WATER PURIFICATION

Seventy percent of the Earth's surface contains water, but only three percent is drinkable.[1] Water is the most precious resource for life and protecting our access to water should be humanities top priority!

WATER PURIFICATION

The objective of water purifications is to eliminate suspended solid particles, colloids, microorganisms, pyrogens, dissolved organic & inorganic substances, and dissolved gasses. Each of these contaminations can cause serious direct or indirect health risks.[1]

TRADITIONAL METHODS

Boiling

The process involves bringing water to a boil for at least one minute. The high temperatures in the boiling water can kill most microorganisms and pathogens.[2] This method of water purification is not effective at removing heavy metals, i.e. lead, debris, etc. from water.[3]

Distillation

The distillation process begins with brining raw water to boil, producing steam. The steam is directed into a second container where it cools and condenses into purified water. Distillation removes most common types of contamination, making the water produced by distillation Type II-III quality water as per the ASTM standards.[2]

Chemical Disinfection

Chemical disinfection is the process of adding disinfectants into the water to remove, deactivate, or kill microorganisms. Several disinfectants can be used for this process, such as chlorine, chlorine dioxide ozone, copper, silver ionization, or bromine.[3]

Filtration

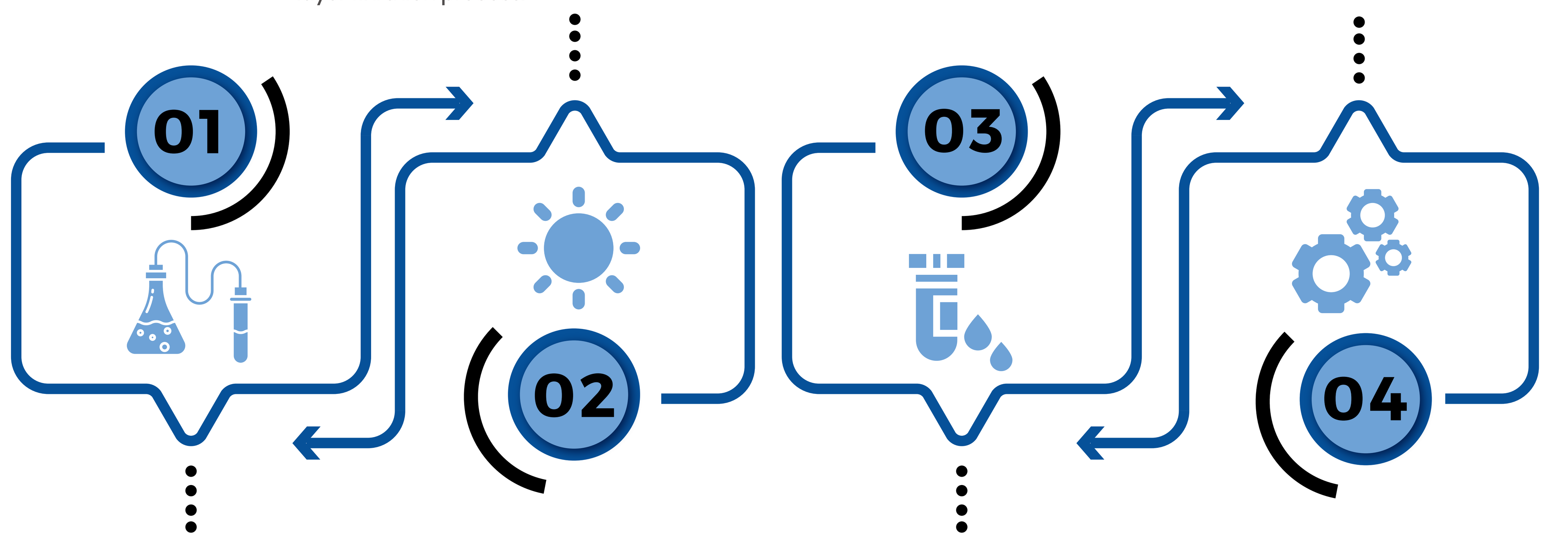
Water filters run water through various sized membranes to separate suspended particles, microbes, bacteria, algae, viruses, and other biological contaminants from the water.[6] The most common filtration membranes are microporous with a 0.03 to 10 micron pore size and ultrafiltration with a 0.002 to 0.1 micron pore size.[7]

UV Light

Ultraviolet (UV) light, which has wavelengths between 200-400nm, kills bacteria and viruses by destroying the molecular bonds that hold their DNA together.[8] In the UV light treatment process, water flows through a stainless -steel chamber with a built-in UV lamp, eliminating microorganisms living in the water.

