Purification of Water

A Research Work Submitted for the partial fulfilment of requirement in Chemistry of Class 11

Submitted to
Moonlight Secondary School
Kumaripati, Lalitpur
Lalitpur, Nepal
2078/12/27

Submitted By
Ritik Yadav
Roll No: 26

CERTIFICATE OF APPROVAL

This is to certify that the project work entitled **Purification of Water** in the partial fulfilment of the requirement of chemistry class 11 **SDC** is submitted by **Ritik Yadav** under the supervision of **Pusp Bhatt** has been accepted.

Supervisor:
Name: **Pusp Bhatt**
Department of Chemistry
Name of School/ College:
Moonlight Secondary School

Head of the Department:
Name: **Rajib Chaudhary**
Department of Chemistry
Name of School/ College:
Moonlight Secondary School

LETTER OF RECOMMENDATION

This is to recommend **Mr. Ritik Yadav** of Moonlight Secondary School has done the project work entitled Purification of Water for the partial fulfilment of the requirement for Chemistry class 11. To the best of my knowledge, this work has not been previously formed for any other degree. He has fulfilled all the requirements laid down by NEB for the submission of project work for the award of +2 degree.

Signature :
Name of Supervisor: Pusp Bhatt
Designation of Supervisor
Date: 2078/12/27

DECLARATION

The project work entitled **Purification of Water**, which is being submitted to the Department of Chemistry, **Moonlight Secondary School,** Nepal for the award of Class 11 degree in Chemistry, is carried out by **Mr. Ritik Yadav** under the supervision of **Pusp Bhatt**, Department of Chemistry, **Moonlight Secondary School**. I hereby, declare that this work is originally done by me and has not been previously formed anywhere else for another degree. Any literature, data or work done by others or cited in this project work has been given due acknowledgement and listed in the reference section.

Signature
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I feel immense pleasure in acknowledging my ineptness and heartfelt sense of gratitude to my respected supervisor **Pusp Bhatt**, Department of Chemistry, **Moonlight Secondary School** for his/her sustained encouragement, regular guidance, inspiration, valuable suggestion and great support throughout my period.

My special thanks go to the Head of Department, **Rajib Chaudhary, Moonlight Secondary School** for providing us necessary requirements and suggestions.

I would like to thank and express my sincere appreciation to My friends, family and teachers.

Thank you all

Name of student: **Ritik Yadav**
Date: **2078/12/27**

Purification Of Water

Water is an essential renewable resource, increasing population, deforestation, soil degradation and desertification, soil and water pollution and the effects of climatic change and consequences such as droughts, changes in weather pattern have ultimately increases the demand for fresh potable water, thus the need for reclamation of used water is being realised. Several countries successfully recycle the water up to the consumable standards. Through worsening the surrounding it varies depending on the treatment systems, limiting the uses, public acceptance. Social and health related controversy is still an international issue. Increasing population and urbanisation increases the need of sophisticated techniques to handle waste water, in many areas contamination of harmful industrial or municipal wastewater into drinking water ways created severe threat to the society, or unsanitary waste water discharging practices have worsen the surrounding environment due to odour, providing sink for pathogens, breeding grounds for mosquitoes and other vectors.

Impurities found in Impure water

There is a long list of completely invisible to the eye pathogens we would not prefer to put into your body, including various bacteria, parasites, and viruses. To make them even scarier, they have nasty sounding names like: **giardia lamblia, cryptosporidium, escherichia coli, salmonella, campylobacter jejuni, hepatitis-A** and on and on. Ignoring these impurities is like inviting bad health.

Ancient Sanskrit and Greek writings recommended water treatment methods. Dating back 6,000 years such writings describe early water treatment as: “Impure water should be purified by being boiled over a fire, or heated in the sun or by dipping a heated iron into it and then allowed to cool, or it may be purified by filtration through sand and coarse gravel.” The Susruta Sanhita, Sanskrit writings about medical concerns, dates from approximately 2000 B.C. and offers evidence of water treatment (Kathy, 2006). Paintings on Egyptian tombs dating to 1500 B.C. showed men filtering water using wick syphons. Egyptians at this time also reported to have used the chemical alum to assist in settling particles and improve the clarity of water. The Egyptians repeatedly used the chemicals like alum and differed from a variety of clays, bauxite or alum from alunite known today potassium alum , Sodium alum,Chrome alum, Ammonium alum.

