Your WaterCare Encyclopedia - A Glossary of Terms

(with abbreviations and MCL = maximum contaminant level)

Absolute filter rating:
Filter rating meaning that 99.9% (essentially all) of the particles larger than a specified micron rating will be trapped on or within the filter.

Adsorb:
The process by which a liquid penetrates the solid structure of the absorbent's fibers or particles, which then swell in size to accommodate the liquid.

Adsorption:
The process of taking up a substance into the physical structure of a liquid or solid by physical or chemical action, but without chemical reaction.

Acidity:
The quantitative capacity of a water or solution to neutralize an alkali. Acidity is the opposite of alkalinity. Waters with a pH of lower than 7.0 are considered to be acidic.

Acid Rain:
Rainfall below the natural pH range, caused by contact with atmospheric pollutants such as nitric and sulfuric oxides and carbon monoxide.

Activated carbon:
A water treatment medium found in block, granulated, or powdered form, which is produced by heating carbonaceous substances (bituminous coal, wood, coconut shell) in the absence of air, creating a highly porous material.

Aeration:
The process of adding air to a water supply for the purpose of oxidizing or mixing.

Algae:
Single-celled or simple multi-celled organisms, commonly found in surface water, which produce their own food through photosynthesis. Excessive algae growth may cause the water to have undesirable odors or tastes, and decay of algae can deplete the oxygen in the water.

Alkalinity:
The quantitative capacity of water to neutralize acid; that is, the measure of how much acid can be added to a liquid without causing a significant change in pH. There are three kinds of alkalinity: Carbonate, bicarbonate, and hydroxide alkalinity. Total alkalinity is the sum of all three kinds of alkalinity.

Alum:
The common name for aluminum sulfate, which is often used as a coagulant in water treatment.

Aluminum: Al+3, secondary MCL: 0.05-0.2 ppm)
Aluminum silicate is the most abundant mineral in the Earth's crust, and it is almost always a major component of turbidity, dust, mud and silt. In addition, soluble aluminum salts are commonly used in municipal water treatment plant, where they form a solid "floc" That entraps turbidity and makes it easier to filter out.

The Secondary MCL for aluminum is not based on its toxicity (which is very low), but rather as an indicator of filter failure. The well-known connection between aluminum plaques in the brain and Alzheimer's disease is now understood to be an effect, not a cause. A concentration of 1.6 ppm is considered extremely high and seldom encountered in drinking water; normal Levels are generally lower that 0.2 ppm. At normal water pH levels, aluminum is particulate in nature and is removed by fine filtration.

Anion:
An ion with a negative charge.

Anion exchange:
An ion exchange process in which anions in solution are exchanged for other anions from an ion exchanger. (Softeners are one type of ion exchanger)

Antimicrobial:
An additive, material, fluid or chemical that inhibits and kills the growth of micro - organisms on contact.

Aquifer:
Natural, underground porous formation where mineral- bearing water flows or is stored. Source of well water.

Arsenic: (As, MCL: 0.05 ppm; under review)
Arsenic is a poison, and its important in water has increased greatly in recent years because new estimates of its toxicity suggest that the MCL should be reduced from 50 ppb (0.05 ppm) to the 1-5 ppb (0.001-0.005 ppm) range. Contamination at that low level in water is unfortunately not rare. It can be removed by ion exchange or filtering through activated alumina, but Reverse Osmosis is the usual remedy.

Asbestos:
A fibrous silicate material, chiefly calcium magnesium silicate; a noncombustible, nonconducting, and chemical - resistant material; a known lung carcinogen.

ASME:
Used in relation to filter vessels. ASME = American Society of Mechanical Engineers, Boiler and Pressure Vessels. Sections VIII and X apply to pressure vessels.

Bacteriostatic:
Having the ability to inhibit the growth of bacteria without destroying the bacteria. For example: Silver-impregnated activated carbon will reduce bacteria colonization in a filter but not eliminate it.

Backwash:
Reversal of a solution's flow through a filtration system. Often used as a cleansing mechanism in sand and dual-media filters.

Bacteria:
Any of a class of microscopic single – celled organisms reproducing by fission or by spores. Characterized by round, rod – like spiral or filamentous bodies, often aggregated into colonies or mobile by means of flagella. Widely dispersed in soil, water, organic matter, and the bodies of plants and animals. Either autotrophic (self-sustaining, self-generative), saprophytic (derives nutrition from non-living organic material already present in the environment), or parasitic (deriving nutrition from another living organism). Often symbiotic in man, but sometimes pathogenic.

Bacteriostatic:
Substance that inhibits bacterial growth and metabolism but does not necessarily kill the cell.

Bar:
Designation of pressure units. 1 bar = psi ÷14.5.

Barium: (Ba+2, MCL: 2 ppm)
Ba++ ion is very common in natural waters, but it hardly ever exceeds 1.0 ppm and is not a problem. Chemically it is similar to calcium and is removed by softeners.

Blind spots:
Any place on a filter septum where liquid cannot flow through due to blinding or plugging.

Blinding:
In depth and surface filtration, a buildup of particulates on or within the filter, preventing fluid flow through the filter at normal pressures.

Blow down:
The withdrawal of water containing a high concentration of solids from an evaporating water system (such as a boiler system) in order to maintain the solids-to-water concentration ratio within specified limits. Steamers "blow down" to eliminate mineral buildup and help prevent scale buildup on surfaces.

Cadmium: (Cd+2, MCL: 0.005 ppm)
Cadmium is very rare in natural water, generally occurring only as a corrosion by-product of galvanized pipes, because cadmium is a common contaminant of impure zinc. Average levels seldom exceed 0.0004 ppm in drinking water, and levels of 0.005 ppm are seldom encountered.

Calcium (Ca): (Ca+2, no MCL)
One of the principal elements making up the earth's crust. Calcium compounds, when dissolved, make water hard. The presence of calcium in water is a factor contributing to the formation of scale and insoluble soap curds, which are a means of clearly identifying hard water. Ca++ ion is the major "hardness" ion (see Total Hardness).

