Water Treatment Processes




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Overview

What is conventional water treatment?

The term **conventional water treatment** refers to the treatment of water from a surface water source by a series of processes aimed at removing suspended and colloidal material from the water, disinfecting the water and stabilising the water quality.

What does conventional water treatment involve?

Conventional treatment of water for domestic use involves a number of treatment steps aimed at achieving the following objectives:

•**Removal of suspended and colloidal matter**to an acceptable level can be done with the following processes:

PROCESS	DESCRIPTION
Coagulation	A process to change the nature of the colloidal material in the water to facilitate its removal.
Flocculation	A process to form larger groups of particles or flocs.
Sedimentation or flotation	A process to remove the flocs from the water.
Sand filtration	A process for final clean-up of the water.

•**Disinfection** to produce water that is safe to drink. This process involves the addition of disinfection chemicals to the water. On large-scale plants chlorine gas (but ozone and chlorine dioxide can also be used) is normally used, while on small plants chlorine granules, Ca (OCl)(commercially known as HTH) are often used for disinfection.

•**Chemical stabilisation** of the water to prevent corrosion of pipelines or the formation of chemical scale in distribution systems and fixtures. Chemical stability is achieved by addition of different chemicals, such as lime and/or carbon dioxide to the water.

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Sedimentation

Sedimentation is the process in which the flocs that have been formed during coagulation and flocculation are allowed to settle from the water.

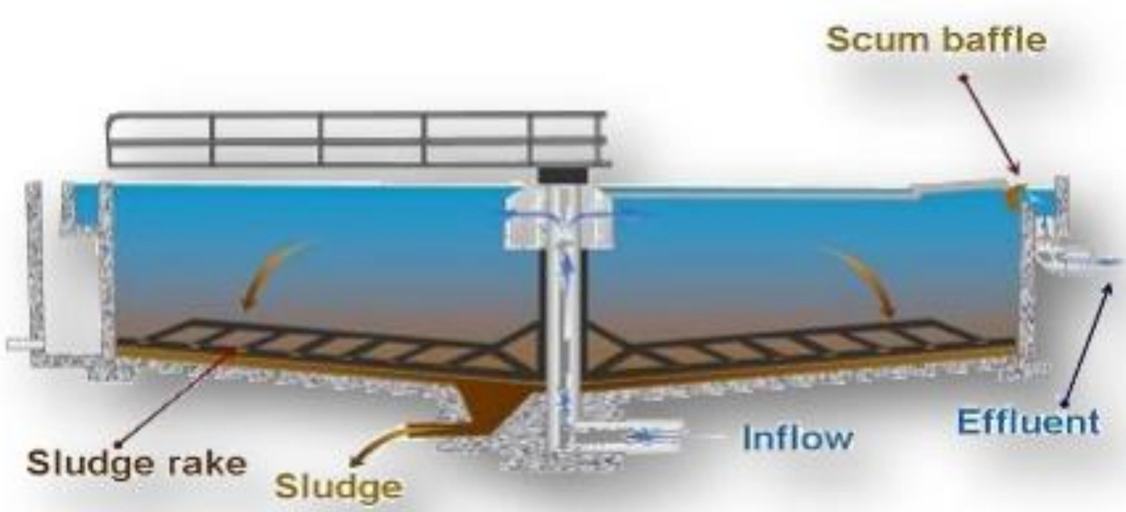
Sedimentation is a suitable process for the removal of flocs formed from silt and clay particles that are relatively heavy and settle readily. However, certain flocs are relatively light and do not settle readily and a process such as flotation must be used for their removal. Light flocs are formed when algae or organic matter is flocculated.

The flocs collect as sludge at the bottom of the sedimentation tank from where it must be removed on a regular basis. The clean water leaves the sedimentation tank through collection troughs located at top of the tank.

There are a variety of designs for sedimentation tanks available. These include:

- **Large rectangular tanks** in which the water enters one side and leaves at the other end. This type id normally used at large conventional treatment tanks.