As far back as 500 BC it’s believed that the famous Greek scientist, Hippocrates invented the first early water filter… in the form of a cloth bag! This simple device was known as the **‘Hippocratic sleeve’**. The cloth acted like a sieve to filter out the impurities from the Greek aqueducts.The water was boiled and poured through the cloth, which trapped the sediments that were causing the bad taste and smell…creating cleaner, better tasting drinking water.

Drinking-water services

Sustainable Development Goal target 6.1 calls for universal and equitable access to safe and affordable drinking water. The target is tracked with the indicator of "safely managed drinking water services" – drinking water from an improved water source that is located on premises, available when needed, and free from faecal and priority chemical contamination.

In 2020, 5.8 billion people used safely managed drinking-water services – that is, they used improved water sources located on premises, available when needed, and free from contamination. The remaining 2 billion people without safely managed services in 2020 included:

- 1.2 billion people with *basic* services, meaning an improved water source located within a round trip of 30 minutes;
- 282 million people with *limited* services, or an improved water source requiring more than 30 minutes to collect water;
- 368 million people taking water from unprotected wells and springs; and
- 122 million people collect untreated surface water from lakes, ponds, rivers and streams.

Sharp geographic, sociocultural and economic inequalities persist, not only between rural and urban areas but also in towns and cities where people living in low-income, informal or illegal settlements usually have less access to improved sources of drinking-water than other residents.

Water and health

Contaminated water and poor sanitation are linked to transmission of diseases such as cholera, diarrhoea, dysentery, hepatitis A, typhoid and polio. Absent, inadequate, or inappropriately managed water and sanitation services expose individuals to preventable health risks.Globally, 15% of patients develop an infection during a hospital stay, with the proportion much greater in low-income countries.

Inadequate management of urban, industrial and agricultural wastewater means the drinking-water of hundreds of millions of people is dangerously contaminated or chemically polluted. Natural presence of chemicals, particularly in groundwater, can also be of health significance, including arsenic and fluoride, while other chemicals, such as lead, may be elevated in drinking-water as a result of leaching from water supply components in contact with drinking-water.

Some 829 000 people are estimated to die each year from diarrhoea as a result of unsafe drinking-water, sanitation and hand hygiene. Yet diarrhoea is largely preventable, and the deaths of 297 000 children aged under 5 years could be avoided each year if these risk factors were addressed. Where water is not readily available, people may decide handwashing is not a priority, thereby adding to the likelihood of diarrhoea and other diseases.

Diarrhoea is the most widely known disease linked to contaminated food and water but there are other hazards. In 2017, over 220 million people required preventative treatment for schistosomiasis – an acute and chronic disease caused by parasitic worms contracted through exposure to infected water.

In many parts of the world, insects that live or breed in water carry and transmit diseases such as dengue fever. The simple intervention of covering water storage containers can reduce vector breeding and may also reduce faecal contamination of water at the household level.

MATERIAL AND METHODOLOGY

There are several methods used in the water purification process, which few include:

Boiling

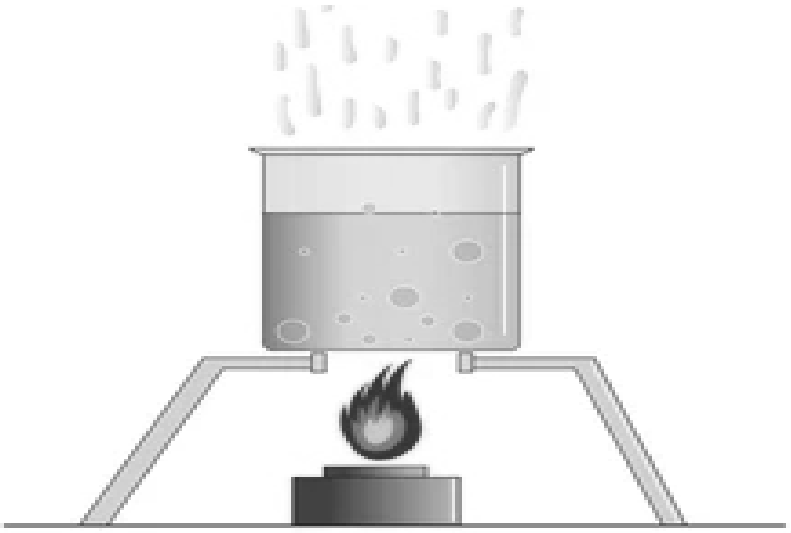


Figure: Boiling Water

The least expensive and most effective solution is boiling. Boiling will kill bacteria, parasites, and viruses. Many people advise bringing water to a hard boil for 5 minutes, and perhaps longer at higher elevation. More current literature, however, suggests merely reaching the boiling is sufficient and effective. The downside of boiling of course is inconvenience. To boil water you must set up a stove, consume fuel, wait for it to boil, and once boiled, wait some more for it to cool down so you can drink it. Boiling is probably a more practical approach when you are in camp for cooking anyway, but not as easy to deploy when travelling on the trail.Heating water to a high temperature, 100°C, kills most of the pathogenic organisms, particularly viruses and bacteria causing waterborne diseases

Distillation

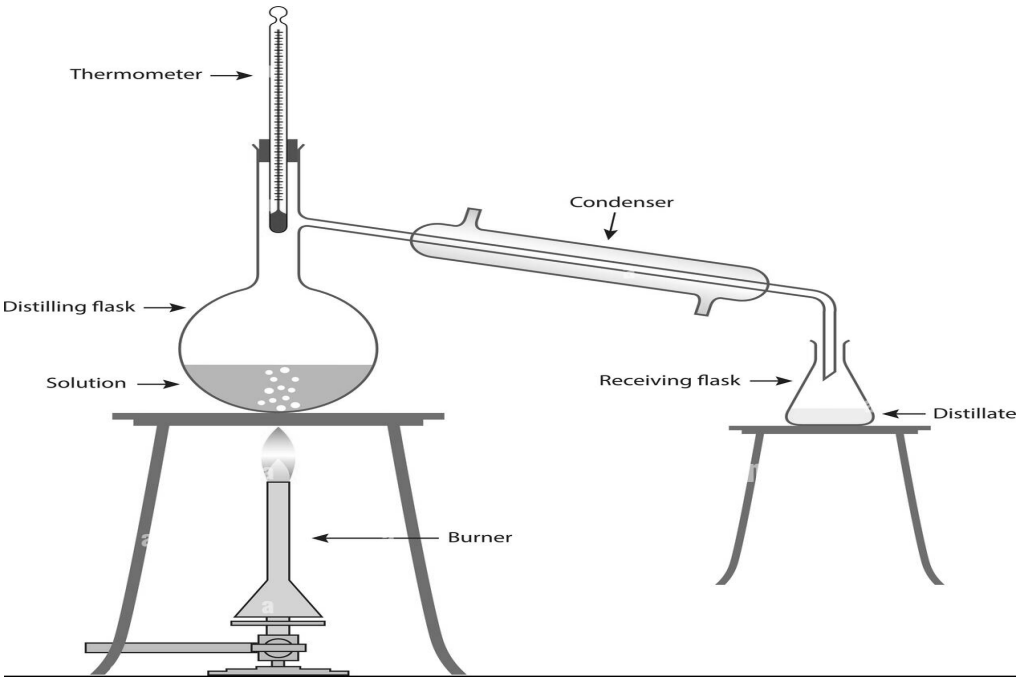


Figure: Distillation of Water

Distillation is one of the oldest methods of water treatment and is still in use today, though not commonly as a home treatment method. It can effectively remove many contaminants from drinking water, including bacteria, inorganic and many organic compounds. It is a process that relies on evaporation to purify water. Contaminated water is heated to form steam. Inorganic compounds and large non-volatile organic molecules do not evaporate with the water and are left behind. The steam then cools and condenses to form purified water.

Distillation effectively removes inorganic compounds such as metals (lead), nitrate, and other nuisance particles such as iron and hardness from a contaminated water supply.

Distillation's effectiveness in removing organic compounds varies, depending on such chemical characteristics of the organic compound as solubility and boiling point. Organic compounds with boiling points lower than the boiling point of water (ex. benzene and toluene) vaporise along with the water.