Calcium carbonate ($CaCO_3$):
A chemical compound found in nature as calcite (in limestone, marble, and chalk) and aragonite (in pearls) and in plant ashes, bones, and many shells.

Cation:
An ion carrying one or more positive charges.

Caustic soda:
Sodium hydroxide (NaOH), commonly known as lye. A commonly-used chemical in water treatment.

Cellulose:
A fibrous material of vegetable origin used as a filter medium.

Charcoal:
An adsorbent carbon product, which has about one-third the surface area of activated carbon.

Chemical feeder:
A pump used to meter chemicals such as acid, chlorine or polyphosphate into a feed water supply.

Chloride: (C1-, Secondary MCL: 250 ppm)
C1- ion, like Na+, is almost universally present in tap water, but generally at low levels, and it is seldom of any consequence. When both Na+ and C1- are elevated, suspect seawater intrusion. Levels range from 1-250 mg/L in drinking water. A noticeable taste occurs at 250 mg/L. Reverse Osmosis is the only reasonable remedy.

Chlorine: (C12 no MCL)
A gas widely used in the disinfection of water and as an oxidizing agent for organic matter, manganese, iron, and hydrogen sulfide. Chlorine is known to react with organic matter in the water to form Trihalomethanes (THM's) as suspected carcinogen. Disinfectant chlorine may be in the form of Free Chlorine (fast acting) and Combined Chlorine (slow acting).

Monochloramine is a tamed, slowed down derivative of free chlorine. Treatment levels in tap water range from zero or trace to 3 ppm, usually around 0.5 ppm if it is "Free Available Chlorine" (FAC) or around 1 ppm if it is Monochloramine, which is called "combined chlorine". Analysis is best on site; chlorine residuals disappear in transit to a laboratory. Filtration through activated carbon is the preferred remedy to chlorine under normal intermittent flow conditions.

Chloramines:
Chemical complexes formed from the reaction between ammonia and chlorine being used to disinfect many municipal water supplies. Unlike chlorine, chloramines do not combine with organics in the water to form potentially dangerous Trihalomethanes (THM's). Water containing chloramines may not be used for fish tanks or for kidney dialysis application. The proportions of the chloramines depend on the physical and chemical properties of the water.

Chlorination:
The treatment process in which chlorine gas or a chlorine solution is added to water for disinfection and control of microorganisms. Chlorination is also used in the oxidation of dissolved iron, manganese, and hydrogen sulfide impurities.

Chromium: (Cr+3, CrO4-2, MCL: 0.1 ppm)
Naturally occurring Cr+++ in water is very unusual and not a problem. However, industrial pollution from metal plating operations used to be common. Drinking water levels on average contain 0.008 ppm or less: levels above 0.03 ppm are considered extremely high.

Coagulant:
Chemical added in water and wastewater applications to cause the formation of flocs that adsorb, entrap, or otherwise bring together suspended matter defined as colloidal. Compounds of iron and aluminum are generally used to form flocs to allow removal of turbidity, bacteria, color, and other finely divided matter from water and wastewater.

Coliform bacteria:
A particular group of bacterial primarily found in human and animal intestines and wastes. These bacteria are widely used as indicator organisms to show the presence of such wastes in water and the possible presence of pathogenic (disease producing) bacteria.

Colour: (Secondary MCL: 15 CU)
Colour in water means the yellow to brown colour of the tannins, lignins, and humic acids that leach out of decaying wood and other vegetation. These substances are not toxic, but they are the most common source of THMs and other disinfection by-products when chlorinated. A value of 5 units is barely detectable; 300 are like weak tea.

Condensate:
Water obtained through evaporation and subsequent condensation. Normally the water resulting from condensing plant steam originally generated in a boiler. Water condensed in a water still operation is usually called distillate.

Conductivity:
The property of a substance's (in this case, water) ability to transmit electricity. The inverse of resistivity. Measured by a conductivity meter, and described in micro Siemens/cm.

Contact time:
The length of time an absorbant or adsorbant is in contact with a liquid prior to being removed by the filter or to the occurrence of a chemical change.

Contaminant:
A Source of contamination, an impurity. Any substance in water other than H20.

Copper: (Cu+ or Cu+2, "Action Level": 1.3 ppm)
Copper occurs as Cu+ and Cu++ ions corroded from copper pipe and fittings of brass (a copper-zinc alloy), and also as organic complexes used to inhibit algae in reservoirs. It is now regulated by controlling the pH, alkalinity and Langelier index so that the water does not corrode plumbing materials to produce copper or lead. Copper drinking water levels hardly ever reach 1.0 ppm and on average are below 0.05 ppm.

Cryptosporidium:
A waterborne protozoan that forms cysts and causes acute gastrointestinal illness in humans. Cryptosporidium is commonly found in unfiltered surface water and is resistant to disinfectants such as chlorine and ultraviolet light. It can be removed by filtration that captures all particles of one micron and greater in size. (See cysts)

Cyst:
A capsule or protective sac produced about themselves by many protozoans (as well as some bacteria and algae) as preparation for entering a resting or a specialized reproductive stage. Similar to spores, cysts tend to be more resistant to destruction by disinfection. Fortunately, protozoan cysts are typically 2 to 50 microns in diameter and can be removed from water by fine filtration.

Deionization:
Process utilizing specially - manufactured ion exchange resins which remove ionized salts from water. Can theoretically remove 100% of salts. Deionization typically does not remove organics, virus or bacteria, except through "accidental" trapping in the resin and specially- made strong base anion resins which will remove gram - negative bacteria.

Delta P:
The pressure drop or loss (in psi) by flowing water in a pressurized system as the result of the velocity and turbulence of the flowing water, restrictions the water flows through, and roughness of surfaces the water flows past. The symbol for delta P is ΔP

Demineralization:
The process of removing minerals from water, usually through deionization, reverse osmosis or distillation.

Dew point:
The temperature to which air must be cooled to cause condensation of the water vapor it contains.

Differential:
The difference in pressure between the upstream and downstream sides of a filter. It can also be the difference in pressure between two points in a system or of a component in such system.

