surface Sourced Water:
This water has everything in it that comes down with the rain and is in the surface source. Surface waters are easily polluted (or contaminated) with microorganisms that cause waterborne diseases and chemicals that enter the stream from surface runoff and upstream discharges[3]. Further, it can contain environmental pollutants that can come with the rain, as well as bacterial organisms that are in bird droppings (eg. *Cryptosporidium parvum*)[4]

Problems of Groundwater:
Ground water can contain naturally occurring minerals (hardness) and metals (arsenic[5] fluoride[6]) in varying concentrations.Stressors that affect ground water condition include application of pesticides and fertilizers to the land, waste from livestock and other animals, waste from landfills, mining operations, septic systems, and unintentional releases such as chemical spills or leaks from storage tanks. Groundwater sources can become contaminated with germs, such as bacteria, viruses, and parasites[7].

All of these problems arise at the point of entry of the water into the house and are treated before use with various treatment technologies.

To know what each technology does and how it affects the water at your house, we need to take a look at the contaminants that have to be dealt with. Since many of these are chemically suspended in the water and not visible, it is necessary to analyze the chemistry of the water we drink.

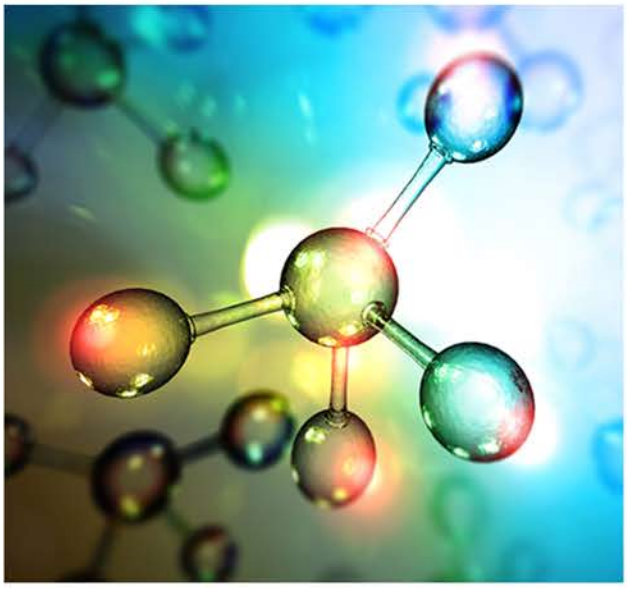
Water Chemistry 101

Water is composed of two hydrogen atoms and one oxygen atom, making the chemical symbol H_2O.

Apart from the basic hydrology, water can also contain other physical, chemical, biological, or radiological substance or matter. These are called contaminants, but despite the word having a more negative implication, there are are also healthy substances in water, so must define them regarding harmful vs. harmless.

General categories of drinking water contaminants

Water can have soluble and insoluble substances other than the molecule H2O. All insoluble substances are solid while soluble substances are dissolved.



Insoluble
Insoluble physical contaminants are suspended solids like sediment or particulate matter and are visible in the water. They are measured in NTU (Nephelometric Turbidity Unit) because they affect the turbidity and clarity of the water. Water with high NTU values looks unpleasant, water that has low levels of NTU (below 1) looks crystal clear.

Soluble
These substances can be inorganic or organic, they can be ionised (electrically charged) or non-ionised. They are present in the water in form of ions or molecules of various sizes. They are measured in ppm (parts per million) or mg/l (milligram per litre) and the comprehensive value of all soluble substances is the TDS (Total Dissolved Solids).

Organic contaminants are pollutants and pesticides in the water that result from natural decay of plants (tannins) and soil erosion, from traces of industrial processes or from runoff eg. nitrite, nitrate, potassium, glyphosates). They are soluble, measured in ppm (parts per million) and are visible as colourisation only in high concentration. Organic susbtances in the water can be harmless yet aesthetically unpleasant (tannins) or harmful (solvents, pharmaceuticals)[8].

When you boil and evaporate water, you are being left with the contaminants, which are now a dry residual, of the dehydrated soluble substances. Sea water has a sizeable quantity of dry residual, it can be 35g to 40g per litre of sea water. River or lake water on the other hand has a residual of 50 to 500 ppm or mg/l.

The dry residual are the Total Dissolved Solids (TDS) and are measured in ppm (parts per million)
So, in terms of these numbers, sea water has a TDS of 3500 ppm and lake water has a TDS of approx. 500 ppm.