Water Filters

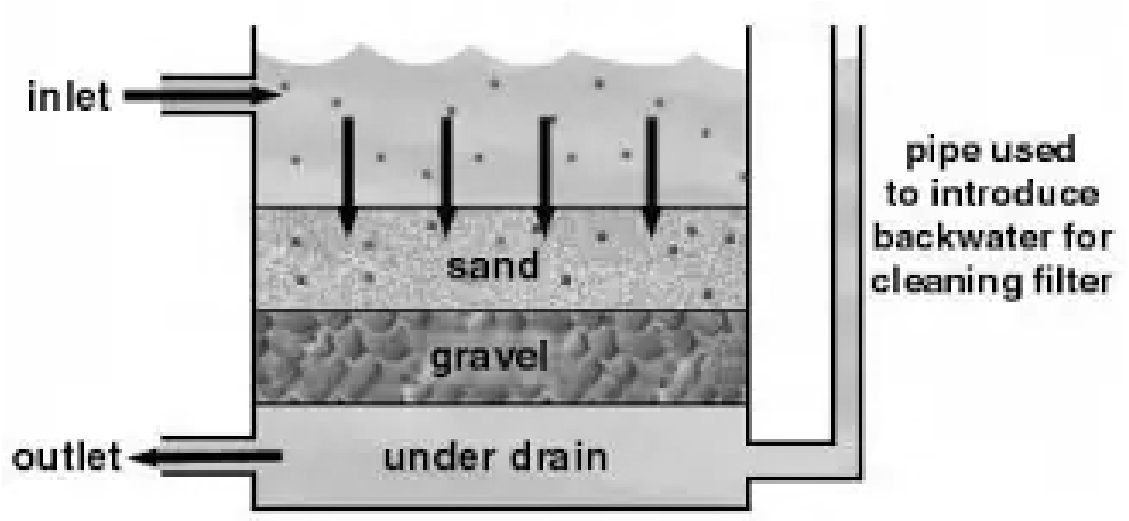


Figure: Filtration of Water

Water filtration is the process of removing or reducing the concentration of particulate matter, including suspended particles, parasites, bacteria, algae, viruses, and fungi, as well as other undesirable chemical and biological contaminants from contaminated water to produce safe and clean water for a specific purpose, such as drinking, medical, and pharmaceutical applications.

Once the flocs have settled to the bottom of the water, the clear water on top is filtered to separate additional solids from the water. During filtration, the clear water passes through filters that have different pore sizes and are made of different materials (such as sand, gravel, and charcoal). These filters remove dissolved particles and germs, such as dust, chemicals, parasites, bacteria, and viruses. Activated carbon filters also remove any bad odours.

Water treatment plants can use a process called ultrafiltration in addition to or instead of traditional filtration. During ultrafiltration, the water goes through a filter membrane with very small pores. This filter only lets through water and other small molecules (such as salts and tiny, charged molecules).

