SOLARBAG TECHNICAL REPORTS

PURE HEALTH WATER

SOLARBAG®

the future of portable water purification

This document is a compilation of current technical reports, studies, certifications and contaminant removal specifications for the SolarBag. For any further technical questions, please contact Dan Bruce at Pure Health Water (dbruce@purehealthwater.com).

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DIMENSIONS + WEIGHT

Weight: 4 ounces (104 grams)

Capacity: .92 gallons (3.5 liters)

Shipping: Packs flat

Nalgene cap interfaces with industry standard fittings and accessories

First Time Use

Rinse Your SolarBag

Before using the SolarBag for the first time:

1. Remove the cap and insert the attached pre-filter into the SolarBag.
2. Rinse the SolarBag by pouring water through the pre-filter from the tap or source water you intend to purify.
3. Remove the pre-filter.
4. Empty the SolarBag.
5. Repeat rinse.

Using Your SolarBag in 3 Easy Steps

1. Fill the SolarBag

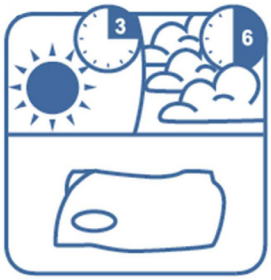
Remove the cap and insert the pre-filter into the SolarBag, fold elastic edge over the SolarBag opening to hold in place. Pour the source water through the pre-filter until the SolarBag is full. Remove the pre-filter and replace the cap.

3. Drink It

Once the water has been purified, use it or pour it into a clean container for drinking or storage. This way you are free to purify more water in your SolarBag while enjoying the previous batch.

2. Purify Your Water

Simply place the full SolarBag on a surface that will be exposed to sunlight for the next few hours; do not place it in a shaded area.



On a clear, warm, sunny day the SolarBag will destroy harmful microbes and chemicals in 2-3 hours. As conditions become cloudy and cool, the energy from the sun is reduced and the time required for purification can take closer to 4-6 hours.

Special Procedures

Pur-Blue Process Timer and Integrity Test

For your convenience, we have included a bottle of the Pur-Blue Process Timer so that you can estimate treatment time in your climate and verify that your SolarBag is still operating correctly.

Simply add one drop of the Pur-Blue to the SolarBag after you have filled it with water, then use the SolarBag as normal. When the color is gone you know the time it takes to treat water in your climate and that your SolarBag is operating correctly.

If the blue color does not go away replace the SolarBag.

Sediment

Water sources with high turbidity due to sediment are difficult to see through and should be allowed to settle in a separate bucket or container until the suspended solids are at the bottom. Transfer the water to the SolarBag through the pre-filter, being careful not to transfer the sediment at the bottom of the container.

Pre-Filter Maintenance

The attached pre-filter can accumulate dirt and grime over time, slowing the rate at which water can be poured into the SolarBag. The pre-filter can be gently washed by hand or you can routinely rinse the pre-filter as needed by pouring water back through it to maximize your flow.

Storage

Before use the SolarBag has a dry shelf life of five years. Do not fold or crush during storage.

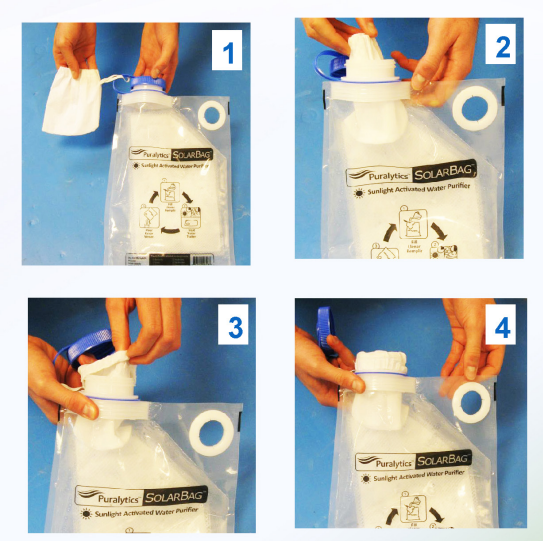
Additional Instructions

The SolarBag does not desalinate water (turn salt water into fresh water). Good water sources for the SolarBag include, lakes, rivers, wells, springs, rain water and tap water.

During purification, place the SolarBag on any flat horizontal surface where it will be exposed to direct sunlight, not shade, and not hung or supported vertically.

Do not shake or twist a SolarBag as that can damage the integrity of the nanotechnology mesh.

PRE-FILTER



Instructions for Use of Pre-Filter

1. Check for filter
2. Put filter into the SolarBag
3. Stretch the elastic band around the outside of the opening
4. Pour the water through the filter into the SolarBag

Pre-Filter material: Pellon® - 40 wt

Removes particles larger than 100 µm in diameter

EPA Purifier Tests - University of Arizona – Tucson, Arizona

Three Puralytics bags each were filled with 2.5 liters of general case water or worst case water. The worst water was pre-filtered through pre-filter cloth (sock filters, with the elastic band at the top and attached to the cap lanyard). The pre-filters were design to reduce the turbidity, but also were found to reduce the concentration of oocysts.

Chemoptix Microanalysis, LLC – West Linn, Oregon

The custom sock filter that comes attached to every SolarBag was analyzed at Chemoptix for pore size. Pores on the filter material were measured for size through the use of turbid water with a wide range of particle densities. The study found that the sock filter removed more than 97% of particles larger than 100 µm in diameter, making it an effective filter for particles exceeding that size.

Light Activated Nanotechnology for Drinking Water Purification

By Mark D. Owen and Dr. Tom Hawkins

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Abstract:
A water purification process is described which uses LEDs or sunlight to excite a nanotechnology coated mesh to activate five photochemical processes. These processes – photolysis, photocatalytic oxidation, photocatalytic reduction, photodisinfection, and photoadsorption – have separately been proven to be effective, and the results of their synergistic combination under LED illumination are reported. The resulting photochemical process is effective at achieving complete disinfection, plus detoxification of water by the removal of heavy metals, and the reduction through photodegradation of microorganisms, organic, and inorganic chemicals. Systems involving the technology have been commercialized and shown to require minimal maintenance, consumables, facilities requirements, with low energy consumption, low pressure drop resulting in low costs for purified water. An overview of the technology and the application of the systems for drinking water disinfection and detoxification is presented.

