# Recent Technological Advancements In The Field Of Water Filtration

## Introduction

Engineers of all forms endeavour to convert complex problems into simpler more understandable problems that can be solved easily. While water may be the essence of life it can also potentially be the carrier of dirt, minerals, chemicals, microscopic organisms, bacteria's and other contaminants which can greatly compromise one's health. As a result, engineers all around the world have collectively and individually designed and produced a wide range of water filtration technologies. However, such advancements dependably have their upsides and downsides and accordingly further advances are constantly required, in order to accomplish the best results possible. This report aims to discuss and outline 3 recent technological advancements in the field of water filtration particularly focusing on value and performance and highlight one technology that should be further investigated and developed.

Over the years engineers globally have successfully developed effective water filtration technologies, all ranging from very expensive and complex to simple and cheap. The three introduced below are some of the recent and ongoing developments.

## Solar Sterilisation (SODIS) –

Solar sterilisation is a process that utilises solar energy to make biologically contaminated water safe for human consumption. The UV radiation and heat kills the microbes present in the water, thus making it harmless while also reducing the transmission of diseases via water.

This form of filtration is the cheapest as it merely requires a container for the water and sunlight. According to WHO statistics, 80% of the diseases in developing countries are caused by water related bacteria. Thus, this technology possesses great potential due to its low-cost nature, effectiveness in filtering water and its ability to be used nearly anywhere as all it requires is sunlight. Due to its effectiveness this technology has already been implemented in various developing countries. For e.g. the SODIS utilises both UV light and increased temperature to sterilise water, with the only resources required being sunlight and PET plastic bottles. SODIS is free, effective and a standout amongst the best alternatives for decentralized water filtration in developing countries, where resources are scarce. Another effective way of utilising the SODIS method is by using plastic bags instead of bottles, have proved to yield 74% higher treatment efficiency. They are also much cheaper, smaller, and easier to pack and transport but however unlike bottles they aren't a point-of-use method and will require additional containers for consumption thus increasing the risk of secondary water contamination. Studies have proven the effectiveness of the SODIS method, as SODIS users show reduction values of 30%-80% when it comes to diarrhea. Therefore, SODIS is a viable water treatment method which can easily be applied to areas that lack a centralised water treatment plant or access to other means of water treatment or disinfection. This method is highly economical and has a very low investment cost as it relies on locally available supplies such as plastic bottles and sunlight, thus making it available to all.

However, like all things there are some limitations to this method. In the case of water that is contaminated with non-biological or is highly turbid (>30NTU), SODIS cannot be used alone additional filtration or flocculation is required before the water can be treated with SODIS. Recent developments have found that salt can be utilised as an effective flocculation agent to decrease turbidity. Therefore, expanding the geographical areas in which SODIS can be used, thus allowing highly turbid water to be treated for relatively low costs. However, the SODIS method lacks the ability to treat large volumes or water or improve the chemical quality of water. This method also requires the user to be very cautious as if the water bottle is not left in the sun for the appropriate length of time, the water may not be safe to drink, possibly resulting in severe illness. This can be an issue if the strength of sunlight varies greatly due to overcast or climate. As like all things, there are both positives and negatives but if caution is taken then the positives far outweigh the negatives.

## Solar distillation –

Solar distillation is a water filtration process which utilises solar energy to evaporate water and store its condensate within a closed system. Unlike solar sterilisation, this method also filters cloudy, salty or otherwise unconsumable water due to the presence of minerals and debris through the process of evaporation and condensation. This method can either be cheap and simple or expensive and sophisticated, depending on the required degree of filtration. This method of filtration is often used in remote communities where there is a lack of clean or fresh water. Stills where solar distillation takes place are often a container with a black bottom filled with water, and topped with a clear glass lid. The clear glass lid allows the sunlight to pass through, and the black bottom maximises heat absorption, which accordingly increases the rate of evaporation. The clear topping traps the evaporated water and is channelled away. As most pollutants don’t evaporate with the water, the condensate is pure water.

This form of water filtration is of great benefit as its relatively cheap and requires almost no maintenance as it has no moving parts. It can be used on a house hold level perfect for communities lacking a centralised water filtration system. This process is also very eco-friendly as it utilises renewable solar energy, therefore no pollution and no energy costs.

However, this method also presents some disadvantages, with the main disadvantage being that it can only operate when there is sunlight present, with efficiency heavily relying on the strength of the sunlight. The rate of distillation is very slow and thus time consuming, as it can only filter 6 litres of water on a sunny day hence making it useful for an individual or a household and essentially redundant for large scale water filtration. If the appropriate measures are not taken to safely dispose waste from the distillation process, it can act as a potential source of pollution. Like the technology previously mentioned, solar distillation also has its ups and downs, however proves to be superior to solar sterilisation due to the fact it can be used with highly turbid water as well.

## Procleanse –

Procleanse is a very recently developed All-in-One water filtration system. It’s the perfect filtration system for developing countries where there is a lack of access to safe drinking water, as it’s an extremely low-cost system, with the only cost being the initial purchase cost. Procleanse presents a filtration system capable of filtering 8 litres of water every hour, without

the expenditure of energy, no additional chemicals and no maintenance. Its capable of providing a family of 6 with clean drinking water for 10 years, money-wise they are essentially paying $0.001 cents per litre of water over the systems lifetime. In comparison with other filtration systems it’s considerably cheaper.

The filtration process is fairly simple. The user simply pours dirty contaminate water into the built-in filtration chamber. As the water flows through a strainer, large debris and any potential pathogens they may carry. Consequently, proprietary cleansing materials work to neutralise contaminants through an ion exchange. Then the water simply flows through to an 18-litre storage tank, ready to be used. The active ions further continue the decontamination process.

Compared to the common sand-based filtration systems, the ceramic particles prove to be 10 times more efficient at filtering small and large microorganisms as well as reducing turbidity. The fact that this system utilises a two-stage filtration process consisting of porous granular media filtration and biocidal ion exchange, it ensures maximum filtration. Statistically, this system is capable of removing >99.999% of E. coli. Protozoa and Viruses, found according to extensive water quality tests, presenting results that exceed WHO expectations.

## Conclusion/Procleanse for further development–

Contaminated water is responsible for approximately 2.2 million deaths a year, 1 million of those being children under the age of 6. This is the reality in third world countries due to the lack of a centralised water filtration system. Engineers have been designing point of use water filtration systems for third world /developing countries to address particular factors, such as filtering performance, low weight, economical, low maintenance, power requirements. Most products address some of these factors, but rarely all. Examples can be made from the water filtration systems mentioned above. For e.g. While Both solar sterilisation and solar distillation address most of the factors, they are either big and bulky or lack in filtering performance. Procleanse water filtration system however addresses all these factors, however makes a slight sacrifice in cost in order to ensure quality. While the initial start-up cost might be higher than the other 2 systems, the value provided by Procleanse is far greater at $0.001 cents per litre of water for 10 years. The system weighs merely 18.14 kg allowing for easy transport, it’s also highly durable and no filters or materials are ever needed to be replaced, meaning there’s no ongoing costs. Various charitable establishments have extended their support to the Procleanse water filtration system, and was recently deemed to be one of the most innovative filtration technologies in recent times. Therefore, in light of all the findings presented above, the Procleanse water filtration system is the most appropriate for further research and consequent development, as it in its current form addresses all the factors required for a low-cost water filtration system aimed at third world countries.