Chlorination

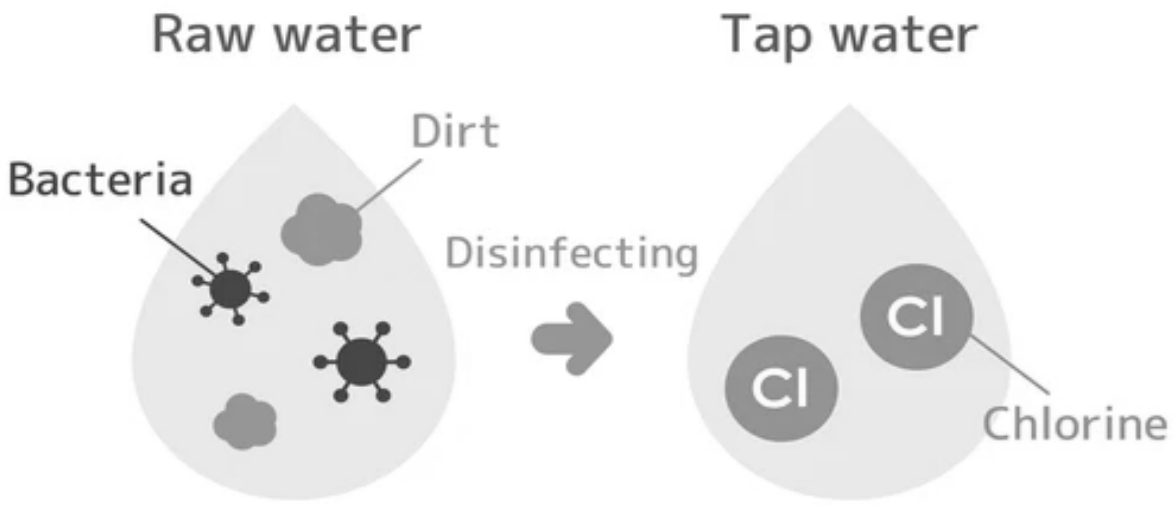


Figure: Raw Water to Chlorinated Water

Chlorination is one of many methods that can be used to disinfect water. This method was first used over a century ago, and is still used today. It is a chemical disinfection method that uses various types of chlorine or chlorine-containing substances for the oxidation and disinfection of what will be the potable water source.A large amount of research and many studies have been conducted to ensure success in new treatment plants using chlorine as a disinfectant. A leading advantage of chlorination is that it has proven effective against bacteria and viruses; however, it cannot inactivate all microbes. Some protozoan cysts are resistant to the effects of chlorine. Any type of chlorine that is added to water during the treatment process will result in the formation of hypochlorous acid (HOCl) and hypochlorite ions (OCl-), which are the main disinfecting compounds in chlorinated water. More detail is provided later on in this fact sheet.

Chemical reaction Involved:

A Form of Chlorine + H_2O $\rightarrow$ HOCl + OCl^-

Ozonation

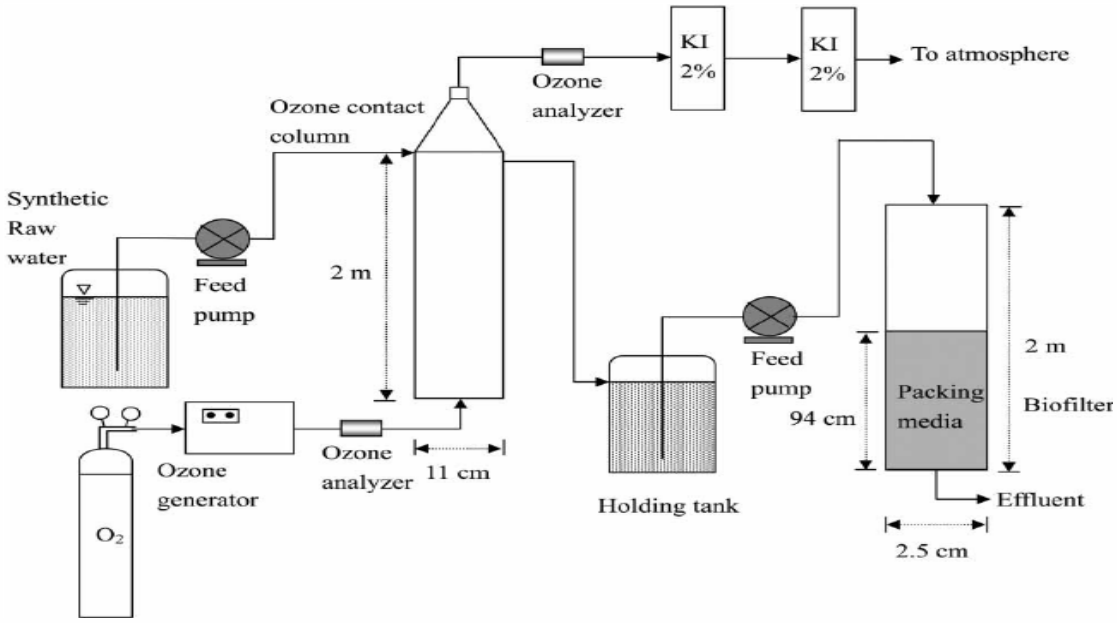


Figure: Ozonation of Water

Ozone (O_3) has been used in water treatment since the late 19th century. Today it is applied for the disinfection of drinking water, for the removal of effluents from wastewater treatment plants in a process called ozonation (or ozonation) as well as for the degradation of organic and inorganic pollutants in wastewater.