- **Circular tanks** with flat or cone shaped bottoms are also used, especially at smaller works. Flocculated water enters the tank at a central distribution section and clarified water leaves the tank at collection troughs at the circumference of the tank. The design and flow conditions in a sedimentation tank must be such that the minimum amount of flocs leaves with the clarified water.



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Sedimentation

The flocs that settle in the sedimentation tank collect at the bottom of the tank as sludge from where it must be removed on a regular basis to prevent accumulation in the tank. If sludge is not withdrawn regularly according to operating schedules, the quality of the clarified water may deteriorate due to re-entrainment.

The sludge from the sedimentation tank has a large pollution potential because it contains all the suspended material removed from the water together with the chemicals used for coagulation. It must therefore be disposed of in a proper manner to prevent contamination of water source. The sludge is withdrawn from the sedimentation tank in a diluted form (2-5% solids) and is sometimes thickened (Excess water removed) before disposal. At smaller treatment works sludge is disposed of in sludge lagoons. The lagoons are large holding dams in which the sludge compacts and clear water accumulates on top of the sludge. The clear water may be recycled to the inlet of the plant.

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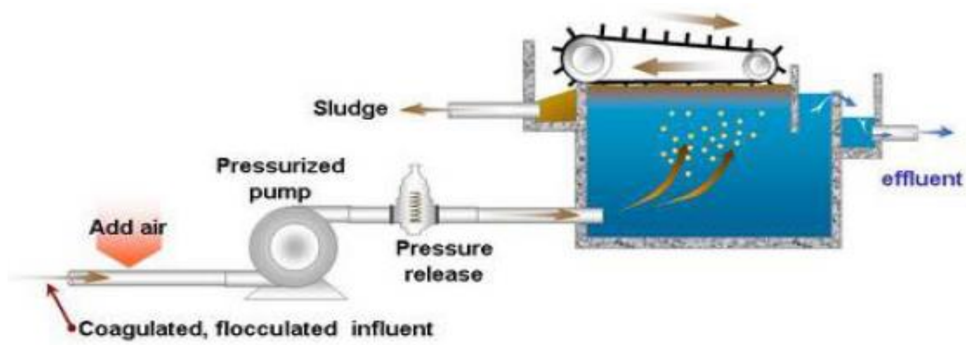
Flotation

Why is flotation used for water treatment?

Flotation is an effective process for the removal of relatively light types of flocs.

What does the flotation process involve?

Flotation involves the formation of small bubbles in water that has to be flocculated. The bubbles attach to the floc causing them to rise to the surface where they are collected as a froth that is removed from the top of the flotation unit. A typical flotation unit is illustrated below.



How is the fine bubbles formed?

Air is dissolved under pressure in a small amount of water in a device called a saturator. This water that is saturated with dissolved air is added to the main stream of water that is to be treated. When the pressure is released after the saturated water is mixed with the water to be treated, the dissolved air comes out of solution in the form of fine bubbles.

How does flotation differ from sedimentation?

Both sedimentation and flotation remove the bulk of the flocs from the water. However, most of the time a small amount of (broken) flocs or non-flocculated colloidal material remains in the water. This material has to be removed to ensure a low enough turbidity in the water. A sufficiently low turbidity level is required for the effective disinfection of the water and to remove all traces of murkiness from the water. Removal of turbidity to low levels is achieved by means of sand filtration. Sedimentation and flotation are two processes that perform the same function. Sedimentation is normally used when raw water contains mainly silt or clay particles, while flotation is normally used when the raw water contains algae or other types of organic material.

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Coagulation and flocculation

What does coagulation involve?

Coagulation is the process by means of which the colloidal particles are destabilised (i.e. the nature of the colloidal particles is changed so that they form flocs through the process of flocculation that can be separated from the water). Destabilisation is achieved through the addition of chemicals (called coagulants) to the water.