NEW METHODS

Due to the constant need and scarcity of drinking water, researchers have been developing new water purification methods. These approaches use cutting edge science and technology and could revolutionize how us humans create drinking water.



01 Nanomaterials

Nanomaterials are chemical substances or materials that are manufactured and used at a very small scale.[4] The novel characteristics of nanomaterials can be used to improve various water purification processes:

- Nanosorbents: nanoparticles can be used to absorb inorganic and organic pollutants from contaminated water.[5]
- Nanocatalysts: titanium dioxide (TiO_2) nanoparticles can act as a catalyst to help UV light remove organic compounds from contaminated water.[5]
- Nanostructured filtration: Nanomaterials can provide more efficient and cost-effective membranes for water filtration.[5]
- Bioactive nanoparticles: Magnesium oxide and silver nanoparticles can be used as biocides that combat bacteria such as Escherichia coli.[5]

02 Solar

Companies are testing solar powered water filtration systems. In these systems, solar panels produce electricity helping a pump move water from a reservoir through a water filtration system, producing clean drinking water.[11] These systems are better suited for cleaning highly contaminated water due to the multi-layer filtration process.

03 Plasma

Plasma activated water (PAW), uses a cold plasma reaction with air to create ionized air, which sends elections flying into H_2O water molecules. During the collusions H_2O is split into atomic hydrogen (H) and an OH-radical which combines with another oxygen to create a hydroxyl radical (HO_2).[6] Hydroxyl radicals react with and destroy organic pollutants inside water in a process called advanced oxidation process (AOP).[7]

04 Omni Processor

A system that takes in human/animal bio waste and boils it to separate liquids from the solid matter. The boiling process transforms the liquids into steam and the solid matter into ash. The steam is used to drive a turbine, producing enough electricity to power the Omni Processor with residual electricity to contribute to a power grid. The steam is finally condensed and filtered to create drinkable water.[8] The Omni Processor is presented as a new economic model, allowing the owner of the system to profit from solving problems of waste management, power generation, and water purification for local communities.[9]

WATER PURIFICATION FOR DEVELOPING COUNTRIES

WATER FILTER[16]

Step 1
Acquire a container that is open at the top and has a bottom opening for filtered water to passthrough. A 2-liter soda bottle can be used by cutting off the bottom then flipping it upside down.

Step 2
Build the filter by filling the container in the order shown

Step 3
Pour contaminated water slowly through the filter and catch the water coming out of the filter with a clean container.

Layer 7
Cover the opening with porous cloth, allowing water to pass through.

Layer 6
Gravel (2-3 inches).

Layer 5
Fine sand (2-3 inches).

Layer 4
Coarse sand, pebble size or smaller (2-3 inches).

Layer 3
Fine sand (2-3 inches).

Layer 2
Small charcoal crumbles.

Layer 1
Fine cloth or paper fabric.

NOTE: Small microorganisms and pathogens might still exist in the water after filtering. It is recommended that you pass the water through one of the following methods to further purify the water before drinking

Solar Disinfection (SODIS)[17]

1. Fill clear plastic soda bottles with low-turbidity (clear) water.
2. Place water into direct sun light .
   a. For sunny days, let sit for 6 hours.
   b. For cloudy days, let sit for 2 days.
3. The water is now purified from most microorganisms.

Boiling water[18]

1. Fill a pot with low-turbidity (clear) water.
   a. If water is cloudy, let it settle and filter it through a clean cloth, or coffee filter.
2. Bring water to a rolling boil for at least one minute.
   a. At altitudes above 5,000 feet (1,000 meters), boil water for three minutes.
3. The water is now purified of most microorganisms and pathogens. Let water cool naturally and store it in clean containers with covers.

Distillation[19]

1. Fill a pot with water.
2. Enclose the pot with a lid with one single opening toward the top.
3. Attach a pipe (PBC, stainless steal, copper, rubber) to the opening. Attach the other end of the pipe to a second container to act as a reservoir that collects the clean water.
   a. The pipe will act as a radiator, condensing the steam back into water. There must be enough pipe (at least a foot long) to cool the steam. Larger pots will require larger pipes.
4. Bring the water in the pot to a boil. Keep the boil going until all water has evaporated.
5. The reservoir now has drinking water purified of most microorganisms and pathogen.

ACCESS TO NEW PURIFICATION METHODS FOR DEVELOPING COUNTRIES

Obtain water containers using nanomaterial water filters:
https://iconlifesaver.com/become-a-partner/humanitarian/?v=7516fd43adaa

Access to portable, solar powered water filtration systems:
https://www.worldwatersolar.com/quench/

Plasma oxidizer water treatment:
https://flowrox.com/contact-us/

Omni Processor:
https://www.sedron.com/contact/

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