Dirt Capacity:
The weight of a specified artificial contaminant which must be added to the influent to produce a given differential pressure across a filter at specified conditions. Used as an indication of the relative service life.

Disinfectant:
A fluid or gas used to disinfect filters, demineralized water systems, pipe, pipelines, systems, vessels, etc.

Disinfection:
The treatment of water to inactivate, destroy, and/or remove pathogenic (disease producing) bacteria, viruses, cysts, and other microorganisms for the purpose of making water microbiologically safe for human consumption. Disinfection may also be called sterilization.

Dissolved solids:
The residual material remaining from a filtered source after evaporating the solution to a dry state.

Distillation:
The process of condensing steam from boiling water on a cool surface. Most contaminants do not vaporize and therefore do not pass to the distillate. Removes nearly 100% of all impurities.

Distilled water:
Water which has been cleansed by passing through one or more evaporation-condensation cycles until it contains a very low amount of dissolved solids (usually less than 5.0 ppm TDS).

Efficiency:
The ability, expressed as a percent, of a filter to remove a specified artificial contaminant at a given contaminant concentration under specified test conditions.

Effluent:
The outflow from any water processing system or device.

Exhaustion:
In water softening or ion exchange, the point where the resin can no longer exchange additional ions of the type the process was designed for.

Feed/Feed water:
The input solution to a treatment/purification system, including the raw water supply prior to any treatment.

Ferric iron:
Small solid iron particles containing trivalent iron, usually as gelatinous ferric oxide which is suspended in water and visible as “rusty water.” Ferric iron can normally be removed by filtration. Also called precipitated iron.

Ferrous iron:
A divalent iron ion, usually as ferrous bicarbonate, which when dissolved in water produces a clear solution. It is usually removed by cation exchange water softening or oxidation.

Filter:
A device installed as part of the water system through which water flows for the purpose of removing turbidity, taste, color, iron, or odor. Filters can be loose media beds in tanks or cartridge type devices and filter media may be used for mechanical, adsorptive, neutralizing, or catalyst/oxidation filtration processes.

Filterability:
This is a standard test for the plugging tendency of a water sample. It measures the time it takes to filter 250 mL through a standard 47 mm diameter, 0.45 um membrane filter disc with constant vacuum of 8 psi. Less than 3 minutes is good; 5-10 minutes indicates a need for pre-filtration, 10-15 minutes indicates a high likelihood of plugging fine-filters, and 15 minutes or more predicts severe “short life” problems for fine-filters.

Filtrate:
Any liquid that has passed through the filter medium. Sometimes erroneously called effluent. Also known as the clarified effluent from a filter.

Filtration:
The process of separating solids from a liquid by means of a porous substance such as a permeable fabric or membrane or layers of inert media.

Filtration rate:
The volume of liquid that passes through a given area in a specified time. Usually expressed as gallons per square foot per minute (or hour).

Floc:
Coagulated groupings of formerly suspended particles which then settle by gravity.

Flocculants:
Chemical (s) which, when added to water, cause suspended particles to coagulate into larger groupings (flocs) which then settle by gravity.

Flocculation:
The process of agglomerating particles into larger groupings called flocs, which then settle by gravity.

Fluoride: (F-, MCL: 14 ppm)
The F- ion is hardly ever found in natural water, but is intentionally added by most waterworks to inhibit tooth decay. Allowed concentrations are 1-4 mg/L-1 ppm where the climate is hot and a lot of water is consumed, and 4 ppm where it is cooler and people do not drink so much water. Unwanted fluoride can be removed by reverse osmosis or filtration through activated alumina.

FTU:
Formazine Turbidity Units – a measure of turbidity, by a nephelometer.

Giardia / Giardia Lamblia:
A type of cyst found in the intestines of mammals and in water contaminated by mammal droppings. The Giardia Lamblia cyst, which is common and frequently carried in water, is capable of causing a contagious waterborne disease characterized by acute diarrhea. This disease is sometimes called beaver fever.

gpg:
Grains per gallon

gpm:
Gallons per minute

Grain:
A unit of weight equal to 0.0648 grams or 0.000143 pounds or 1/7000th of a pound.

Grains per gallon:
A common method of reporting water analysis in the United States and Canada. One grain per gallon equals 17.1 parts per million (ppm) or 17.1 milligrams per liter.

Groundwater:
Water confined in permeable sand layers or cavities between rock and clay. All subsurface water.

Hardness:
A common quality of water that contains dissolved compounds of calcium and magnesium and, sometimes, other divalent and trivalent metallic elements. Hardness prevents soap from lathering by causing the development of an insoluble curdy precipitate in the water; hardness typically causes the buildup of hardness scale (such as seen in cooking pots and pans), Dissolved calcium and magnesium salts are primarily responsible for most scaling in pipes, boilers, and water heaters, and cause numerous problems in the laundry, kitchen, and bath. Hardness us usually expressed in grains per gallon or (or ppm) as calcium carbonate equivalent.

The degree of hardness standard as established by the American Agricultural Society of Engineers (S-369) and the Water Quality Association (WQA) is:

Term		Grains/gallon	Mg/Liter (ppm)
Soft	=	Less than 1.0	Less than 17.1
Slightly Hard	=	1.0 to 3.5	17.1 to 60
Moderately Hard	=	3.5 to 7.0	60 to 120
Hard	=	7.0 to 10	120 to 180
Very Hard	=	10.5 and above	180 and above

Heavy metals:
Metals having a high density or specific gravity of approximately 5.0 or higher. The elemental weight is also high. A generic term used to describe contaminants such as cadmium, lead, and mercury. In low concentrations most are toxic to humans.

High purity water:
Highly treated water with attention to microbiological reduction or elimination; the term commonly used in the pharmaceutical industry.

Hydraulic:
Referring to water or other fluids in motion.

Hydrogen sulfide: (H2S)
A corrosive and flammable gas often found dissolved in well water and often accompanied by iron and low pH values. Hydrogen sulfide develops from decaying organic matter, from sulfate-reducing bacteria and from petroleum refining. A very disagreeable “rotten egg” odor is characteristic of the presence of hydrogen sulfide. May be oxidized and filtered.