Different chemicals can be used as coagulants. The most common coagulants are aluminium sulphate, ferric chloride, lime, and polyelectrolytes. Coagulant-aids are also sometimes used. These are substances added in very small quantities to improve the action of the primary coagulant (See fact sheet on Coagulant Chemicals).

What does flocculation involve?

Flocculation is considered to be part of the coagulation process and can take place in different types of equipment. A simple mechanical stirrer can be used for flocculation or a specially designed channel with baffles to create the desired flow conditions can also be used to flocculate the particles in the water. The basis of the design of a flocculation channel is that the flow velocity of the water has to be reduced from a high initial value to a much lower value to enable large, strong flocs to grow. If the flow velocity is too high the flocs may break up again, causing settling of the broken flocs to be incomplete.

The objective of the flocculation step is to cause the individual destabilised colloidal particles to collide with one another and with the precipitate formed by the coagulant in order to form larger floc particles. Flocculation involves the stirring of water to which a coagulant has been added at a slow rate, causing the individual particles to "collide" with each other and with the flocs formed by the coagulant. In this way the destabilised individual colloidal particles are agglomerated and incorporated into the larger floc particles.

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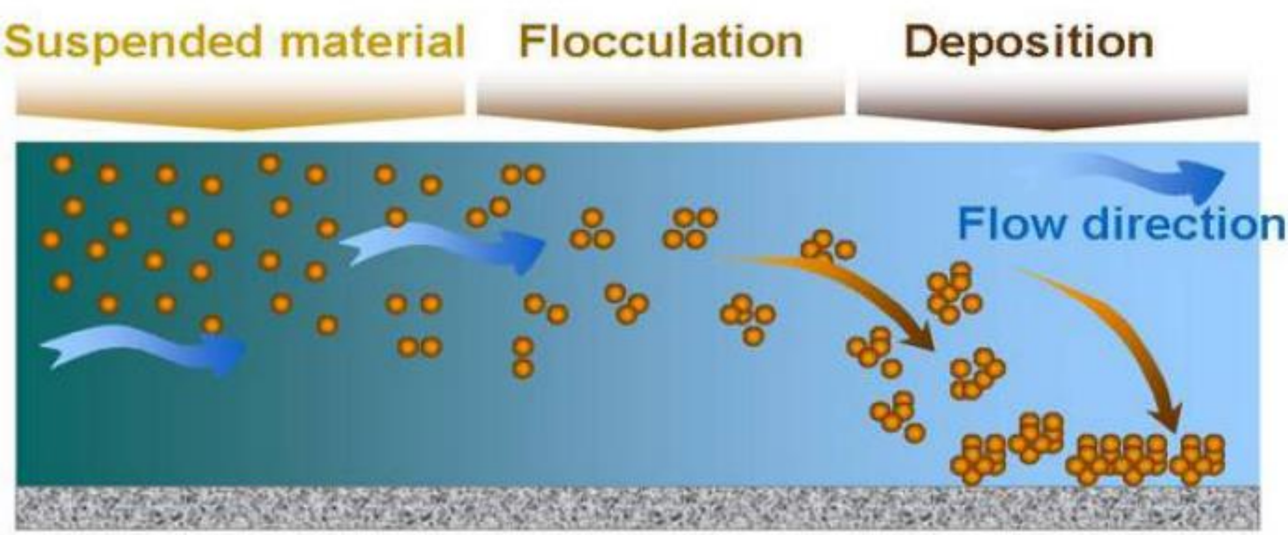
Coagulation and flocculation

Flocculation is controlled through the introduction of energy into the water (through paddles or by means of baffles in the flocculation channel) to produce the right conditions (required velocity gradient) for flocs to grow to the optimum size and strength. The velocity gradient (or G-value) is an extremely important factor that determines the probability of particles to collide and form flocs. If the G-values are too low, the probability of collisions is low and poor floc formation results. If it is too high, shear forces become large and this may result in floc break-up. Acceptable G-values for the coagulation process is between 400 and 100 s-1 . For the flocculation process, it is in the order of 100s $^{-1}$..