Key words: Photochemical; Photocatalytic Oxidation; Advanced oxidation; LED; Titanium dioxide; Water purification.

Introduction

Nearly 1 Billion people lack access to any form of improved water supply within 1 km of their home [1]. The poorest 4 Billion people collectively spend more than $20B/yr on water collection and treatment. This consists of collecting water from surface sources often polluted with unknown amounts of animal waste, chemicals, heavy metals, and biological agents; partially treated piped water; shared community resources, individual water purifiers, and mobile water vendors [2].

Figure 1 **Polluted surface sources, long transportation distances, and inadequate storage or treatment is the water situation for billions of people.**

Light Activated Nanotechnology for Drinking Water Purification

Mark D. Owen, Puralytics

The United Nations has asserted safe water as a basic human right [3]. The World Health Organization has defined safe water as when people have access to an improved water source, when the germs are killed or removed, and when toxins are reduced to acceptable levels [4] The UN Millennial 15 year goal from 2000 to 2015 was to provide access to improved water sources, and most people who remain without access are in more remote areas [5]. An improved water source can mean a piped source, a well and pump, a filter, or a bore hole. “Improved” does not mean the water is safe, just that access to enough water has been improved in some way. Germs make you sick tomorrow, toxins hurt you slowly and permanently, and both must be removed for water to be safe. However, the solutions provided by UN organizations and almost every other AID organization and government agency are aimed either at improving access to water or partial disinfection. Toxins are often not measured, and the solutions provided don’t remove them. The majority of the world, >4B people by some calculations, do not have access to SAFE water, where toxins and germs are removed, and that number is increasing, even in places like the United States. Providing municipal treatment systems to urban communities in the world is NOT working, and it won’t work going forward. New solutions aimed at providing safe drinking water for everyone must be developed.

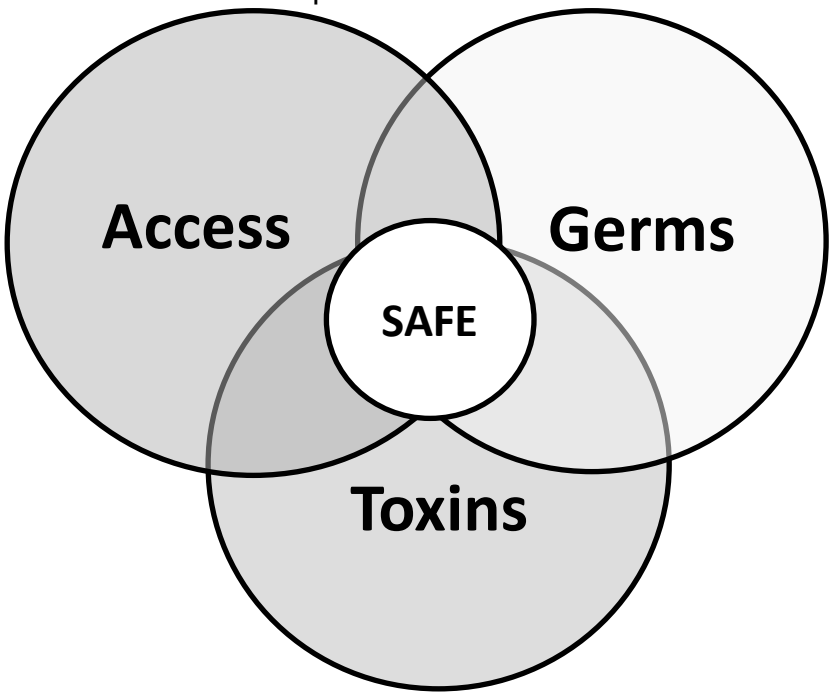


Figure 2 **For water to be *Safe,* a person must have access to enough water, it must be disinfected of germs, and detoxified of chemical and naturally occurring toxins.**

A number of technologies, mostly highly refined versions of 19th and 20th century inventions, are in use to remove contaminants from drinking water, including filtration, reverse osmosis, germicidal lamps, chlorination, and ozonation. However, there are over 1000 new industrial contaminants introduced into the environment each year, mostly new organic chemical compounds, as shown in Figure 3, which were not conceived when these treatment technologies were invented and which cannot practically be removed by these technologies. What is needed are new treatment technologies that address 21st century contaminants, especially organic chemical compounds, with high energy and water efficiency and with simple installation and maintenance suitable for developing world deployment, providing low cost, safe drinking water.