Influent:
The stream of water to be treated as it flows into any kind of water treatment unit or device, such as hard water into a softener or turbid water into a filter.

Ion:
An atom or radical (group of atoms) which carries an electrical charge as the result of having lost or gained electrons. Positively charged ions are called cations; negatively charged ions are called anions.

Ion exchange:
A permanent insoluble material (usually a synthetic resin) which contains ions that will exchange reversibly with other ions in a surrounding solution. Both cation and anion exchangers are used in water conditioning.

Iron: (Fe+2, Fe+3, secondary MCL: 0.2 ppm)
Iron in water is harmless, but it causes a metallic taste and contributes to colour, turbidity, and scaling. When it is in reduced form, called "ferrous" iron (Fe++), it is fully soluble and produces its characteristic taste and rust stains at concentrations as low as 0.2 ppm. When it is oxidized to Fe++ (ferric iron") by chlorine or other disinfectants, or even by ordinary dissolved oxygen, it immediately precipitates as a rust-coloured particle also known as "iron floc". This is a gooey material, which is readily incorporated into scale and can clog filters quickly when present at levels above 0.2 ppm. When iron is present at the same time as sulfide (see sulfide), black iron sulfide is formed. When present along with tannins and lignins (see "Colour"), they combine to form an organic complex known as "heme iron", which is difficult to remove. Most drinking water supplies contain iron levels below 0.2 ppm levels up to 1.0 ppm are considered high, levels from 1.0 ppm to 5.0 ppm which are extremely high are not often found. The most common remedy is simple filtration. Coarse profilers do well and are recommended to extend the life of fine-filters. If the water is not chlorinated, chemical oxidation must precede filtration.

Iron bacteria:
Bacteria which thrive on iron and are able to actually use ferrous iron (as found in water or steel pipes) in their metabolic processes, to incorporate ferric iron in their cell structure, and to deposit gelatinous (slimy) ferric hydroxide iron compounds in their life processes. Iron bacteria can cause plugging, staining, and taste and odor problems in foodservice water applications.

Langelier Index Value:
The LI is a mathematical estimation of the chemical tendency of water to deposit or to dissolve lime scale (calcium carbonate, CaCO3). It is equal to the actual, measured pH of the water minus the calculated pH at which the water would be saturated with calcium carbonate. A negative value indicates an inability to form scale or a tendency to dissolve scale; a positive value predicts a problem with deposition of lime scale. A value of 0 to + 0.5, a slight scaling tendency; 0.5 to 1.0, moderate; 1.0 to 1.5 heavy scale; and 1.5 to 2.0 and above, severe.

Lead: (Pb, MCL: 15 ppb)
Serious lead poisoning is almost always due to ingestion of paint chips or breathing the dust, but low-level poisoning is more insidious, and that is often traced to drinking water. It occurs as particles of lead oxide or carbonate and as ordinary Pb++ ion, all derived from corrosion of plumbing materials containing lead. These include lead pipes, lead service connections, lead-based solder for joining copper pipe, and various fittings and faucets made of brass containing lead. Levels in potable water are limited by treatment to no greater that 15 ppb (0.015 ppm). Drinking water levels of lead on average seldom exceed .004 ppm (4 ppb). Lead can be removed or reduced in several ways.
When the pH is moderate or high and the water has at least 50 ppm of alkalinity, virtually all lead will be in particle form that will be removed by any fine-filter. Activated carbon has modest capacity for adsorbing lead; so most large carbon filters with significant organic chemical reduction capability can be relied on to remove lead as well. Lead also absorbs onto activated alumina, "bone char," and other specialty absorbents, which are used in filters.

Lime scale:
Hard water scale formed in pipes and vessels (generally more severe on the hot water side) containing a high percentage of calcium carbonate (CaCO3) or magnesium carbonate (MgCO3). Becomes particularly troublesome in cooking steamers, coffee equipment, and ice making equipment in foodservice applications as scale forms on heating elements, boiler casings, and evaporators.

Magnesium: (Mg+2, no MCL)
Mg++ ion is one of the major "hardness" ions (see Total Hardness), dissolved from dolomite mineral in soil and limestone, usually found at a level one-third to one-half that of the calcium ion in water.

Manganese: (Mn+2, secondary MCL: 0.05 ppm by itself, 0.3 ppm Fe + Mn)
When Mn++ ion occurs in water, it is usually associated with iron, causing the stains, etc. to be black instead of rust-red. At one time, manganese had its own Secondary MCL of 0.05 ppm; now, it is just lumped in with iron for a limit of 0.3 ppm Fe + Mn. Levels in drinking water supplies are at or below 0.03 ppm Mn; levels up to 0.5 are considered very high; levels from 0.5 to 2.5 ppm are extremely high; and levels above 2.5 are rare. Remedies are the same as for iron.

MCL:
The Maximum Contaminant Level is the official, legal limit for that parameter, established by the U.S. EPA and adopted by the State health or environmental agencies. "Primary" MCLs are mandatory limits for health reasons, and "secondary" MCLs are recommended limits for aesthetic (taste) reasons.

Media:
The material that performs the actual separation of solids from liquids. Sometimes erroneously used to mean septum.

Media migration:
Release of filtration media particles into the effluent of the filter.

Medium:
The porous material that performs the actual process of filtration. The plural of this word is "media".

Membrane:
(Polymeric). High engineered polymer film containing controlled distribution of pores. Membranes serve as a barrier permitting the passage of materials only up to a certain size, shape, or character. Membranes are used as the separation mechanism in reverse osmosis, electro dialysis, ultra-filtration, Nanofiltration, and micro filtration, as disc filters in labs and as pleated final filter cartridges, particularly in pharmaceutical and electronic applications.

Mesh:
Number of strands in a linear inch of woven filter fabric, usually wire. It is also used as a septum.

Mg/L:
Milligrams per liter is the most common unit of concentration, and it is essentially equivalent to "parts per million" or ppm. That is because water has a density of 1 g/mL when pure. Thus, a liter of water weighs a million mg, 1 mg/L = 1ppm.