Ref: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, p. 16

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Coagulation : Important factors and the beaker test

Coagulation: Important factors

Definition: "The process of adding chemicals to water to destabilize charges on naturally occurring particles to facilitate their subsequent aggregation and removal by flocculation or filtration."
Centres for Disease Control and Prevention (CDC) (http://0-ww.cdc.gov.mill1.sjlibrary.org/)

There are a number of very important factors to consider when you want to ensure proper and successful coagulation:

•The best coagulant and coagulant–aid (if required) must be identified for the specific raw water, the optimum dosage must be determined for the range of turbidities normally encountered in the plant and optimum conditions of pH and alkalinity must be determined for the different chemicals and dosages. This is normally done in a laboratory by means of beaker tests.

•The coagulant (and coagulant-aid) must be added to the water at a point and under

•conditions that will ensure rapid dispersion and complete mixing of the small volume of coagulant with the large body of water.

•The pH and alkalinity of the raw water must be adjusted according to the levels identified in the beaker tests.

•Coagulant storage and preparation of the solution (especially for polyelectrolytes) must be done strictly according to the directions of the supplier.

•If there are algae present in the raw water, it may be necessary to add a small amount of chlorine to the raw water (pre-chlorinate) to kill the algae before coagulation.







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Coagulation : Important factors and the beaker test

The beaker test

A typical beaker test is done in the following way:

- A specified volume (e.g. 750ml) of the water, which requires treatment, is measured into 6 beakers.
- Predetermined quantities (e.g. 5, 10, 15, 20, 30 and 40mg/l) of the selected coagulant are added to the water in each beaker.
- The contents of each beaker are then rapidly stirred for one minute, after which time they are stirred at a slow rate for approximately 20 minutes.
- After the stirrers have been switched off, the formation and subsequent settling of the flocs can be observed.
- After 30 minutes, the turbidity of the clear water in each beaker (supernatant) is
- measured.
- These measurements, as well as visual observation, are used to determine the optimum dosage of the coagulant.

Ref: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02.







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Coagulation Chemicals

Different chemicals can be used as coagulants. The most common coagulants are aluminium sulphate, ferric chloride, lime and polyelectrolytes. Coagulant-aids are also sometimes used. These are substances added in very small quantities to improve the action of the primary coagulant. The characteristics of the different coagulants and the way in which they function are as follows:

- **Aluminium sulphate** ($Al_2(SO_4)_3.16H_2O$) is commonly used as a coagulant. The alum is dissolved in the water and the aluminium ions (Al^{3+}) that form, have a high capacity to neutralise the negative charges which are carried by the colloidal particles and which contribute to their stability. The aluminium ions hydrolyse and form aluminium hydroxide ($Al(OH)_3$), which precipitates as a solid. During flocculation when the water is slowly stirred, the aluminium hydroxide flocs "catch" or enmesh the small colloidal particles. The flocs settle readily and most of them can be removed in a sedimentation tank.

- **Ferric chloride** ($FeCl_3$) is commonly used as a coagulant. When added to water, the ion precipitates as ferric hydroxide ($Fe(OH)_3$) and the hydroxide flocs enmesh the colloidal particles in the same way as the aluminium hydroxide flocs do. The optimum pH for precipitation of iron is not as critical as with aluminium and pH values of between 5 and 8 give good precipitation.

- **Lime** can also be used as coagulant, but its action is different from that of alum and ferric chloride. When lime is added to water the pH increases, resulting in the formation of carbonate ions from the natural alkalinity in the water. The increase in carbonate concentration together with calcium added in the lime results in the precipitation of calcium carbonate ($CaCO_3$). The calcium carbonate crystals enmesh colloidal particles in the same way as alum or ferric flocs. When lime is used as a coagulant, the pH has to be lowered in order to stabilise the water chemically. Carbon dioxide is normally used for this purpose.

- **Polyelectrolytes** are mostly used to assist the flocculation process and are often called flocculation aids. They are polymeric organic compounds of long polymer chains that act to enmesh particles in the water. Polyelectrolytes can be cationic (carrying a positive charge), anionic (carrying a negative charge) or non-ionic (carrying no net charge).