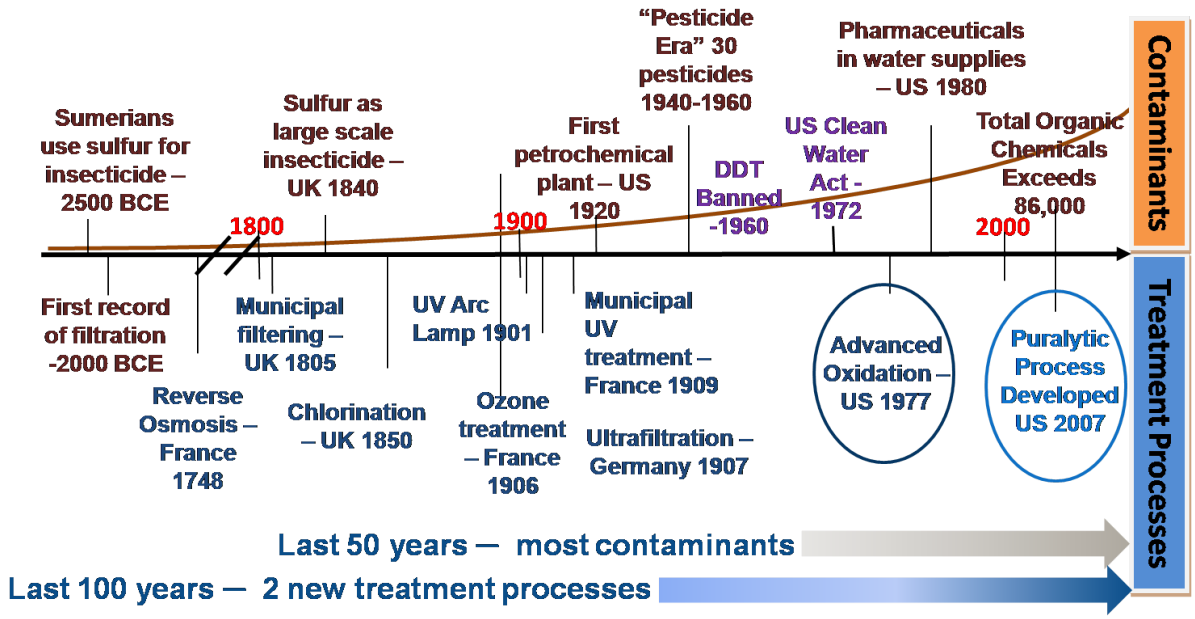


Figure 3. Current water purification status: new pollutants, old purification technologies.

Developing World and Crises

In the developing world, many point of use water purifiers for pathogenic contaminants have been developed, such as disinfecting chemicals, antimicrobial filters, thermal or sunlight disinfection systems, etc., but the ability to address toxins are severely limited in these solutions. In fact, no practical point of use solutions are available that satisfy the basic requirements established by the World Health Organization (WHO), including removal of pathogens, chemicals, and heavy metals [3].

In these guidelines, WHO establishes the need to address not only the microbiological contaminants in water which cause acute illnesses, but also the many other contaminants that lead to chronic health issues. Specifically, WHO defines safe drinking water as water that

> *"does not contain any significant risk to health over a lifetime of consumption, including different sensitivities which may occur between life stages." [3]*

Many common contaminants in polluted water are well known to cause cancer, defects in infants or other illnesses, as well as affecting neurological processes, even at consumption rates as low as 2 liters per day.

Water treatment is only a part of the solution. Transporting or storing water can also introduce contaminants. Additionally, water treatment solutions require skill, maintenance, and consumable supplies which might make them impractical or prohibitively expensive in actual use. In rural, remote, and crisis situations, these needs are amplified. Following a hurricane, earthquake, regional conflict, or environmental disaster, clean water becomes an immediate issue after basic triage. In each large scale disaster – tsunamis, hurricanes/cyclones, earthquakes, etc. – water supply has become critical by day 3 of the crisis, and often remains so for months or years after the acute crisis is over.

Developed World Water Problems A December, 2009 *New York Times* investigative series titled “Toxic Waters” began “The 35-year-old federal law regulating tap water is so out of date that the water Americans drink can pose what scientists say are serious health risks — and still be legal.”[15] Gasoline additives, pharmaceuticals, gas fracking chemicals, industrial solvents, pesticides and many other contaminants have been reported in numerous research papers to be present in municipal, surface, and ground water in both developed and undeveloped countries. Many of these contaminants are man-made chemical compounds that require new technology to remove, including MTBE and other petrochemical products, pharmaceuticals and personal care products (PPCPs), pesticides, insecticides, herbicides, cleaning solvents, textile dyes, and endocrine disrupting compounds (EDCs). Therefore, the compelling, unmet market need is for water treatment solutions that address these man-made chemical contaminants, while also treating microorganisms and other toxic compounds such as heavy metals which might be in water.

In industrial nations, point source or decentralized water purification systems are also used to further purify municipal water or groundwater to remove residual contaminants that could affect processes or products.

- Industrial users – laboratories, food processing lines, water bottling plants, etc. – purify water to remove contaminants that could destabilize production processes, to ensure consistent product quality, or to minimize risk associated with process waste.
- Institutional, commercial, and residential users of drinking water – government facilities, schools, homes, restaurants, coffee shops, hotels, etc. – purify water to ensure drinking water safety and quality.

Currently, multi-stage systems incorporating filters, reverse osmosis, and UV sterilization processes are used for these point source solutions. These systems are almost always customized for the individual application or customer, so system integrators and value-added resellers are used to specify and install what should/could be an appliance. Current trends in contaminant monitoring, government regulations, and health awareness are expanding the need for these decentralized point source drinking water solution as shown in figure 4.

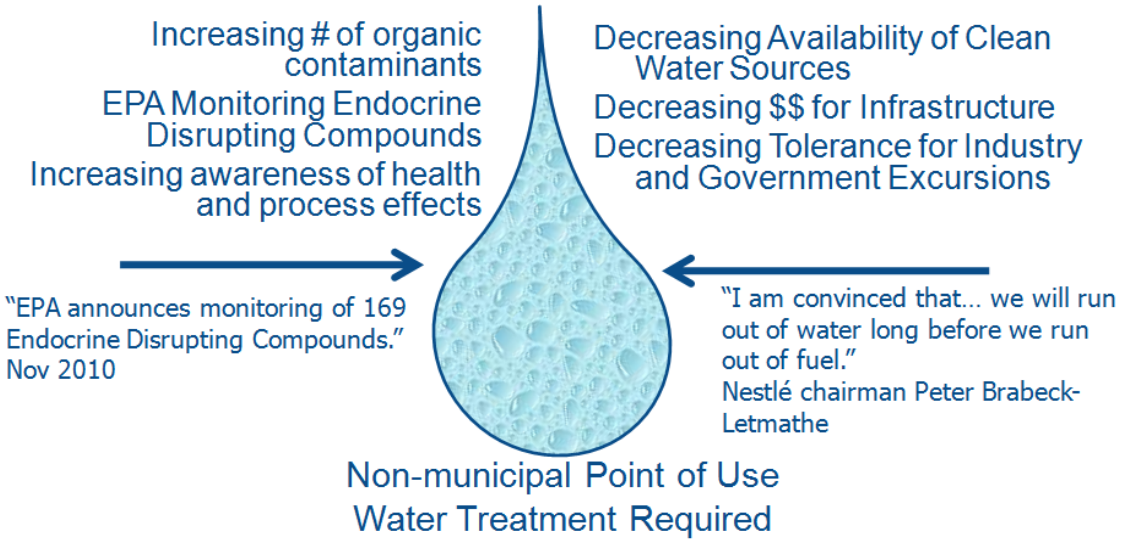


Figure 4- Regulations, water quality and water demand all push toward the growing use of decentralized, point source water purification systems.

