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WATER PURIFICATION

Hope Amidst The Global Water Crisis

THE SCARCITY OF CLEAN WATER

For you and me, clean water is everywhere from our kitchen faucets to our refrigerator taps, but for many people around the world, water is a scarce commodity.

2.2 billion people do not have access to safe water sources in their home [1]

India

Since 2015, more than 8.3 million people were exposed to harmful contaminants in their drinking water. [2]

Africa

50% of water in Sub-Saharan Africa comes from polluted sources. 60% of the time, water is unavailable for up to 48 [2] hours.

Nepal

91% of the population's drinking water contains significant traces of E-coli and other diseases. [2]

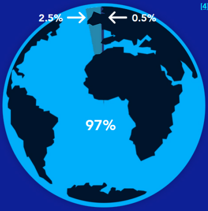
4 billion

people experience water scarcity during at least one month of the year. By 2024, it is estimated that [3]

600 million

children will be living in areas of extremely high water stress. [3]

97 percent: undrinkable seawater
2.5 percent: Frozen freshwater
0.5 percent: Accessible freshwater



[4]

WHERE DOES CLEAN WATER COME FROM?

In developed countries like the US, water is cleaned and filtered in Water Treatment centers. These facilities usually combine four purification methods to create the safest and most hygenic water for surrounding communities. [5]

1. Coagulation and Flocculation [6]

The purification process of adding positively charged chemicals in water to cause negatively charged dirt and pollutants to form clumps called floc.

2. Sedimentation [7]

Floc and other solids settle to the bottom of the water supply due to gravity. This leaves clear water on top to be further filtered and processed.

3. Filtration [8]

Clear top water is passed through filters of various porosity (sand, gravel, charcoal) and is cleansed of dust, parasites, bacteria, viruses, and harmful chemicals.

4. Disinfection [9]

Disinfectants such as chlorine and chloramine are added to the water to kill remaining parasites, bacteria, viruses, and also protect the water as it travels through pipes

Distillation [10]

Distillation is the process of heating water until it boils and then cooling the evaporated water so it condenses back into water without pollutants and bacteria that was originally in it.

Distillation is not utilized in water treatment facility because it is very costly and time consuming at industrial scales, however, for a small sample, distillation is one of the most simple and effective purification method.

« **Now That's Interesting**

Can we build these water treatment centers in developing countries?

Developing nations around the world have their own plants near cities, but it is difficult to construct and sustain a water treatment plant in rural areas. Instead the people living here rely other forms of water purification.

Boiling [11]

Boiling water is the oldest form of household water purification and kills diseases emerging from spores, cysts, ova, and bacteria.

Boiling is the oldest form of household water purification!

Filtration

Pouring water through fine cloth or different porous materials can remove suspended solids and harmful protozoa.

Biosand is a special type of filter that combines biological filtration with common sand and gravel. [13]

FOUR LAYERS OF SARI CLOTH [12]
(a common Indian fabric)
can filter out
99 PERCENT
of cholera bacteria!

Solar Disinfection [14]

Bottles of water are shaken and left out in the sun for 6 hours of the day in order to kill pathogens.

The special reaction between UV rays and oxygen act to deactivate disease causing bacteria.

Solar disinfection is used by over **2 million people** in **28 developing countries**

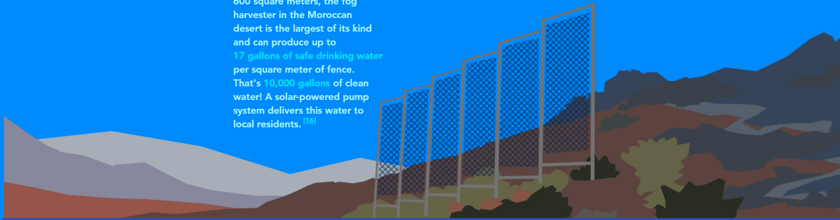
Fog Harvesting [15]

Fog harvesters are large mesh nets that purify water by collecting clean vapors from clouds of fog that move through them. The droplets caught in the net are pulled down by gravity and stored in a reservoir for later use.

Fog Harvesters are essentially large nets and can be easily constructed in areas of need

With an area over

600 square meters, the fog harvester in the Moroccan desert is the largest of its kind and can produce up to 17 gallons of safe drinking water per square meter of fence. That's 10,000 gallons of clean water! A solar-powered pump system delivers this water to local residents. [16]



How are we providing our water purification methods to developing countries?

Recent technological development utilize variations of membrane filtration to bring clean water to the parts of the world that need it the most. Membrane filters trap bacteria, viruses, and other contaminants while letting only pure water through.