Micron:
A metric unit of measurement equal to one millionth of a meter or one thousandth of a millimeter, or about 0.00003937 inches. The symbol for micron is the Greek letter u.

Micron rating:
A measurement applied to filters or filter media to indicate the particle size at which suspended solids above that size will be removed. As used in the water treatment industry, this may be an absolute or a nominal rating.

Microorganism:
A living organism invisible or barely visible to the naked eye and generally observable only through a microscope. Also called a microbe. Microorganisms are generally considered to include algae, bacteria, fungi, protozoa, and viruses.

Mineral water:
Water that is naturally or artificially impregnated with mineral salts or gases (carbon dioxide). The term also designated bottled water that contains no less than 250ppm total dissolved solids (TDS) and originates from a groundwater source.

Mixed bed:
An ion exchange tank consisting of both cation and anion resin mixed together. Provides the most complete deionization of water, up to 18.3 megohm/cm resistivity. Commonly used to polish water already treated by two - bed ion exchange tanks or reverse osmosis.

Module:
A membrane element combined with the membrane element housing.

Molecule:
The smallest physical unit of a compound or chemical, composed of one or more atoms, which retains the properties of that substance.

Nanofiltration:
A cross flow membrane separation process which removes particles in the 250 to 1000 molecular weight range, selected salts and most organics; sometimes referred to as a softening membrane process.

Naturally soft water:
Ground, surface, or rain water sufficiently free of calcium and magnesium salts so that no curd will form when soap is used and no calcium or magnesium-based scale will form when the water is heated or frozen.

Nephelometer:
A device used to measure mainly low turbidity water with results expressed in Nephelometric Turbidity Units (NTU).

Nickel: (Ni+2, MCL: 0.1 ppm)
The metal is used in corrosion-resistant alloys and plantings for some food service equipment. Generally, drinking water contains levels below 0.03 ppm.

Nitrate: (NO3-, MCL: 10 ppm as N, 45 ppm as NO3-)
No3- ion is seldom present at significant levels except in areas with intensive agriculture. It is a major constituent of fertilizers applied to crops and of animal manure from beef, pork, and chicken production. It is important because intestinal bacteria readily convert nitrate into nitrite, NO2-, which is one of the causes of Sudden Infant Death Syndrome or “Blue Babies”. Nitrite binds to infant hemoglobin and interferes with oxygen transmission until the age of about 3-6 months, at which time infant hemoglobin is replaced with adult hemoglobin, which is not sensitive to nitrite. Maximum safe levels are 45 M/L as Nitrate.

Nitrate levels in drinking water normally do not exceed 20 ppm Nitrate (4 ppm as N) or 0.2 ppm Nitrite. Nitrite also

combines with myoglobin in muscle tissue, thus preserving the colour of fresh meat even after cooking, causing a problem of consumer acceptance with light meats like chicken, which are marinated in sauces made from high-nitrite water. Reverse Osmosis is the usual remedy, although very costly ion exchange resins that are more or less specific for nitrate do exist.

Nominal filter rating:
Filter rating indicating the approximate size particle, the majority of which will not pass through the filter. It is generally interpreted as meaning that the filter will retain 85% of the particles of the size equal to the nominal rating, but this is not a guarantee that this will occur.

NSF:
National Sanitation Foundation, a third-party organization that tests foodservice equipment to exacting standards. NSF ratings ensure that a product will; perform as promised, state clearly what the product will and won't do, and offer comparisons between various manufacturers' products.

NTU: Nephelometric turbidity unit.

Odour: (Secondary MCL: 3 T.O.N.)
All odours are gases, those dissolved in water are often dissipated during transit, and so they can change or disappear before the sample reaches the laboratory. Except for chlorine and iron, virtually all taste and odour (T&O) in water is microbial in origin. Common earthy-musty-fishy-moldy T&O is produced by algae in reservoirs, filamentous bacteria called actinomycetes, and also molds. Rotten egg odour is hydrogen sulfide produced by anaerobic bacteria deep in wells or in stagnant, dead-end pipes. Sometimes combinations of iron and sulfur bacteria produce strange "septic" smells. Finally, it is possible for marginal disinfection with chlorine or ozone to produce traces of phenol or phenolic compounds, which combine with the remaining traces of chlorine to produce chlorophenols, which are extremely potent producers of "medicinal" T&O.

Odour is measured by trained people and reported as a "Threshold Odour number" (T.O.N.), which is the dilution factor required to make the odour disappear. A T.O.N. of 3 or less is considered acceptable. The preferred remedy is activated carbon filtration, which is very effective at removing nearly all foul tastes and odours, with the single exception of hydrogen sulfide. Carbon's capacity for hydrogen sulfide is quickly exhausted and chemical oxidation is always worthwhile.

Oxidize:
To increase a molecule in positive valence; to lose electrons to an oxidizing agent.

Oxidizing agent:
A chemical agent that gains electron (i.e. is reduced) and brings about the oxidation of other substances. Examples of oxidizing agents include oxygen, ozone, chlorine, and peroxide.

Ozone:
An unstable, highly reactive state of the oxygen formed by passing air or oxygen through a high voltage electric charge or strong light source. An excellent oxidizing agent and bactericide.

Particulate:
Minute, separate pieces of matter.

Permeable:
Allowing some material to pass through.

Permeate:
That portion of the feed stream which passes through a membrane, leaving behind a more concentrated stream.

pH: (secondary MCL pH 6.5 - 8.5)
The term "pH" is chemist's jargon for the level of acidity in water. The hydrogen ion, H+, is the basis or embodiment of all acids and the pH scale indicates the concentration of H+. Values range from zero (extremely strong acid) to 14 (extremely strong base or alkali), with the neutral point in the middle at pH 7.0. It is a logarithmic scale, so values differing by one unit indicate ten-fold differences. Acidity of pH 5 is ten times more acid then pH 6, and 100 times more acid than pH 7. Carbonated beverages are usually pH 3-4, wines slightly lower, and stomach acid is pH 1. Blood and body fluids are pH 7.4, drinking water is usually pH 7-9, antacids are pH 10 or so, and lye or drain cleaners are pH 12-14.