Therefore, a low-cost, low maintenance, water purification system is needed to purify water to meet the WHO Guidelines, both disinfecting and detoxifying the water, and to provide safe drinking water for anyone, anywhere in the world.

The Strengths/Limitations of Current Water Treatment Technologies

Since each water treatment is constructed of multiple processes and technologies, it is important to understand the strengths and limitations of these technologies. The processes available for disinfecting and detoxifying water include:

- **Chlorination,** the process of adding chlorine, a strong oxidant, to water is effective and widely used to disinfect water and to provide a residual disinfectant that disinfects pipes and containers. However, in the presence of natural organic matter in the water, undesirable byproducts can be formed, and some pathogens are chlorine resistant. The taste and smell associated with this process have hindered adoption in developing countries.
- **Ozonation,** another strong oxidant, is also used in water treatment, to provide disinfection and some chemical breakdown. The process has narrow process windows and can also produce undesirable byproducts.
- **Distillation,** the process of boiling water and condensing the vapor removes a broad range of contaminants, but is an energy intensive process. Some dissolved organics are transferred to the distillate, especially those with boiling points near or below that of water. Thermal distillation for desalination can be practical when using waste heat from power generation at large scales.
- **Filtration**, including granular activated carbon, ceramic or polymer microporous filters, removes a moderately wide range of contaminants, but requires

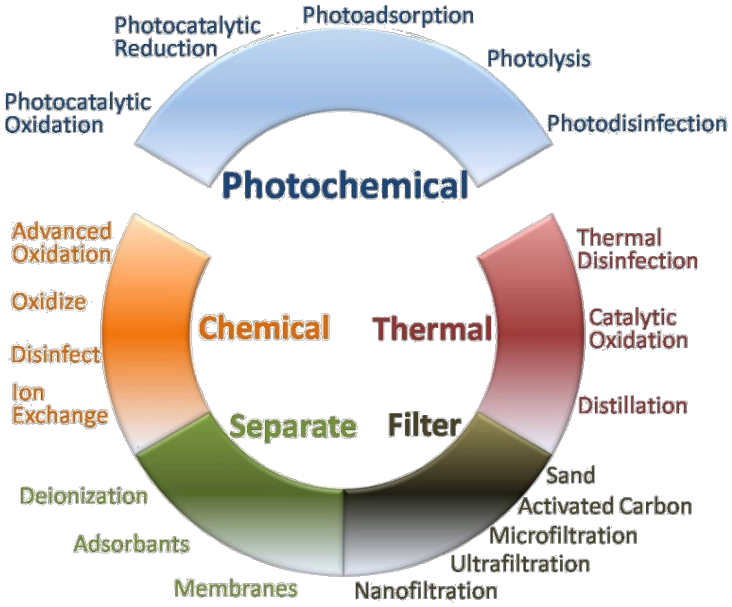
monitoring and filter replacement to assure continuous performance, and saturated filter elements require regeneration or disposal.

- **Reverse Osmosis (RO)**, applies pressure to a membrane to remove ionic and high molecular weight contaminants from solution. RO effectively removes inorganic mineral salts, but typically requires significant energy and generates a waste stream that has greater volume than the purified water stream. It also fails to remove many soluble organic contaminants including some pharmaceuticals, petroleum byproducts, pesticides and herbicides, and other lower molecular weight compounds. RO is another method of desalination widely deployed.
- **UV Germicidal Irradiation (UVGI)** from mercury lamps is an effective disinfectant in clear, transparent water, but monitoring, cleaning, and pre-filtration are required to assure germicidal performance.
- **Ion Exchange** is effective for targeting specific minerals for removal, but does not effectively remove organics, particles, pyrogens, or microorganisms, and requires frequent resin pack change or regeneration processes.
- **Continuous Deionization** removes only a limited number of charged organics, requires very pure feed water for efficient operation, and is commonly used only in laboratory grade water applications.
- **UV Oxidation** uses a deep-UV light 185nm to produce ozone, hydrogen peroxide, and hydroxyl radicals which are effective at the photodegradation and or photolysis of organic chemicals. The ozone and hydrogen peroxide persist beyond the reactor and must be removed, and mercury lamps are very inefficient at producing this wavelength of light.
- **Advanced Oxidation Processes** using hydroxyl radicals produced by UV-activation of ozone and hydrogen peroxide are effective at oxidizing contaminants, but require production and storage of toxic chemicals and are therefore generally impractical in smaller-scale, point source drinking water applications.

Photochemical Water Purification

Puralytics has commercialized a combination of five photochemical processes that have been shown to reduce a broad range of contaminants. These photochemical processes are driven both directly by light and indirectly through light activation of a semiconductor catalyst. These processes include:

- **Photocatalytic Oxidation** – an advanced oxidation process employing hydroxyl radicals produced at the surface of a photocatalyst activated by light.
- **Photolysis** – the direct breaking of molecular bonds by light of appropriate wavelengths.
- **Photocatalytic Reduction** – reduction of a contaminant to a less toxic state at the surface of a photocatalyst.
- **Photoadsorption** – the light enhanced adsorption of contaminants to a surface.
- **Photodisinfection** – using one or more bands of light to disinfect water.

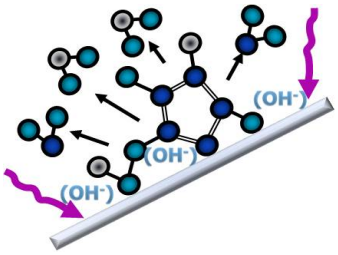


These new processes provide new tools to address the emerging contaminants entering our water supplies, as can be seen in Figure 5. In fact, these synergistic processes can improve removal of trace chemical contaminants, reduce maintenance and consumable replacement frequencies and reduce water waste, thereby providing environmental and health benefits and reducing overall cost of ownership.