Biological contaminants are organisms like microbes, bacteria, protozoa, viruses, parasites(*Paramecium*, *E. coli,* Coliform, Hepatitis, *V. cholerae, Giardia, Cryptosporidium, Legionella, Nematode* and many more[9]).

Radiological contaminants are elements with an unbalanced number of neutrons and protons and can emit ionizing radiation, like cesium, plutonium, uranium[10].

Solid and Dissolved Contaminants in Water

Once we have established what may be in the water (and we are only talking about drinking water), let's see how this applies to our water so we can make a strategy to remove the challenges, and have clear clean and safe water at all taps in the house.

Refresh - the water can have insoluble or solid contaminants (1), dissolved chemicals (2) or organics (3), biological contaminants or pathogens (4) and radiological contaminants (5).

1 Solid Contaminants

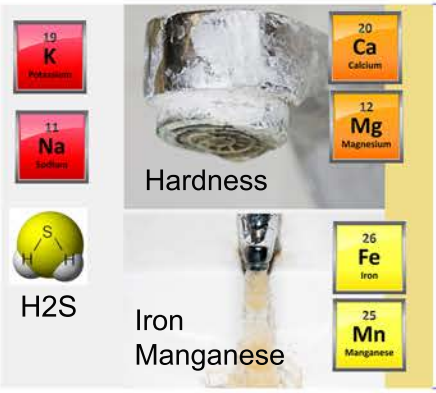
These occur only in water from surface sources or wells. City water typically does not contain solids.

Solid, insoluble substances or sediments are small impurities like sand, rust, dirt, silt or scale.

They are generally not harmful for human health but can be considered an aesthetic contaminant and are physically filtered out.

See page 8 -> 1. Solid Material, Sediments

2.1 Generally Harmless Dissolved Chemical Contaminants

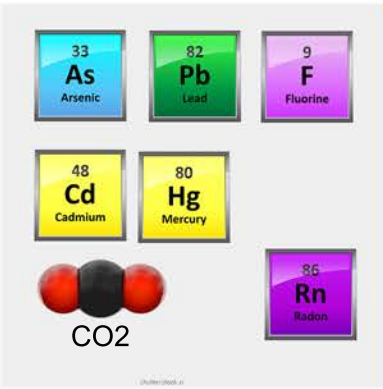


Soluble chemical substances can be present in all water for drinking (city water, well water, surface water) in various concentrations. They come in form of molecules and formulas and can not be filtered out with physical filtration methods.

There are **harmless chemicals and minerals** (calcium, magnesium, potassium, sodium), **harmless heavy metals** (iron, manganese), and **harmless gase**s (hydrogen sulfide), they show up as scale or precipitation, colourization or they impart odour.

These can be removed for aesthetic reasons. See page 9 -> 2.1

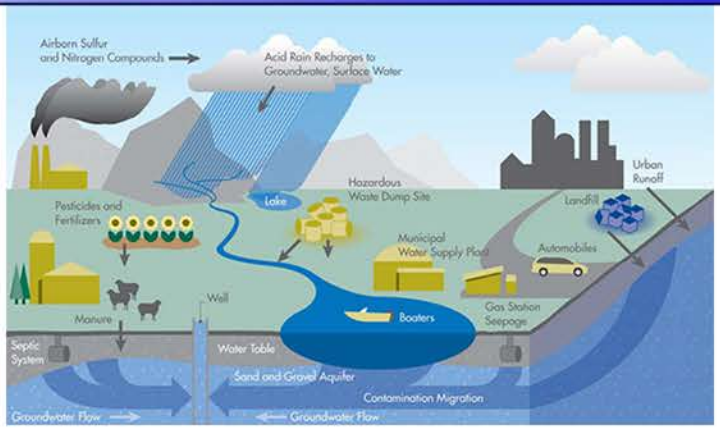
2.2 Harmful Dissolved Chemical Contaminants



There are **harmful chemicals and heavy metals** (arsenic, lead, copper, cadmium, antimony, mercury, fluoride) and **harmful gases** (carbon dioxide, radon). “Forever chemicals” Perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) are part of a large group of man-made chemicals known as perfluoroalkyl and polyfluoroalkyl substances (PFAS).

These chemicals need to be removed for safety resons if the concentration is above the MCL (Maximum Concentration Level) set by the EPA. See page 9 -> 2.2

3. Organic Contaminants



Organic Contaminants are substances containing carbon and hydrogen. They are dissolved and appear as chemical compounds. Some are naturally occurring, others are man-made, and there can be a combination of both.