The pH of drinking water is important because "acidic water" (pH less than 7) is a major cause of corrosion, which may leach toxic levels of lead, copper, zinc, and cadmium from the plumbing. Scaling is prominent when pH values exceed 8.5 in combination with high hardness and alkalinity. Remedies entail adding a chemical of the opposite character, to neutralize or consume the excess acidity or alkalinity. Acid waters are neutralized by the addition of sodium carbonate ("soda ash") or sodium hydroxide ("caustic soda"). Alkaline waters are treated with the addition of an acidulate such as food grade citric acid. Ion exchange can also be used to correct pH.

Phosphate: (PO4-3, no MCL)
PO4-3 ion is not usually found as significant levels in tap water, but phosphate compounds are often intentionally added by the waterworks or by point-of-use treatment. Zinc orthophosphate is used to form a protective coating on the plumbing, to prevent corrosion and limit the leaching of copper and lead. Polyphosphates are polymers units, which are used to inhibit the formation and deposition of lime scale. Useful levels for scale reduction are in the range of about ½-10 ppm; more than 15 ppm may lead to deposition of "phosphate scale" (calcium phosphate) in very hard waters. In other words, too much polyphosphate actually makes the scale problem worse. In some water supplies phosphate is the nutrient most needed for microbial growth (the "limiting nutrient"). Thus, where bacterial re-growth is a problem, avoiding phosphate use may be beneficial to maintaining low plate counts.

Polyphosphate:
A form of phosphate polymer consisting of a series of condensed phosphoric acids containing more than one atom of phosphorous.

Potable (drinking) water:
A water supply which meets U.S. E.P.A and/or state water quality standards and that is considered safe and fit for human consumption.

Potassium: (K+, no MCL)
K+ ion is similar to sodium in being common, non-toxic, and widespread, but it is usually only a very minor constituent. Presence of a substantial level may be a sigma functioning softener using potassium chloride (KC1) in place of sodium chloride (NaC1). Filtration will not alleviate this problem.

POE:
Point-of-Entry.

POU:
Point-of-Use.

Pore:
An opening in a membrane or filter matrix.

Porous:
The ability of certain substances to pass fluids due to an open physical structure.

ppb:
Parts per billion, commonly considered equivalent to micrograms per liter (ug/L).

ppm:
Parts per million, commonly considered equivalent to milligrams per liter (mg/L).

ppt:
Parts per trillion, commonly considered equivalent to nanograms per liter (ng/L).

Precipitate:
An insoluble product that is in the solution or liquid mixture.

Precipitation:
The process of producing an insoluble reaction product from a chemical reaction, usually a crystalline compound that grows in size to be settleable.

Precoat:
The application, usually by slurry, of a very fine granular filter medium such as diatomaceous earth to a retaining membrane or fabric surface prior to a service run. Precoat filtration is used in applications almost exclusively in the cartridge format. Precoat filters have a very high dirt holding capacity. The Precoat cake is more stable than the granular media depth filters. It is unusual to find water pressures high enough to break through a Precoat. Research and actual usage indicate the gallonage is increased by the square of the area increase. For example, tripling the area by using three Precoat filters in parallel does not produce triple the capacity, it produces 3 squared or 9 times the capacity.

Precoat filters are also capable of removing asbestos fibers to an acceptable level. Another area where the Precoat process has found application is in cyst removal. Precoat filtration has been shown to remove Giardia and cryptosporidium over a broad range of operating conditions typical of potable water filtration.

psi:
Pounds per square inch (pressure).

psid:
Pounds per square inch differential.

psig:
Pounds per square inch gauge.

Pure water:
This term has no real meaning unless the word “pure” is defined by some standard. The Water Quality Association recommends against the use of the words “Pure Water” in advertising unless the meaning of “pure” is very clearly explained for the consumer.

Rated capacity:
The manufacturer’s statement regarding the expected number of days the equipment will be in service or the expected number of gallons of product water delivered before service is required or flow rates diminish to an unacceptable level.

Rated service flow:
The manufacturer-specified maximum and minimum flow rates at which a particular piece of water treatment equipment will continuously produce the desired quality of water.

Residual chlorine:
Chlorine allowed to remain in treated water after a specified period of contact time and to provide disinfection protection throughout the distribution system. Residual chlorine is the difference between the total chlorine added and that consumed by the oxidizable matter. Residual chlorine may be evident by taste or odour in municipal water.

Resin:
(ion exchange): Specially manufactured polymer beads used in the ion exchange process to remove dissolved salts from water.

Resistivity:
The property of a substance (in this case, water) to resist the flow of electricity; the measurement of that resistance. The inverse of conductivity. Measured by a resistivity monitor and described in megohm-cm.

Reverse osmosis (RO):
A water treatment process that removes undesirable materials from water by using pressure to force the water molecules through a semi permeable membrane. This is called “reverse osmosis” because the pressure forces the water to flow in the reverse direction than that of natural osmosis. (Natural osmosis is the flow from a diluted to a concentrated solution. Reverse osmosis is the flow from a concentrated to a diluted solution).

Saturation:
The point at which a solution contains enough of a dissolved solid, liquid, or gas so that no more will dissolve into the solution at a given temperature and pressure.

Scaling:
The buildup of precipitated salts on such surfaces as pipes, tanks and boiler condensate tubes.

Screen:
A term commonly used for septum. Also, a wire mesh screen used to screen out large sized particles that would clog a filter cartridge. Usually installed on the suction side of a pump.

SDI:
Silt Density Index – test used to measure the level of suspended solids in feed water for a reverse osmosis system.

Semi permeable:
In membranes, a membrane which allows a solvent such as water to pass through, while rejecting certain dissolved or colloidal substances.

Selenium: (Se, MCL: 0.05 ppm: under review)
Selenium is chemically similar to sulfur and occurs in water as selenate, SeO4-2, and selenite, SeO3-2 ions (analogous to sulfate and sulfite). Selenium is an unusual contaminant in that it is also a required nutrient, and adverse health effects are nearly as often due to selenium deficiency as to selenium poisoning. However, no “minimum MCL” has been proposed for water, because water is not supposed to be treated as a nutritional source, and almost all selenium exposure is via food, not water. Selenium levels in drinking water generally are well below 0.05 ppm, seldom exceeding 0.005 ppm.