Ozonation is an efficient treatment to reduce the amounts of micropollutants released in the aquatic systems by wastewater treatment plants (MARGOT et al. 2011). Although no residual by-products are generated by ozone itself, some concerns are raised regarding oxidation by-products when water containing both organics and ions, such as bromide, iodide and chlorine ions, are treated with ozonation. A typical ozonation system consists of an ozone generator and a reactor where ozone is bubbled into the water to be treated.

UV-Light Treatment

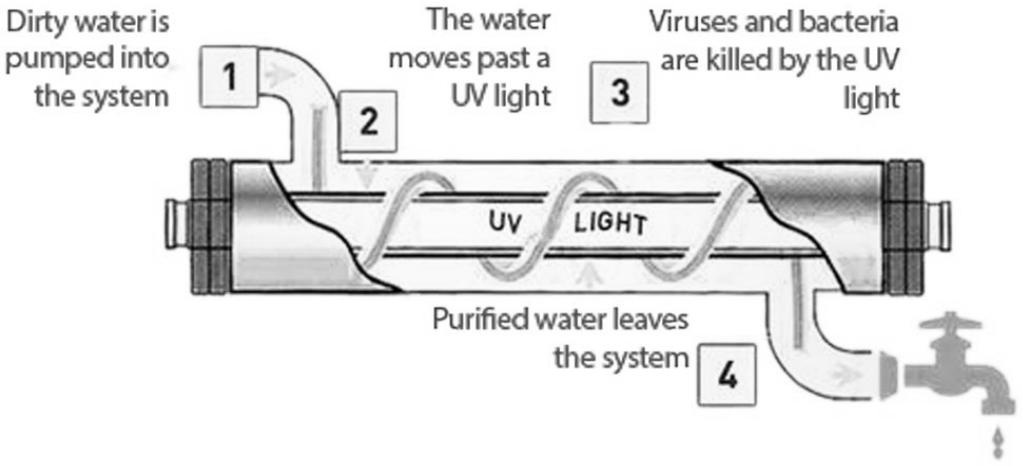
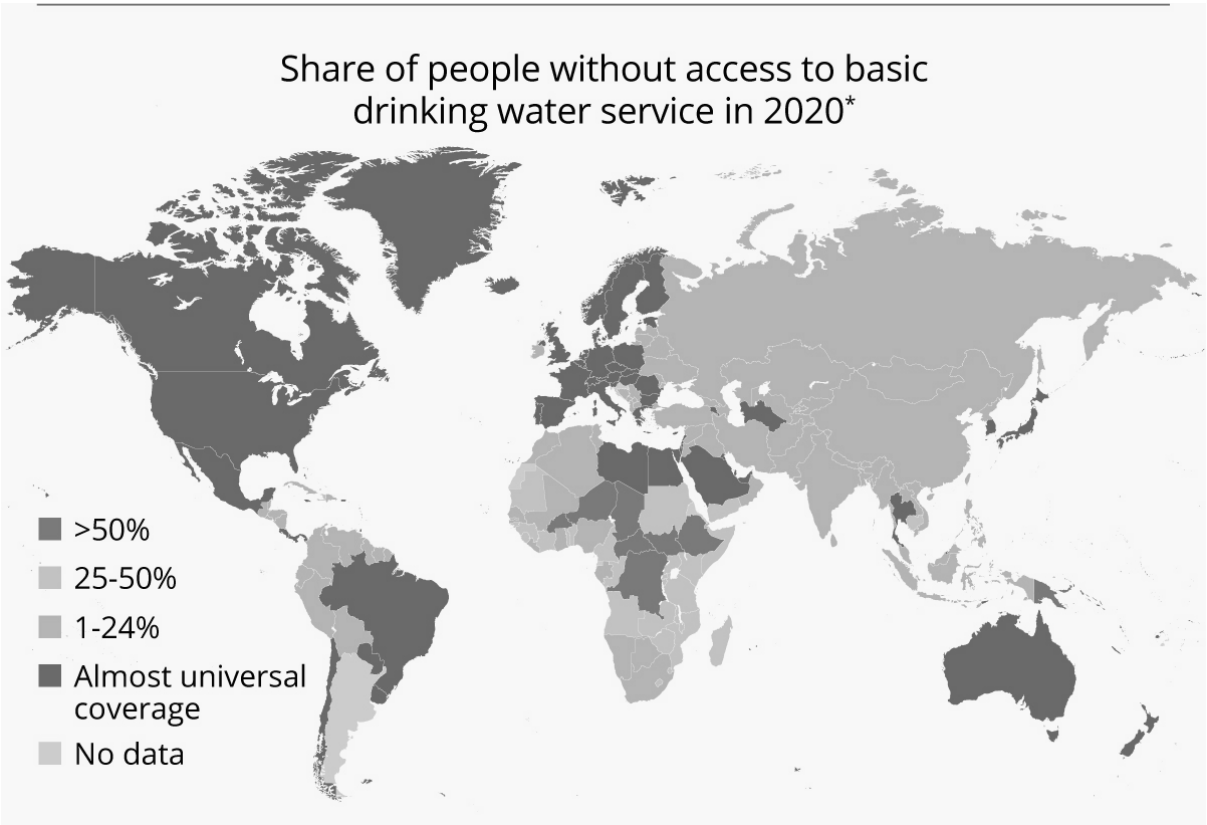