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Coagulation Chemicals

- **Aluminium polymers**, such as poly-aluminium chloride that give rapid flocculation, efficient removal of organics and less alum under certain conditions, but at a higher cost.

- **Activated silica** is sometimes used as a flocculant together with alum as coagulant.

- **Bentonite and/or kaolin** are sometimes added to water when the water to be flocculated contains too few particles for effective flocculation.

References: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, pp. 21 to 22.

"Using a world first technique, CSIRO has found convincing evidence that the use of alum - aluminium sulphate - to treat drinking water is safe.
"We found that the aluminium we get from alum-treated drinking water is such an insignificant amount we don't need to worry. Only 1-2% of our daily intake of aluminium comes from water and of this, only the barest trace is absorbed. Much of the aluminium that is absorbed is then excreted in urine," CSIRO scientist Dr Jenny Stauber says. The results have significance for water authorities around the world who use alum to clarify drinking water as part of the water treatment process. Alum is later filtered from the water, but a small fraction dissolves and is not removed.

The cause of Alzheimer's disease is subject to international research. A variety of possible causes have been considered however no link between aluminium intake and Alzheimer's has been established. However some conflicting evidence in earlier studies suggested that aluminium that is left in treated drinking water may be more readily taken up by the body than aluminium from other sources. "Aluminium is the Earth's third most common element and occurs naturally in food and water. Most of the aluminium we consume in our food and drinking water is not absorbed and goes straight through our bodies to be excreted in faeces. What we were interested in was the trace that is absorbed into our blood," Dr Stauber says. "If aluminium from water were to significantly increase the total amount of aluminium in the human body, it would have to be in a form that is much more easily absorbed into our bloodstream (i.e. more bioavailable) than aluminium in food (which has low bioavailability). This is because a greater proportion of our daily intake of aluminium comes from food," Dr Stauber says. "We were able to calculate that aluminium from alum-treated drinking water would contribute less than 1 per cent to our body burden of aluminium over a lifetime. However the good news is that a related study on food shows that even what we get from food is well within the safe limits determined by the World Health Organisation," Dr Stauber says."

CSIRO, the Commonwealth Scientific and Industrial Research Organisation. Media Release: Ref 98/258. 2 November 1998

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Disinfection: Overview

What does disinfection entail?

•**Disinfection** of water entails the addition of the required amount of a chemical agent or disinfectant (e.g. Chlorine gas, Cl2, ozone, chlorine dioxide and other chlorine compounds such as calcium hypochlorite (HTH), sodium hypochlorite (bleach) and monochloramine) to the water and allowing contact between the water and disinfectant for a predetermined period of time (under specified conditions of pH and temperature).

•The term disinfection of water refers to the destruction of harmful micro-organisms in water to make it fit for domestic use. Water that is disinfected is safe to drink but it may still contain harmless micro-organisms.

•**Sterilisation** on the other hand, refers to the destruction of all organisms and applies only to specific applications such as the production of water for sterile intravenous drips, etc.

•Other methods of disinfection of water include **boiling of the water** or **radiation with ultraviolet light.**

Is disinfection still necessary after suspended and colloidal matter has been removed?

A large fraction of bacteria and larger micro-organisms are removed during clarification processes, especially by sand filtration. However, many bacteria and viruses still remain in clarified water even at low turbidity levels.

Disinfection: Overview

What else can be done to ensure that drinking water is safe?

Before disinfection, there are several other precautions that can keep drinking water safe:

- **Prevent** pathogens from entering the water sources.

- **Clarify** the water to remove the maximum number of micro-organisms from the water

- **Disinfect** the water source.