Organic chemicals reach the water supply from industrial and agricultural runoff, from improper disposal of household products (paint and cleaning products), or domestic animals.

They include pesticides, herbicides, solvents, petroleum-derived products, and many other types of compounds.

There are two main categories of organic contaminants: Total Organic Carbon (TOCs) and Volatile Organic Compounds (VOCs).

TOCs are all-organic carbon compounds including decaying plant and animal matter. High TOC levels may be found in some surface water supplies (streams, rivers, lakes, reservoirs)

VOCs are contaminants like solvents, hydrocarbons, alcohols and other industrial compounds (eg. Benzene, Trichlorethylene, Vinyl chloride, Styrene, Tetrachlorethylene.)

3.1 Not Harmful Organics

Tannins

Decaying plant matter shows up in the water as tannins and lignins, they are seasonal and climate dependent.

These are generally not a health hazard, even in higher concentrations, but are an aesthetical problem, they have staining quality and can have an effect on the taste and smell of the water.

Tannins are easily removed from drinking water
See page 9 -> 3.1, for elevated levels see page 12

3.2. Harmful Organics

There can be harmful chemical compounds or byproducts of chemical reactions and traces of industrial processes in the water supply (solvents, cleaning agents, paint removers, chemical extractors, adhesive components), resulting in toxic pollution.

Trace amounts of pharmaceuticals may be present in some cases, they accumulate in the water over time.

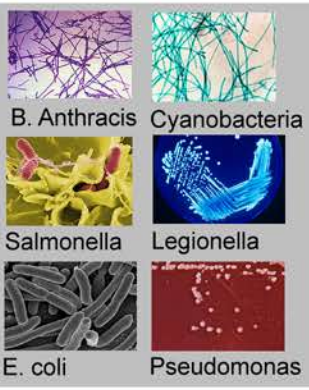
Pesticides, herbicides and insecticides are organics from runoff that can contaminate the water supply.
See page 9 -> 3.2, for elevated levels see page 12

4 Pathogens / Biological Contaminants

Biological contaminants are any organisms that are in the water, they can be bacteria, parasites, protists, viruses or fungi. Bacteria and viruses are everywhere in our environment, including in surface waters and groundwater. They are microbial, so they will not be caught in a filter.

Typically they are harmful, especially in high concentrations, so they need to be removed from drinking water to make it safe.

4.1 Bacteria

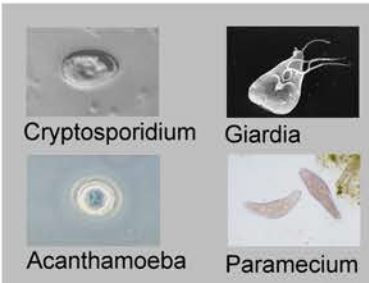


Bacteria that can be present in drinking water are *Bacillus anthracis, Campylobacter jejuni, Cyanobacteria, Escherichia coli, Legionella, Listeria, Pseudomonas aeruginosa, Salmonella enteritidis, Shigella dysenteriae, Vibrio cholerae* and many more.

It is not practical to test drinking water for every type of pathogen, but it is simple to test drinking water for coliform bacteria. The presence of coliform bacteria can indicate there may be harmful pathogens in the water.

Removal of bacteria see page 10 -> 4.

4.2 Pathogenic Protists and Parasites

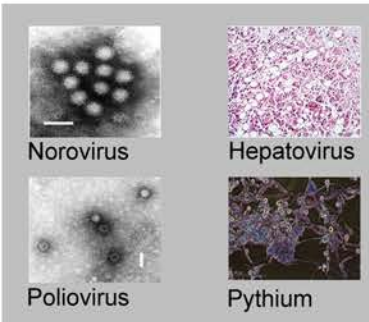


Some severe diseases of humans are caused by **protists** and **parasites** in drinking water (protists are primarily blood parasites): Malaria, Trypanosomiasis, Leishmaniasis, Toxoplasmosis, Amoebic dysentery.

Cryptosporidium parvum, *Giardia lamblia, Acanthamoeba* spp. (cysts), *Chlorella vulgaris*, *Naegleria fowleri* (cysts), *Paramecium* spp, *Toxoplasma gondii* are pathogenic protists.

Removal of protists and parasites see page 10 -> 4.