Figure 5. New photochemical purification technologies address emerging contaminants

The Puralytics Process

Puralytics has developed a unique and innovative "purification engine" for water, which is scalable and can be packaged to meet the needs of the target markets. The core technology uses light energy supplied by either semiconductor LEDs or sunlight to activate a nanotechnology coated fibrous mesh and thereby to enable the five simultaneous and synergistic purification processes described below:



Photocatalytic Oxidation. Illumination of the photocatalyst with precise wavelength photons produces highly reactive hydroxyl radicals. These break the carbon bonds in organic compounds in the water, providing destruction of the emerging contaminants, including pesticides, petrochemicals, and pharmaceuticals. Photocatalytic oxidation (PCO) by a photo-activated semiconductor photocatalyst has been actively studied [9-12] as an advanced oxidation process applicable to water purification. This process offers non-selective degradation of organic contaminants in water into simpler and less toxic compounds, and ultimately into inorganic ions, CO_2 and water. PCO involves the absorption of energetic photons by the semiconductor and the subsequent production of hydroxyl radicals at the semiconductor surface. While many nanotechnology catalysts have been studied, anatase TiO_2 is a particularly effective semiconductor photocatalyst in converting light into hydroxyl radicals – a more powerful oxidizing agent than ozone and twice as powerful as chlorine – with sufficient energy to completely mineralize organic contaminants. The critical reaction pathway is:

$(TiO_2) + h\nu \rightarrow e^- + h^+$ [electron/hole production]

$(H_2O \leftrightarrows H^+ + OH^-)_{ads} + h^+ \rightarrow H^+ + OH^\circ$ [hydroxyl radical production]

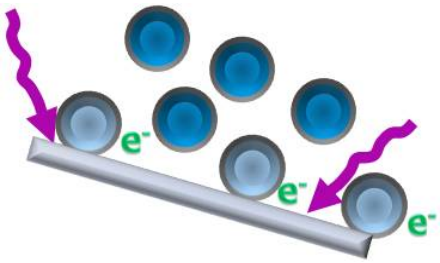
Reactant + OH° → Intermediates → $CO_2 + H_2O$+ minerals.

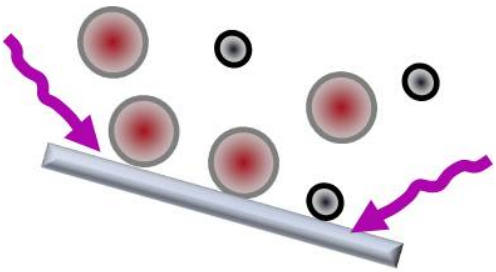
However, cost-effective production of sufficiently high photocatalyst surface area in contact with water, and delivery of enough energetic photons to the semiconductor to activate it, has proven difficult. Systems employing UV-activated TiO_2 slurries have been demonstrated to be effective in breaking down most organic contaminants [13-14], but require complicated, expensive systems for management of the slurry material. Puralytics uses an order of magnitude increase in surface area in a fixed bed reactor with a significant improvement in mass transport over these slurry systems.

Optimized illumination sources are also needed for cost-effective water purification systems. At low UV intensities, less than about 3 mW/cm^2 at wavelengths below 400 nm, production of hydroxyl radicals by UV-illuminated anatase TiO2 photocatalyst is known to be linearly proportional to the UVA intensity, while the production of hydroxyl radicals has been reported [9-10] to increase sub-linearly at higher UVA intensities. Most research to date has been done with lamps illuminating a slurry. These lamps have typically been low pressure Hg lamps emitting at 254 nm or Hg "black light" lamps emitting in the UVA band near 365-370 nm with limited optical flux and efficiency. LEDs are now able to more efficiently emit a band or bands of light that can more optimally excite photocatalytic processes, with important advantages:

- The UVA intensity can be significantly increased without exceeding the range of linear proportionality between intensity and hydroxyl radical production.
- The photocatalyst can applied to a transparent, fixed substrate increasing both surface area and mass transport compared to slurry systems.
- LED illumination avoids the issues associated with using lamps.

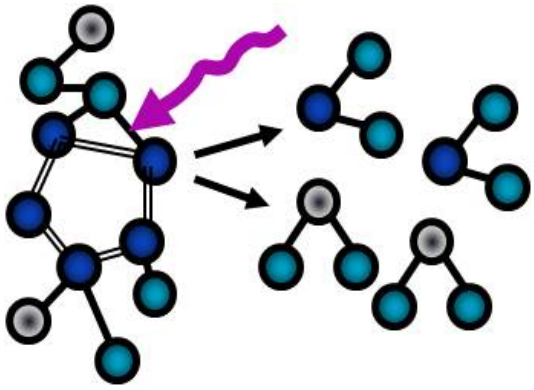
Photocatalytic Reduction. Free electrons produced on the illuminated photocatalyst instantly react with many positive valence compounds including heavy metals and inorganics, reducing them to a less toxic, more elemental state. These reduced compounds demonstrate an enhance affinity for adsorption to the TiO_2 surface, where further oxidation or deposition can occur. Many inorganic compounds and heavy metals have been reported to photoreduce [10].



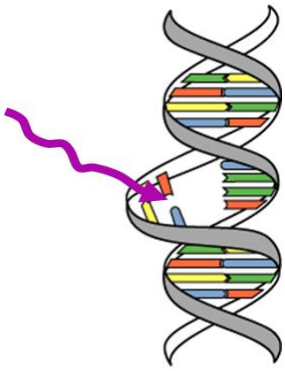


Photoadsorption. The light activated photocatalyst strongly and irreversibly adsorbs heavy metals including mercury, lead, selenium, arsenic, permanganate, and other toxic compounds. Previous reduction reactions enhance this process. Heavy metals are permanently retained in the system, and properly managed when catalyst

replaced. While TiO_2 is already an excellent medium for contaminant adsorption, anatase TiO2 under exposure to UV light becomes an even more aggressive adsorber, and can also irreversibly photodeposit certain contaminants on the TiO2 surface. Compounds involving noble metals and non-noble heavy metals with favorable redox potentials have been shown to photodegrade [6] into molecular components, photoreduce into less toxic forms, and then photodeposit onto the catalyst.