- **Check for effectiveness** of disinfection or whether the water is safe to drink, by:

    - Testing of indicator organisms, e.g.*E. coli*.
    - Determining the amount of residual chlorine in the water. If there is residual chlorine present in water with a low turbidity, it can normally be accepted that the water is safe to drink

Indicator organisms are microbes of faecal origin occurring in large numbers in faeces, but which are causative themselves of the particular disease under consideration, but which indicate the presence of faecal contamination of water, and thus the possibility of the presence of disease causing microbes).

Ref: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, p. 16.

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Disinfection: Overview

How does disinfection by means of chlorine take place?

Chlorine is a strong oxidising agent and it reacts and oxidises some of the essential systems of micro-organisms, thereby inactivating or destroying them. The different forms, in which chlorine is used for disinfection, have different oxidising powers:

Chlorine gas:
Delivered to the plant in gas cylinders and the chlorine are introduced into the water by means of special dosing devices (chlorinators). Chlorine gas is the form of chlorine that is most commonly used at large-scale plants.

Calcium hypochlorite (commonly known as HTH)
Available in granular or tablet form and is therefore a very convenient to use, especially for smaller or rural plants. It contains between 65% and 70% of available chlorine, it is relatively stable and can be stored for long periods (months) in a cool dry environment.

Sodium hypochlorite (commonly known as household bleach)
Bleach is available as a solution, containing about 6 to 8 % available chlorine. It is relatively unstable and deteriorates fairly rapidly, especially when exposed to sunlight, forming HOCl and OCl- upon dissociation.

Monochloramine(NH2Cl or combined available chlorine)
Formed when HOCl is added to water that contains a small amount of ammonia. The ammonia reacts with HOCl to form monochloramine. It is much less effective as a disinfectant than HOCl, however, it has the same advantage of being much more stable in water than free available chlorine, rendering it more suitable for providing residual protection in larger distribution systems.

How is disinfection by means of chlorine controlled?

Chlorine concentration. Normally, sufficient chlorine must be added to water to give a free chlorine residual of not less than 0,2 mg/l after 20 minutes contact time.
Chlorine contact time. This is the time of contact between the dissolved chlorine and each unit or 'pocket' of water.
pH. Tables are available that give combinations of dosage and contact time at different pH values.
Turbidity. When water contains colloidal particles, they may 'shield' the micro-organisms from the action of the disinfectant, or alternatively react with the chlorine and in this way prevent effective disinfection.

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Disinfection: Overview

Exposure to sunlight and water temperature. Chlorine in water is rapidly broken down by sunlight to the inactive chloride ion Cl-, which has no disinfecting power. Therefore chlorine contact tanks should always be covered and chlorine compounds should be stored in the dark.

Advantages:

•Chlorination is a well-established technology.

•Presently, chlorine is more cost-effective than either UV or ozone disinfection.

•Chlorine disinfection is reliable and effective against a wide spectrum of pathogenic organisms.

•Chlorine is effective in oxidizing certain organic and inorganic compounds.

•Chlorine can eliminate certain noxious odors while disinfecting

ETI (Environmental Technology Initiative). Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No.
CX824652

Disadvantages:

•All forms of chlorine are highly corrosive and toxic. Thus, storage, shipping, and handling pose a risk, requiring increased safety regulations.

ETI (Environmental Technology Initiative). Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No.
CX824652

References: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, pp. 33 - 36

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Disinfection: Ozone

What is ozone?

Oxygen in the air (O_2) is composed of two oxygen molecules. Under certain conditions, three oxygen atoms can be bound together instead, forming ozone (O_3). It is also referred to as activated or enriched oxygen.

Ozone occurs naturally in the earth's atmosphere and protects us from the sun's harmful rays. Thousands of tons of ozone are produced daily during thunderstorms or around high-tension lines.

Ozone is applied commercially as a disinfectant instead of chlorine and other disinfectants. It is used in air and water purification. It destroys algae, bacteria, molds and mildews, eliminates spores, yeast and fungus and inactivates viruses and cysts.

How does ozone disinfect water?

By oxidation of specific cell wall components, the ozone disinfects water and kills bacteria. However, ozone is non specific and it will oxidise many different types of chemicals, both organic and inorganic, e.g. manganese, iron, or minerals, proteins or other organics. The presence of these components will reduce the concentration of ozone in the water and therefore, the germicidal properties of the gas.