4.3 Viruses and Fungi

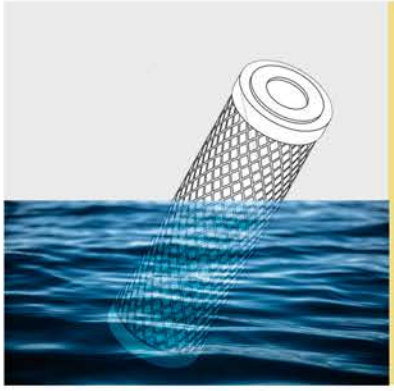


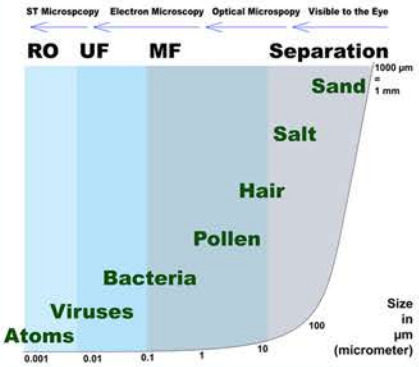
Microbiologically contaminated drinking water can transmit viral diseases such as diarrhoea, cholera, hepatitis, typhoid and polio. Pathogenic **viruses** in water can be Coxsackie, Enterovirus, Norovirus, Rotavirus, Adenovirus, Hepatovirus, Hepevirus. Pathogenic fungi are *Candida albicans, Candida parapsilosis, Aspergillus, Fusarium, Exophiala dermatitidis*, microsporidia. Biofilms are an important habitat for fungi in drinking water. Their development is influenced by many factors including temperature, nutrient concentration, pipe material and water flow rate.
Removal of viruses see page 10 -> 4.

Removal of Solid Contaminants

Making drinking water safe involves physically removing solid contaminants such as rust and dirt with the proper sediment filtration, removing inorganic and organic dissolved substances with separation processes (ion exchange and adsorption), and killing biological microbial pathogens with high intensity UV light, much like the sun.

1. Solid Material, Sediments





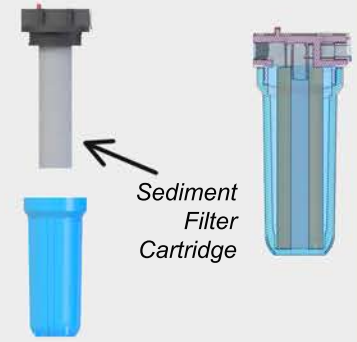
Filtration is used to remove solids and particulate matter from water. Sediments down to 5 microns are removed by MF (Micro Filtration). Anything smaller is not solid and is removed by separation.
See page 9 -> 2. 3.

UF (Ultra Filtration) or RO (Nano Filtration) are not an option for particulate matter removal.

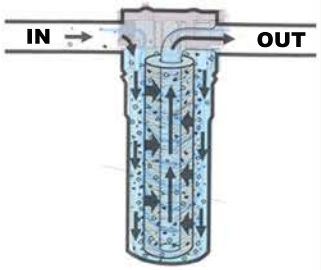
Types of Sediment Filtration Methods

Filtration systems typically comprise of 2 filters, one for solids and one for dissolved contaminants. The first filter housing contains a sediment filter that removes solid substances by direct interception down to 5 microns, where the particles run into a physical barrier and are captured in the filter. This mechanical retention is called sieving.

Principles of Sediment / Particulate Matter Filtration



The sediment filter cartridge removes any solids by direct interception, where the particles run into a physical barrier and are captured in the filter.
The 5 micron sediment filters are the perfect size to remove most debris and solids from the water without clogging up quickly. It is also the required size for the UV process, so that particles in the water can not be used by organisms to shade against the killing rays of the UV lamp. See page 10 -> 4.



Removal of Dissolved Chemicals and Organics

Dissolved substances can not be phsically removed by retention filters, instead ion exchange and a chemical reaction based on adsorptive retention is used. It is when molecules attach to the filter surface and change their molecular structure by losing ions to the media.

2.1 Harmless Dissolved Chemicals, Minerals and Heavy Metals

Coconut Shells are Carbonized and activated to produce resin media

Hardness is not a contaminant but an aesthetic problem.
For removal see page 12.

Iron and Manganese can be aesthetic problems and are removed by the activated carbon in the second filter of a typical filter set to some degree. Carbon filters can also remove **Hydrogen Sulfate** (H_2S - rotten eggs) and other odours.