Septum:
A binding wall or membrane.

Silica: (SiO2, no MCL)
True silica is insoluble glass or sand, silicon dioxide (SiO2), but the term as used in water treatment includes a host of "silicate" ions including SiO3-2 and SiO4-. All are very common (silica and compounds such as aluminum silicate are the predominant minerals of the Earth's crust), and their chemistry is complex. A very hard, glassy scale often forms on heat-exchange surfaces when SiO2 levels exceed 15-20 mg/L, and it cannot be removed with acid or inhibited with polyphosphates.

There is no good remedy for silica scale. Lower concentrations are sometime intentionally added as corrosion inhibitors to produce a "glass lining" on pipes. In drinking water, it ranges from 0-75 mg/L with an average of 7 ppm. Filtration will not remedy silica.

Silver: (Ag+, secondary MCL: 0.1 ppm)
The Ag+ ion only rarely occurs in natural waters, but it is an intentional additive of many water filters because of its weak bacteriostatic effect. Drinking water levels generally never reach levels of 0.04 ppm, and filters containing silver must not exceed .05 ppm Ag feed based on EPA pesticide limits.

Sodium: (Na+, Secondary MCL: 250 mg/L proposed)
Na+ is almost always present in tap water, but it is seldom a major problem. The "salty" taste may be detectable by some people at levels as low as 50 ppm, and most people find water with more than 350 ppm hardness unpalatable. In drinking water, the range is usually 0-100 ppm. Levels of sodium higher than 100 ppm suggest a malfunctioning softener or sea water intrusion. Reverse Osmosis is the only remedy.

Soft water:
Any water which naturally contains less than 1.0 grain per gallon (17.1 mg/L or ppm) of total hardness expressed as calcium carbonate equivalent.

Softened water:
Any water which has been processed in some manner to reduce the total hardness to 1 grain per gallon (17.1 mg/l or ppm) or less expressed as calcium carbonate equivalent.

Spring water:
Water obtained from an underground formation from which water flows naturally to the surface, or would flow naturally to the surface if it were not collected underground.

Static:
Fixed in position, resting; without motion.

Submicron filter:
A cartridge-type membrane filter used in fine particle separation applications to remove particulates of less than one-micron in size.

Sulfate: (SO4-2, MCL: 250 ppm proposed)
SO4-2, ion is common in water but is usually limited to concentrations less than 50 ppm on average and range from 1 ppm to 800 ppm. No adverse health effects have been found to date for levels lower than 500 ppm, but levels above 1,000 ppm have caused diarrhea. Taste threshold is as low as 200 ppm. The suggested upper limit for potable water is 250 mg/L. Levels in the hundreds of ppm contribute to scaling in hot or cold applications when sufficient calcium or magnesium is present.

Sulfide: (S-2, no MCL)
This S-2 ion is derived from hydrogen sulfide gas, H2S, which is the basis of "rotten egg" smell. H2S is highly toxic to breathe, but poisonings are extremely rare due to its obnoxious nature. Sulfide dissipates from water samples quickly, so it must either be analyzed on site or the sample must be stabilized with other chemicals immediately. However, formal analysis is seldom needed, since the human nose is a superior detector. In addition to the smell, hydrogen sulfide is an acid and therefore corrosive, so it is important to remove it even if people become tolerant of the smell. These are two approaches to remedying a rotten egg smell.

In a municipal system with central treatment the best thing is to complain to the waterworks and demand that they flush out the mains regularly and get fresh, oxygenated water into the dead ends. The bacteria that make hydrogen sulfide are killed by dissolved oxygen, and the sulfide itself is readily oxidation system must be installed. A chlorination or ozonation system is best, because disinfection will be accomplished at the same time. Alternately, special oxidizing media called manganese greensand can oxidize without disinfecting.

Sulfur water:
Water containing objectionable amounts of hydrogen sulfide gas which causes an offensive "rotten egg" odor.

Suspended solids:
Solid organic and inorganic particles that are held in suspension in a solution.

Total Alkalinity: (Sum of Carbonate and Bicarbonate, no MCL)
As a word, "alkalinity" means the opposite of acidity, but in water chemistry it is equal to the sum of the concentrations of carbonate (C03-2) and bicarbonate (HCO3-) ions, which act to stabilize, or "buffer" the pH of the water. Low TDS waters with less than 50 ppm (3 GPG) alkalinity are easily overwhelmed by acid rain and are often very corrosive. However, levels above 250 ppm (15 GPG) readily recombine with "hardness" ions (see Total Hardness) to form lime scale (calcium carbonate, CaCO3) in water-using equipment. Also, more than 150 ppm alkalinity interferes with flavor and carbonation in post mix beverages. Since both hardness and alkalinity come from limestone and then later may become lime scale, the concentrations of both are commonly reported as CaCO3" Drinking water supplies seldom exceed values of 300 ppm (18 GPG).

The removal or reduction of alkalinity is called dealkalization, and it can be accomplished in several ways. One is simply to feed an acid or acidulate into the water to neutralize it. Ion exchange methods are also effective. The most extreme approach is to treat the water with a weak acid cation ("WAC") resin that is regenerated with acid (H+) instead of Na+ from salt (NaC1). In this process, much of the hardness is exchanged for H+, and the H+ then neutralizes one molecule of bicarbonate. Thus, both hardness and alkalinity are reduced, producing double the effect on scale.

Total Dissolved Solids (TDS): (secondary MCL 500 ppm; 1,000 ppm in California)
TDS is an approximation of the amount of minerals dissolved in water. It used to be measured by evaporating a sample to dryness and weighing the residue, but that is a lot of trouble and not very precise. Now it is estimated electronically, by measuring the electrical conductivity. TDS is composed of not only hardness ions, but also such compounds as soluble iron, sulfates, dissolved silica, sodium and others. A TDS less than 50 indicates unusually "pure" water that is likely to be "aggressive" (corrosive); 150-300 ppm is average; 500 ppm is the recommended limit, beyond which there are often problems with taste, scaling, soft ice, even diarrhea. A TDS of 2000 ppm or more produces an osmotic pressure of at least 20 psi, thus requiring a pump to provide adequate water pressure for RO, which is the only reasonable remedy for such water. Remedies are limited to reverse osmosis and ion exchange processes.