What are the advantages and disadvantages of ozone treatment?

Advantages:

.It does not leave any residual, harmful chemical in the water.

.Ozonation does not produce any taste or odour in the water.

.Ozone is absolutely environmentally friendly.

.It kills all pathogenic organisms by a direct effect on their DNA.

.Disinfection occurs 30,000 times faster than with chlorine, so a prolonged contact time is unnecessary.

.As ozone is an unstable gas, it has to be produced on site, thus no gas or chemical storage facilities are necessary.

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Disinfection: Ozone

•There is no regrowth of microorganisms after ozonation, unlike ultraviolet and chlorine disinfection.
•Ozone is generated onsite, and thus, there are fewer safety problems associated with shipping and handling.
•Ozone decomposes rapidly, and therefore, it leaves no harmful residual that would need to be removed after treatment.
ETI (Environmental Technology Initiative). Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No.
CX824652

Disadvantages:

1. Ozone is a very powerful oxidant.
2. The initial set-up is costly.
3. High electricity consumption.
4. Unlike chlorine and iodine, ozone does not protect the water after application.

•Ozonation is more complex than other disinfection technologies.

•Ozone is very reactive and corrosive, thus requiring corrosion-resistant material, such as stainless steel.

•Ozone is extremely irritating and possibly toxic, so off-gases from the contactor must be destroyed to prevent worker exposure.

•The cost of treatment is relatively high, being both capital- and power-intensive.

•There is no measurable residual to indicate the efficacy of ozone disinfection.

ETI (Environmental Technology Initiative). Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No.
CX824652

References: 1. Canada Health (2005). Water treatment Devices for disinfection of drinking water. www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/disinfect-desinfection_e.html
2. Aurozon (2007). Air and water treatment consultants. www.aurozon.com/index1.html
3. WISA (2002). Handbook for the operation of waste water treatment works. Ed. Phiilip Pybus

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Disinfection: UV

How does UV radiation work?

Ultraviolet or UV-light is light outside the range usually detectable by the human eye. It can be used to deactivate protozoans so that they can't reproduce and to significantly reduce the bacteria in water.

UV radiation kills or inactivates micro-organisms, provided each organism receives a minimum amount of radiation.

UV radiation functions on the principle that each unit of water must be exposed to the radiation for a minimum amount of time at minimum dosage intensity.

Commercial UV units are used to disinfect water in many small- and large-scale water treatment plants. UV disinfection units have been used for many years and the process is accepted as an effective disinfection method.

It is important that the water to be disinfected is properly pre-treated to ensure a low turbidity, preferably lower than 0,5 NTU. If the water contains high turbidity levels the colloids either absorb some of the radiation or shield the micro-organisms against radiation, which reduces the effectiveness of the process.

A further important aspect is that the UV tubes are prone to the formation of layers of scale or other fouling material. This also reduces the effectiveness of radiation. It is therefore important that the tubes are regularly inspected and cleaned to prevent formation of scale or accumulation of other material on them.

What are the disadvantages and advantages of UV radiation?

UV is as effective as chlorine in destroying micro-organisms.

The **main advantage** of UV disinfection compared to chlorine for small-scale and rural applications is that the handling and dosing of hazardous chlorine compounds is eliminated.

UV disinfection is a physical process rather than a chemical disinfectant; thus eliminating the need to generate, handle, transport, or store toxic/hazardous or corrosive chemicals.

There is no residual effect that can be harmful to humans or aquatic life.

UV disinfection has a shorter contact time when compared with other disinfectants approximately 20 to 30 seconds with low-pressure lamps).

UV disinfection equipment requires less space than other methods.

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Disinfection: UV

What are the disadvantages and advantages of UV radiation?

The **main disadvantage** of UV disinfection is the fact that there is no residual protection against re-contamination. It also has a high operating cost and it must be kept in mind that anything which blocks UV light from reaching the water will result in a lack of treatment.