Elevated levels removal see page 12

2.2 Harmful Dissolved Chemicals, Minerals and Heavy Metals

Carbon Media is pressed into a Carbon Block

Arsenic and **Lead**, **Fluoride** and Contaminants of emerging concern", when occurring in the drinking water, need to be reduced or removed as much as possible.

Average levels of these contaminants can be reduced by the carbon filtration in the water treatment system.

For elevated levels see page 12

3.1 and 3.2 Harmless and Harmful Dissolved Organics

Carbon Block Filter Cartridge

3.1. Not harmful organic contaminants - **Tannins** and **Lignins**
The cation-ion exchange treatment method used in softening systems is effective at removing tannins to a certain degree.

If no softener is installed, the activated carbon in the carbon block filter cartridge can reduce these to some degree.
Elevated levels can be removed with extra treatment, see page 12

3.2 Toxic organic substances (humic acid particles and coagulants, VOCs, disinfection byproducts), are removed by the sediment and carbon filtration to a high degree, elevated levels see page 12

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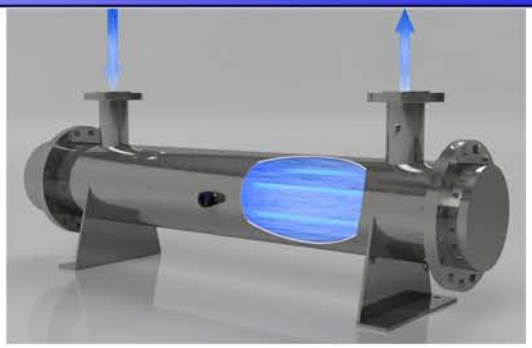


Removal of Pathogens

The two most common methods for the removal and destruction of disease-causing pathogens in drinking water are

1. Chemical based solutions (adding chlorine and chloramine to the water) and
2. UV disinfection, employing ultra-violet light

4. Removal of Pathogens and Biological Contaminants in the Water

While chemical-based solutions have been employed for a very long time, UV disinfection (without using any chemical) has quickly become the favoured method of water disinfection due to its inherent safety, ease of use and the extremely low cost per liter of treated water.

Other methods for at least partial reduction and removal of pathogens include UF and RO systems however they can be expensive and quite wasteful of water due to their design and function.

How Does UV Disinfection Work?

A UV disinfection system, also called sterilizer or purifier, is designed to expose the water running through the unit to a specific wavelength of UV light at 254 nanometers. To achieve this, a translucent UV emitting light source (UV lamp) is placed inside a stainless steel reaction chamber. The UV light is penetrating the water thoroughly while it flows by and the wavelength of the UV rays are effectively disrupting the DNA or RNA of pathogens, such as bacteria, viruses, and protozoa, rendering them unable to reproduce or cause infections.

Conclusion

The vast majority of households will benefit greatly using a basic, low-cost, whole home water treatment system made up of a dual filtration system (sediment and carbon block filters) and a properly sized UV disinfection system. This will serve to process all the water in the home, all the time to ensure a high quality of drinking and wash-up water is always available, in unlimited quantities.

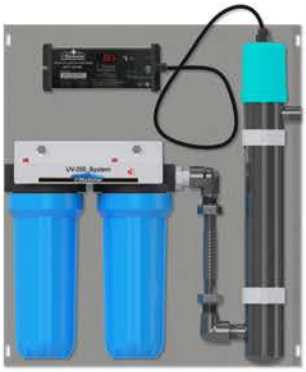
Households with specific issues whether related to water hardness, clarity, chemical or radiological contaminants, may contact us for additional information and guidance.

Wyckomar Whole Home Water Treatment Systems

The ideal basic whole-home water treatment system for everyone. Available in various sizes and flow rates.

These whole house water treatment systems are perfect for all applications (groundwater, surface water, municipal water) in the different sizes. They will take care of all common contaminants and pathogens and provide clean clear water to every tap in the home.

SYS250-POU



The **POU-250** System is perfectly suited for smaller homes and will easily serve a family of 3 with filtered and UV disinfected water through the entire home.
Stage 1 Ten inch filter removes sediments and helps clarify the water.
Stage 2 filtration is a carbon block filter to remove foul taste and odour plus other contaminants.
Stage 3 is UV disinfection to kill disease-causing pathogens including virus and bacteria.