Photolysis. High energy photons directly disassociate many chemical compounds, complementing and enhancing the effectiveness of the other processes. The multiple wavelengths of light used in the Puralytics process broaden the effectiveness of this process. Photolysis is the direct absorption by a contaminant molecule of photons with sufficient energy to directly dissociate chemical bonds. Shorter wavelengths are more energetic and therefore more effective over a wider range of chemical bonds. Hundreds of organic contaminants have been shown to photodegrade under UVA, UVB, and UVC light through direct photolysis.



Photodisinfection. The primary mechanism for sterilization of organisms is disruption of DNA molecules, thereby preventing reproduction. With multiple wavelengths, very high light intensity, and the other synergistic processes, pathogens are disinfected more effectively than standard germicidal irradiation. The combination provides improved sterilization of aggressive viruses, resistant bacteria, protozoa, and molds. Ultraviolet germicidal irradiation with mercury lamps is a well-established process for sterilizing pathogens. For germicidal applications, the 250-280 nm wavelength band is effective at disrupting the DNA of microorganisms. Monochromatic radiation within this band, such as the 254 nm radiation from a low-pressure mercury lamp, sterilizes microorganisms, but a band of wavelengths above 265 nm would be even more effective [7] and reduce dark repair of DNA [8]. Higher-pressure mercury and xenon lamps produce broadband radiation – inefficient for disinfection or for activating a semiconductor photocatalyst. Moreover, UV lamp sources are fragile, and mercury lamps in particular are environmental hazards. UV LEDs, spanning multiple wavelength bands, are effective, safe, and can uniformly illuminate a large area.

These five photochemical processes destroy a broad range of contaminants, effectively removing them from the environment, in a self-cleaning process. Since the nanotechnology is not consumed by these reactions, and only metals remain on the catalyst over time, the media does not need to be replaced until the catalyst is saturated with metals. These reactions can be enabled either through direct sunlight illumination or by using solid state LEDs to provide the precise wavelengths of light that are needed.

The combined reactions primarily produce pure H_2O, dissolved CO_2, and trace minerals as byproducts.
These photochemical processes, working together within the Puralytics products, provide a disruptive new entry to the water purification market and enable new applications not currently possible.

Test Results

The product technology has been tested in challenge water to exceed the *US EPA Guide Standard and Protocol for Evaluation of Microbiological Water Purifiers* [16]. Specific tests on representative contaminants were conducted using appropriate test methods at 3rd party test labs with results as shown in Figure 6 below.

Contaminant	Compound Feed (ppm)	Product (ppm)	% Reduced	Log Reduction
Raoultella Terrigena	10^6 CFU/L	ND	99.9999%	>6
Poliovirus type 1	10^6 PFU/L	ND	99.9999%	>6
Cryptosporidium Parvum Oocysts	2 x10^8 PFU/L		99.99%	>4.1
Simian Rotavirus	10^6 PFU/L	ND	99.9999%	>6
Malathion	0.0089	<0.00006	>99%	>2.17
Pyriproxyfen	0.0071	<0.00006	>99%	>2.17
Prometon	0.0089	<0.00006	>99%	>2.07
Carbon tetrachloride	3.317	2.293	30.9%	0.160
1,2,3-trichloropropane	2.842	0.979	65.5%	0.463
Methyl tert-butyl ether	2.000	0.014	99.3%	2.150
Nitrobenzene	2.626	0.025	99.0%	2.018
Trichloroethylene	2.555	0.002	99.9%	3.133
Toluene	1.694	0.001	99.9%	3.201
Caffeine	3.883	0.513	86.8%	0.879
Arsenic	0.535	0.002	99.6%	2.40
Lead	0.535	0.002	99.6%	2.40
Mercury	0.393	0.0014	99.6%	2.45
Selenium	0.617	0.028	95.5%	1.35

Figure 6- Shield system removal performance on representative contaminants as tested by Oregon Health Sciences University, Pacific Agricultural Labs, University of Arizona, and Test America.

The five photochemical processes synergistically combine to reduce or eliminate a range of contaminants as shown in Figure 7 below. Over 800 contaminants have been researched and shown to be reduced by one or more of the photochemical processes. Note that several contaminants have been reported to be reduced by two or more of these processes.

	Puralytics Active Purification Processes				
Contaminant	**Photocatalytic Oxidation**	**Photocatalytic Reduction**	**Photolysis**	**Photo Adsorption**	**Photo Disinfection**
Dichromate	■	■		■	
Arsenic		■		■	
Caffeine	■		■		
Cerium		■		■	
Cobalt		■		■	
Copper		■		■	
Cryptosporidium	■				■
Estradiol	■		■		
Giardia lamblia	■				■
Heterotrophic plate count	■				■
Lead		■		■	
Lead dioxide		■		■	
Legionella	■				■
Legionella pneumophila	■				■
Manganese Oxide		■		■	
Mercury (inorganic)		■		■	
Permanganate		■		■	
Saccharomyces cerevisiae	■				■
Silver		■		■	
Staphylococcus aureus	■				■
Streptococcus faecalis	■				■
Streptococcus sobrinus	■				■
Styrene	■		■		
Sulfamethoxazole	■		■		
Total Coliforms (including fecal coliform and E. Coli)	■				■
Turbidity	■			■	
Viruses (enteric)	■				■
1,1,1,2-Tetrachloroethane	■				
1,1,1,2-Trichloroethane	■				

Figure 7- Sample of over 800 contaminants that have published research showing reduction by one or more of the five photochemical processes herein reported. A complete list can be downloaded at www.puralytics.com.

Conclusions

A water treatment system has been developed that incorporates five photochemical processes based upon light activated nanotechnology that work synergistically together to completely destroy microorganisms and significantly reduce a broad spectrum of chemical contaminants including emerging organic chemicals of concern, as well as many inorganic chemicals and heavy metals.

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GENERAL QUESTIONS

There are hundreds of water purifiers. What's the big deal about this one?

Simply put, no other portable water purifier on the market reduces as many contaminants, metals and pathogens as the SolarBag. If you find one, let us know about it. It's also extremely easy to use because it doesn't require any electricity or chemicals and has no moving parts. Plus the purified water tastes great, unlike iodine tablets and other purifiers.