Low dosages may not effectively inactivate some viruses, spores, and cysts.
Turbidity and total suspended solids (TSS) in the wastewater can render UV disinfection ineffective. UV disinfection with low-pressure lamps is not as effective for secondary effluent with TSS levels above 30 mg/L.
UV disinfection is not as cost-effective as chlorination, but costs are competitive when chlorination-dechlorination is used.
Here is no measurable residual to indicate the efficacy of UV disinfection.

ETI (Environmental Technology Initiative). Project funded by the U.S. Environmental Protection Agency under Assistance Agreement No. CX824652

Ref: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, p. 37.

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Residual handling and treatment

What waste products are generated during water treatment?

Substances removed during water treatment form waste products. These substances include:

- **debris** removed from the raw water by screens
- **suspended and colloidal** material removed during sedimentation and filtration
- in the case of specialised processes, different **waste streams** are formed such as the brine from desalination plants.

How can waste be handled and disposed of ?

There are different methods of handling and disposal of waste products. Organic wastes must be stabilised before disposal, while inorganic wastes are normally concentrated or dewatered before disposal.

Sludge is produced at a water treatment plants. It contains colloidal and suspended material that settled in the sedimentation tank. The quantity and quality of the sludge depends on the raw water quality and the type of coagulant and flocculants used. For turbid waters (where the suspended solids concentration is more than 1000 mg/l), about 1% to 3% of the water treated, can be generated as sludge.

Sludge must be discharged in its most concentrated form, as the water discharged with the sludge, is very seldom reclaimed on a small works and is therefore lost.

At small water treatment works, holding ponds or dams are provided of sufficient size to hold all the sludge produced at the water treatment works. The normal practice is to have two dams side by side, which would allow the waterworks operator to take one dam out of operation, allow the clear water on top of the sludge layer to drain out, or evaporate. The sludge is allowed to dry out after which it can then be removed from the dry pond and used as a landfill on a suitable site.

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Residual handling and treatment

The solids remaining in the water after sedimentation are removed in the sand filters. The suspended solids remain in the upper layer of the sand in the filter bed and are removed during back washing of the filter bed, forming the filter wash water which normally contains 100 to 1000mg/l solids. In small plants wash water is gravitated to a holding tank or sludge lagoon, where most of the suspended matter settles and the overflow runs into the nearest stream. At larger works, the supernatant from the wash water is returned to the head of the works, after settling of the suspended solids. At an effective water treatment plant, the filter wash water volume is between 2% and 5 % of the water treated volume.

Chemical wastes are produced in most treatment works. The chemicals used at the plant (coagulants, stabilizing agents and disinfectants) are fed into day tanks, where they are diluted to be fed, with dosing pumps or gravity feeders to the incoming raw water. When these tanks are cleaned, chemical wastes are produced. It is good practice to clean these holding tanks on a regular basis and drain the residues into the filter wash water/sludge system where it will find its way in the sludge lagoons.

The residues should not be discharged into a natural water course as it could lead to fish kills as slugs of the residues could dramatically change the pH conditions in small ponds.

Screenings are substances removed by screens placed at the entrance of a water treatment works. The purpose is to keep out weeds, algae and floating debris. These screenings consist of grass, weeds, wood, etc. and could be disposed of in fills or could be burned.
Algae can be removed by mechanical screens or strainers, or by a flotation plant. These organic residues can be disposed of in sludge lagoons, to an existing sewage works or dumped on waste heaps. The dried algae can also be composted and then disposed of in landfills.
The processes used for the removal of dissolved inorganic substances always produce rejects and concentrates, which must be disposed of and which require special methods to ensure that the environment is not polluted. The usual method of disposal is in a lined dam with sufficient area to allow for full evaporation and ensuring that overflow or leakage does not take place.

Ref: DWAF (2002). Quality of domestic water supplies. Vol. 4: Treatment Guide. WRC No. TT 181/02, p. 83

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