SunSpring Hybrid [17]

by Innovative Water Technologies

Powered by solar and wind energy, this portable, self-contained microbiological water purification system provides more than 20,000 liters of clean water a day for rural communities. It uses similar membrane filtration methods used by industrial water treatment plants.

Innovative Water Technologies has provided **30 countries** to date with their patented SubSpring Hybrid, bringing clean water to Haiti, Thailand, Guatemala, Mexico, Cuba, and more! [18]

Lifestraw [19]

by Vestergaard

Lifestraw is a portable handheld drinking straw that uses revolutionary fiber filter technology to remove 99.99% of germs as water passes through. It can purify up to 1,000 liters of water.

Vestergaard has delivered life straws to **3 million children** and they work with non-profits to continually provide this technology to Kenya, Puerto Rico, India, El Salvador, and many other developing countries.

Hydropanel [20]

by Source

Source Global has installed hydropanels in remote areas

Hydropanel is highly advanced hardware that uses solar energy to power fans that pull air through a hygroscopic membrane, trapping clean pollutant free water for drinking.

of **45 countries** including the Palawan province in the Philippines. Here, the hydropanels provide **40,000 liters of clean water every month** [21]

RESEARCH AND FUTURE TECHNOLOGIES!

The Brilliance of Membrane Distillation! [22]

What is Membrane Distillation?

Membrane distillation uses a thin, water-repellant membrane that only allows water vapors to pass through, separating clean and pure water from contaminated water.

Research and Developments

- *Experimenting with different membrane types and materials*
- *Using solar and waste heat as source for membrane distillation*

Applications

Aside from providing safe drinking water to communities in need, membrane distillation has the potential to unlock 97 percent of the global water supply (seawater) for consumption.

Getting it out there!

Once membrane distillation is ready for mass-production, it can be incorporated in **solar powered filters** such as **Hydropanel** and be distributed to developing countries around the world. [23]

Using the entire light spectrum to purify water! [24]

What is this technology?

Researchers at SLAC National Accelerator Laboratory and Stanford University have made prototypes of UV water purifiers which use the entire EM spectrum instead of just UV light. This cut purification time from 48 hours to 20 minutes!

Developments

- *Developments in killing more pathogens besides the three strains of bacteria it was tested on (E.coli, enterococcus and another lactic acid bacteria)*
- *Research in removing chemical pollutants from water*

Applications

Solar powered chemical reactions kill 99.99% of bacteria in a 25-milliliter vessel in 20 minutes but device can be scaled to purify any amount of water. The researchers of this product want to make it suitable for removing all types of bacteria and hard chemicals.

Getting it out there!

With **2.2 billion people** in the world not having access to clean water, this device has the power to benefit many lives.
It costs
only a few dollars
and can be mass produced and distributed in packages to areas of need. [25]

WHO IS HELPING WITH THE WATER CRISIS?

Aside from corporations like Vestergaard, Innovative Water Technolgies, and Source who distribute their own patented technologies to areas of need, several other organizations make efforts to raise awareness, provide relief, and research innovative solutions for the global water crisis.

World Vision[26]

For more than 30 years, World Vision has been partnering and collaborating with community leaders and local residents to provide safe water and sanitation while promoting hygiene education.

By working with local entrepenuerus, World Vision is able to provide low-cost water supplies for digging wells and transport water.

Statistics and data

- 463,177 household latrines constructed
- clean water provided to 3.4 million people
- Hygiene importance taught to 4.3 million people

WaterAid[27]

WaterAid employs a unique two-tiered method to solving the water crisis. First, they have field offices working with local communities around the world in order to provide clean water, safe plumbing, and good

Statistics and data

- 26.4 million people provided with clean water
- 4/4 star rating by Charity Navigator in 2017

hygiene. Second, they work with governments in the US and Internationally to better provide these vital services.

They work in Ethiopia, Uganda, Ghana, Nicaragua, the US, India, Nepal, and many other countries [].

Water for people

[28]

Water For People is a global non profit which aims to bring clean water and sanitation solutions to developing communities indefinitely. Like World VIsion and WaterAid, they work with local governments, businesses, and community leaders to build wells, place pipes, and install taps.

Statistics and data

- 3.6 million people impacted
- 1.3 million people with sanitation services
- 3,913 communities reached with clean water

Charity Water

[29]

Charity water delivers water purification technologies to areas in need while simultaneously funding infrastructure and sanitation projects. They work with local partners and continue to monitor, evaluate, and maintain a sustainable water future.

Statistics and data

- Funded 59,608 water projects
- provided water for over 11 million people
- Programs in 29 countries

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