I don't get it. How does this thing work?

Inside the SolarBag is a nanotechnology-coated mesh insert, which is activated by the UV rays of the sun. This initiates a purification process which includes five separate photochemical actions addressing more contaminants than any other portable water treatment product.

- Chemicals are broken down to harmless minerals
- Metals are removed from the water and sequestered by the insert
- Pathogens are killed and rendered harmless

This sounds too good to be true. What's the fine print?

The SolarBag offers the broadest contaminant removal of any portable water purifier. It does not, however, desalinate water (turn salt water into fresh water).

Extremely cloudy or turbid water (darker than tea color) inhibits sunlight, slowing the purification process. Generally speaking, if you cannot see through the water in the SolarBag, it is probably too turbid to use. If another water source is not available, pour the turbid water into a separate container and allow suspended solids to settle. Once the solids have settled, try pouring the water back into the SolarBag.

Fine, suspended inorganic particles (clay, sand, silica) are primarily unaffected by the technology.

Lipids (fats, oils) float on the water and do not come into contact with the nanotechnology mesh.

The nanotechnology is a non-toxic, FDA-approved, food-safe material. Accidental ingestion of the mesh has no adverse health effects.

Is it reusable?

Yes. The SolarBag treats up to 3.5 liters of water at a time, and can be reused hundreds of times. An ongoing field test of the SolarBag in Malawi has found the SolarBag can be used 1000 times without requiring replacement.

How long does it take the SolarBag to purify water?

The SolarBag requires only sunlight to treat water. Treatment is fastest with intense sunlight and is further accelerated with increasing water temperature. Sunny days in lower latitudes are ideal. In higher latitudes or with murky water or with overcast skies, water treatment takes longer. On a clear, warm, sunny day the SolarBag will destroy harmful microbes and chemicals in 2-3 hours. As conditions become cloudy and cool, the energy from the sun is reduced and the time required for purification can take closer to 4-6 hours.

Purification times can be longer on the first and second use of the SolarBag as the device cleans itself of contaminants it may have picked up from the air.

How can I tell when the water is ready?

Simply add one drop of the Pur-Blue (included with purchase) to the SolarBag after you have filled it with water, then use the SolarBag as normal. Pur-Blue is a special type of non-toxic dye, a particularly complex molecule to remove from water. When the blue water becomes clear, the water has been fully treated.

How do I know when a SolarBag is worn out?

The SolarBag is reusable hundreds of times because the nanotechnology-coated mesh is self-cleaning. But if your source water no longer turns clear after a full day of sunlight exposure, the SolarBag has reached the end of its lifespan. Try testing your SolarBag with tap water and a drop of Pur-Blue (included with purchase). If the blue color in the water does not disappear, discard your SolarBag.

How do I dispose of a SolarBag?

Cut the SolarBag open at the base and remove the mesh insert. Dispose of the insert as non-toxic solid waste. The bag can then be recycled as Type 7 plastic (mixed). Check with your local waste management provider to ensure proper disposal.

TECHNICAL QUESTIONS

Can it turn salt water into fresh water?

No. The SolarBag is not a desalination system. It will purify salt water but not remove the salt. For drinking water, fill the SolarBag from fresh water sources only.

Does the SolarBag remove chloride and floride?

Monovalent monatomic anions like chloride or fluoride will not be removed in a SolarBag.

How does the SolarBag remove metals from water?

The simple answer: Harmful metals such as arsenic, mercury, and chromium stick to the surface of the mesh insert and are thereby removed from the water.

The technical answer: Transition and heavy metals such as arsenic, mercury, and chromium are vulnerable to photo-reduction in the SolarBag. Reduced metals are attracted to the positively charged surface of the catalyst and are removed from the water by adsorbing to the catalyst surface. Once adsorbed, the chemistry profile of the metals changes so they are non-toxic.

Can I purify water indoors with light through a window?

Most glass windows block UV rays and thereby inhibit the SolarBag's purification process. Instead, place the SolarBag in an area open to the sky, or open your window so that direct sunlight falls on the SolarBag.

Is the SolarBag BPA free?

Yes. The SolarBag is an engineered bi-layer plastic: the outside layer is designed for strength and resilience; the inside of the bag is BPA-free and designed for water contact.

What is the shelf life of the SolarBag?

The SolarBag has a dry shelf life of seven years. It should be stored in a dry environment and kept out of direct sunlight.

U.S. EPA PROTOCOLS

SUMMARY of EPA Purifier Tests
University of Arizona | Tucson, Arizona

The independent laboratory at the University of Arizona has run several tests to evaluate the ability of the SolarBag to inactivate microbial contaminants in the method outlined in the EPA Guide Standard and Protocol for Testing Microbiological Water Purifiers. The co-author of the document, Dr. Charles Gerba, has overseen all the experiments and ensured that the testing of the SolarBag has been consistent with the EPA guidelines.

Three SolarBags were tested in parallel to evaluate the product's ability to kill bacteria (Raoultella terrigena), virus (poliovirus/rotavirus) and protozoan cysts (cryptosporidium) to the respective levels specified in the EPA guidelines of 6-log (99.9999%), 4-log (99.99%), and 3-log (99.9%). Each contaminant was tested in two different types of water. EPA Test Water #1 represents general test water that is similar to U.S. tap water. EPA Test Water #4 is the EPA standard for worst case water for UV light dependent purification products. Each bag was filled with test water and exposed to direct sunlight for 4 hrs before being sampled.

The results of this testing have demonstrated that the SolarBag exceeded the requirements the EPA guidelines for water purifiers, achieving 6-log reductions on both bacteria and virus and a 4-log reduction on protozoan cysts.

Additional testing demonstrated that the SolarBag removed all arsenic in the challenge water to nondetectable levels below 5 ppb from the EPA limit of 10 ppb.

Department of Soil, Water and
Environmental Science
College of Agriculture and Life Sciences

THE UNIVERSITY OF
ARIZONA®
TUCSON ARIZONA

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This is to certify that the Department of Soil, Water and Environmental Science of University of Arizona has evaluated the Puralytics SolarBag as per *U.S. EPA Guide Standard and Protocol for Evaluation of Microbiological Water Purifiers* and have found that the SolarBag exceeded the required reductions of bacteria, virus and protozoa.