Total Hardness: (sum of Calcium + Magnesium, no MCL)
"Hardness" and "softness" of water are expressions of its tendency to make soap scum or soap suds, determined

by the concentrations of calcium and magnesium in the water. Excess hardness is also often responsible for the curdling of cream and an unsightly scum on coffee and tea. (Other metal ions such as iron, zinc, copper, aluminum, etc. also contribute, but they are seldom present at significant levels). The Ca++ and Mg++ ion concentrations are measured separately and reported as mg/L Ca++ or Mg++.

Then the two values are combined and converted mathematically into "grains per gallon as calcium carbonate" (GPG as CaCO3). Conversion factor 17.12 mg/L Ca++ plus Mg++ =1 GPG as CaCO3. Water with 3 GPG hardness or less is considered "soft" and non-scale forming; 3 to 10 GPG is a moderate scale former, not too troublesome; 10 to 15 GPG is hard and is a good scale former, causing lime scale problems where the water is heated or chilled; greater than 15 GPG is very hard water and a very good scale former which inevitably leads to serious maintenance problems. From 0 – 15 gpg, we recommend polyphosphate feed with fine filtration, from 15 -20 gpg, fine filtration blended with softening, over the 20 GPG range, we recommend reverse osmosis.

Total Organic Carbon (TOC):
TOC is supposed to be a measure of most of the organic material that the test for Total Dissolved Solids misses. It includes the tannins, etc. from decaying vegetation that are responsible for "colour" in water, dissolved fragments of microorganisms and their by-products, and many pollutants, if present. "NPOC" means "Non-Purgeable Organic Carbon" and indicates that dissolved inorganic carbon dioxide, carbonic acid, carbonate, and bicarbonate were purged from the sample before analysis. Drinking water seldom exceeds 2.0 ppm, while levels above 2.0 ppm are considered high and levels above 5.0 are extremely high and are not usually observed. Activated carbon filters are efficient at removing TOC, but much of the colour of tannins can be physically removed by micro-filtration. The combination of lots of carbon and fine filtration is excellent for removal of TOC and colour.

Trihalomethanes (THM's):
A group of organic chemicals, suspected of being carcinogenic, which are formed in water when chlorine being used as a disinfectant reacts with natural organic matter such as humic acids from decayed vegetation. Chloroform is one of the most common THM's formed in this type of reaction. THM's can be removed from water by contact time with GAC at a specified flow rate.

TS:
Total Solids – The sum of total dissolved solids and total suspended solids.

TSS:
Total Suspended Solids – The residual matter which can be removed from a solution by filtration.

Turbidity: (MCL 1.0 TU)
Turbidity is cloudiness or haziness in water, caused by tiny particles of silt, clay, etc. that reflect and scatter light. Sometimes called "suspended solids," turbidity particles are so small (less than a micron) that they never settle out due to gravity. U.S. regulations require that the turbidity be less than 1.0 TU at the time of disinfection, and most waterworks monitor it continuously. Turbidity is analyzed with a light meter set at a right angle to the light source and reported in "Nephelometric turbidity units" (NTU of just TU). Up to 5 TU, very slight cloudiness; 20 TU, definitely cloudy; 100 TU, murky. Values of turbidity for drinking water usually fall within the range of 0 to 1 NTU. Levels from 1 to 5 NTU are considered high, and above 5 NTU extremely high and seldom encountered.

Ultrapure Water:
Highly treated water of high resistivity and no organics; usually used in the semiconductor and pharmaceutical industries.

Ultraviolet (UV):
Radiation having a wave length shorter than visible light but no longer than X-rays. Ultraviolet light with a wave

length of 254 nm is used to kill bacteria and destroy ozone.

Unloading:
The release of contaminant that was originally captured by the filter medium.

Velocity:
Free air passing through a filter panel and measured in feet per minute (fpm). It is determined by the volume of air min (ft3/m) divided by the area of the panel (ft2). It is expressed in this case as ft/min divided by feet per minute (fpm).

Viscosity:
That property of fluids by which they offer resistance to flow. Measured in poise, kinematic viscosity, centistokes, saybolt universal seconds (SUS), seconds saybolt, degree Engler and degree Barbey, Gardner-Holt, etc.

VOC:
Volatile organic compound – synthetic organic compounds which easily volatilize. Many are suspected carcinogens.

Water (H2O):
The liquid that descends from the clouds as rain and forms lakes, streams, and seas. (oceans) Water is a major constituent of all living matter. The human body is approximately 70% water. An odorless, tasteless liquid that exists as ice in solid form and steam in vapor form. It freezes at 32 degrees Fahrenheit and boils at 212 degrees Fahrenheit. It is called the universal solvent. It is a weak electrolyte and is only slightly compressible.

Water hammer:
The shock wave or series of waves caused by the resistance of inertia to an abrupt change (acceleration or deceleration) of water flow through a water piping system. Water hammer may produce instantaneous pressures many times greater than normal pressures. For this reason, many building codes now require the installation of "water hammer arrestors" a device to absorb these shock waves and limit damage to appliances.

Water softening:
The reduction/removal of calcium and magnesium ions, which are the principal cause of hardness in water. The cation exchange resin method is most commonly used for residential and commercial water treatment.

Zinc: (Zn+2, secondary MCL, 5 ppm)
The Zn++ ion occurs in drinking water only as a corrosion by-product from galvanized (zinc-coated) steel pipe or from fittings made of brass (a copped zinc alloy). Zinc is one of the few metals that are dissolved by strong base as well as by acid, and a water pH of 10 higher can produce a metallic, astringent taste, even a touch of nausea if left long enough. Zinc levels in drinking water seldom exceed 2.0 ppm, with levels on average reaching 0.08 ppm but usually lower.