Figure: UV-ray Treatment of Water

UV radiation affects microorganisms by altering the DNA in the cells and impeding reproduction. UV treatment does not remove organisms from the water, it merely inactivates (kills) them. The effectiveness of this process is related to exposure time and lamp intensity as well as general water quality parameters. The exposure time is reported as "microwatt•seconds per square centimetre" (µWatt•sec/cm²), and the U.S. Department of Health and Human Services has established a minimum exposure of 16,000 µWatt•sec/cm² for UV disinfection systems. Most manufacturers provide a lamp intensity of 30,000-50,000 µWatt•sec/cm². In general, coliform bacteria, for example, are destroyed at 7,000 µWatt•sec/cm². Since lamp intensity decreases over time with use, lamp replacement and proper pretreatment are keys to the success of UV disinfection. In addition, UV systems should be equipped with a warning device to alert the owner when lamp intensity falls below the germicidal range. The following gives the irradiation time required to inactivate completely various microorganisms under a 30,000 µWatt•sec/cm² dose at a UV wavelength of 254 nm.

Datas and Statistics of Impure Water

“ Unsafe Water Kills More People Than Disasters and Conflicts ”



Fewer people around the world lack access to basic drinking water services than when the data was last published in 2015. Yet, several countries, especially in Africa, still have a way to go to provide their citizens with safe drinking water. 772 million people around the world still lack even basic access, according to the United Nations, who declared March 22 World Water Day.

This is despite the fact that unsafe water, causing diseases like cholera, typhoid and hepatitis A, is a bigger cause of human death annually than disasters and conflicts combined. This is according to data by PRIO and the Uppsala Conflict Data Program as well as the International Insurance Institute. Children especially are affected by these deadly waterborne diseases.

The UN and WHO joint monitoring program on safe drinking water found that people lacking access to it are currently predominantly located in Africa. South and Central America, on the other hand, offer basic drinking water services (defined as access to protected wells or springs in less than 30 minutes distance) to at least three quarters of the population in all countries except for Haiti. The APAC region generally also provides these basic services to at least three quarters of people, except for in Cambodia and Papua New Guinea.

Conclusion

Water purification, process by which undesired chemical compounds, organic and inorganic materials, and biological contaminants are removed from water. That process also includes distillation (the conversion of a liquid into vapour to condense it back to liquid form) and deionization (ion removal through the extraction of dissolved salts). One major purpose of water purification is to provide clean drinking water. Water purification also meets the needs of medical, pharmacological, chemical, and industrial applications for clean and potable water. The purification procedure reduces the concentration of contaminants such as suspended particles, parasites, bacteria, algae, viruses, and fungi. Water purification takes place on scales from the large (e.g., for an entire city) to the small (e.g., for individual households).Hence, Purification of water is a very important step to remain healthier in life. Purification of Water is not a choice any more, It is Vital and compulsory for a healthy lifestyle.

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