SYS700-POU

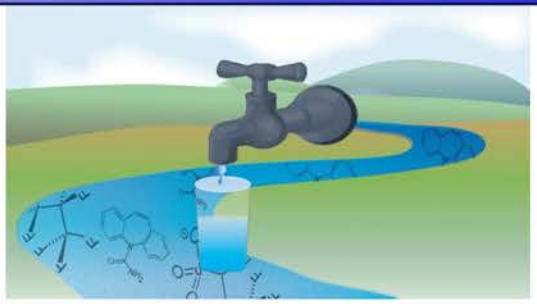
This is our most popular and best-selling whole-home UV system of all time. The **POU-700** is suited for an average sized home of up to 6 people with an average water use pattern.
Stage 1: Twenty inch filter removes sediments and helps clarify the water.
Stage 2: Filtration is a carbon block filter to remove foul taste and odour plus other contaminants.
Stage 3: UV disinfection to kill disease-causing pathogens including virus and bacteria.

SYS1400-POU

The **POU-1400** is a whole-home water treatment system well suited for larger homes and those needing a more robust flow rate and larger water volume on a daily basis.
Stage 1: Twenty inch high-capacity filter removes sediments and helps clarify the water.
Stage 2: Filtration is a carbon block filter to remove foul taste and odour plus other contaminants.
Stage 3: UV disinfection to kill disease-causing pathogens including virus and bacteria.

Removal of Other Contaminants

Additional treatment equipment you may wish to consider. Here we show iitems that can be added to the basic Wyckomar system.



Ref: United States Environmental Protection Agency[11]

Hardness, Tannins

Softener and alternatives

Salty softeners
Saltless softeners

Tannins Filter

Fluoride, Arsenic, Lead

Arsenic and fluoride and lead can be addressed with custom filtration systems that need to be configured and sized properly for your home.

CoEC, PFOS, PFAS

Radionuclides, “Contaminants of emerging concern” and “Forever chemicals”, pharmaceuticals, microplastics, illicit drugs, PAHs and Bisphenol A (BPA) are not regulated but of concern.

The most notorious of these forever chemicals are known by the acronyms PFOS and PFAS and until recently these were difficult if not impossible to remove from drinking water. Specialized and patented filtration technology is becoming available that can remove more than 95% of these modern-era chemicals from your water supply both at the faucet and for whole-home systems as well.

How To Order Whole Home Water Treatment

Once the system has been chosen, here is how to get it to your door:

Find us online at shop.wyckomaruv.com. There you can order direct with a trusted checkout.

Call 1-519-822-1886 or email Wyckomar at sales@wyckomaruv.com to get expert advice and help placing your order.

Your water treatment whole home system will be shipped right to your door ready to get installed.

References

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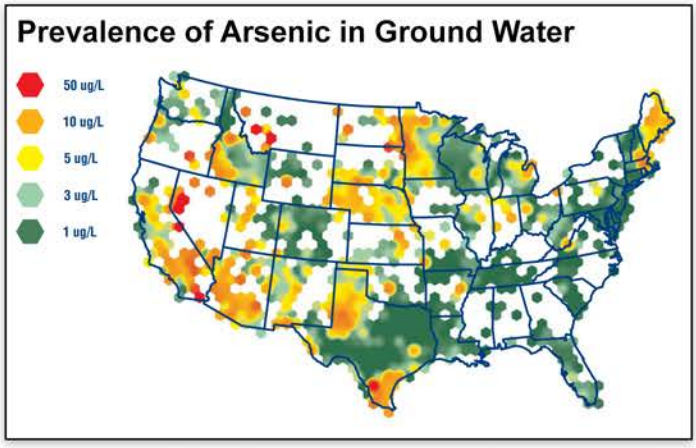

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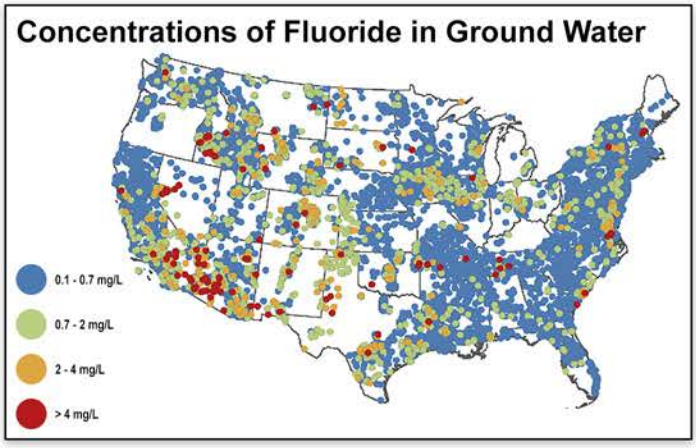

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