Puralytics may use the test report and results for marketing purposes and as independent test results of the SolarBag performance.

Puralytics may reference that the testing was performed at the University of Arizona.

Sincerely,

Charles P. Gerba, Ph.D.

Laura Y. Sifuentes, M.P.H.

Evaluation of Puralytics SolarBags for Removal of Bacteria, Virus and Protozoa According to the U.S. Environmental Protection Guide Standard and Protocol for Testing of Microbiological Purifiers

Laura Y. Sifuentes, M.P.H.

Charles P. Gerba, Ph.D

December 15, 2011

Introduction

To ensure the efficacy of microbiological water purifiers the U.S. Environmental Protection Agency developed the Guide Standard and Protocol for Testing of Microbiological Water Purifiers, which was published in the Federal Register of May 26, 1986. This document provides the details for the test and performance requirements for devices designed to remove microorganisms from water. The guide establishes that any microbiological water purifier be capable of removing or killing enteric bacteria, viruses and protozoan parasites. Such units should be capable of reducing challenge levels of suggested microbial contaminates in each class of microorganism. The units must demonstrate at least a 99.9999% (6 log) removal of the enteric bacterium *Raoultella terrigena* (formally *Klebsiella terrigena*), a 99.99% removal of poliovirus and rotavirus, and a 99.9% removal of *Giardia*. *Cryptosporidium* has been substituted for *Giardia* because of its greater resistance to removal by disinfectants and filtration (Korich et al, 1990).

The purpose of this study was to assess the performance of Puralytics SolarBags to remove test microorganisms in accordance with the EPA Guide Standard and Protocol for Microbiological Water Purifiers.

Material and Methods

Six Puralytics SolarBags were supplied by the manufacturer (Puralytics, 15250 NW Greenbrier Parkway Beaverton, Oregon 97006-5764) and operated according to the manufacturer's instructions.

The units were challenged with both "General Case" (Test Water #1) and "Challenge Test Water "(Test Water # 2 – also referred to as "Worst Case"). Dechlorinated tap water from the University of Arizona (activated-carbon filtered) was used for the general case test water. The chemical/physical properties of this test water are show in Table 1. For the Challenge Test Water the dechlorinated tap water was used and the desired turbidity of the water adjusted by addition of approximately 88 mg/L of AC fine dust to obtain a turbidity of 30 NTU (GM, Flint, MI). total organic carbon (TOC) (10 mg/L was obtained by addition of approximately 23 mg/L of humic acid (Aldrich Chemical Company, WI), and Total Dissolved Solids (TDS) (1,200 mg/L added to obtain a final concentration of approximately 1,500 mg/L), by addition of 1.5 g/L of sea salts (Sigma Chemical Company, St. Louis, MO). The pH was adjusted to 9.0 by addition of 1 N NaOH). For the worst case water challenges the water was held in a refrigerator until the temperature reached 4 ^{o}C.

Table 1. Physical/chemical properties of Tapwater at the University of Arizona (General Case Test Water – Test Water #1)

pH	7.5-7.8
Total Organic Carbon	<1.0 mg/L
Turbidity	<1.0 NTU
Temperature	23-25 ^{o}C
Total Dissolved Solids	200-300 mg/L

Bacterial Analysis

R. terrigena (ATCC-33254) was grown overnight in Trypticase soy broth (EMD, Gibbstown, NJ) at 35 ^{o}C to obtain the organisms in the stationary growth phase. The bacterial cells were pelleted by centrifugation and resuspended in 0.25 M phosphate buffered saline at pH 7.0. This procedure was repeated three times to remove organic matter present in the broth. Bacterial assays were conducted using the spread plate method on EMB agar (EMD, Gibbstown, NJ).

Virus Analysis

Poliovirus type 1 (strain LSC-2ab), obtained from the Dept. of Virology and Epidemiology, Baylor College of Medicine, Houston TX and simian rotavirus (ATCC-VR-899) obtained from the American Type Culture Collection were used. Poliovirus was grown in the BGM cell line and rotavirus in the MA-104 cell line. After observation of extensive cytopathic effects, virus infected cells were harvested by three cycles of freeze-thawing of the infected cell monolayer. The cell lysates were then treated with an equal volume of Vertrel KF (Micro Care Corp., New Britain, CT) at 4 ^{o}C, stirred for 10 min on a magnetic stirrer and centrifuges at 10,000 rpm in a Beckman J2-21 centrifuge. The aqueous phase was collected and filtered through a sterile 0.45 µm pore-size membrane filter and stored at -70 ^{o}C till needed.

Titers of poliovirus and rotavirus were determined by the plaque forming unit method using 25 sq cm tissue culture flasks and 6 well cell culture plates (Smith and Gerba, 1982).

Cryptosporidium

Cryptosporidium parvum oocysts were obtained from the laboratory of Dr. Charles Sterling, University of Arizona. They were collected from the feces of infected calves and purified by discontinuous sucrose gradient (Arrowood et al. 1987). Infectivity of the oocysts was determined by the methods described in Di Giovanni et al. (1999) using infectivity in cell culture.

Test procedures

Worst case water was placed in 4 L beakers and stirred until reagents were completely dissolved. Test microorganisms were added and stirred for one minute (10^6 CFU/L bacteria, 10^6 PFU/L for viruses and 2 X 10^8 for *C. parvum*).

Three Puralytics bags each were filled with 2.5 liters of general case water or worst case water. The worst water was pre-filtered through pre-filter cloth (sock filters, with the elastic band at the top and attached to the cap lanyard). The material used in those filters is Pellon® - 40 wt.). The pre-filters were design to reduce the turbidity, but also were found to reduce the concentration of oocysts.

The bags were placed under direct sunlight for the duration of each experiment. Bags were placed on a cardboard surface with the labels facing down as instructed. The temperature of the water in the bag as well as the air temperature and air humidity was measured at each sampling time. In addition, the UV light intensity was also measured.

Samples were collected from the bags right after addition to the bags and after four hours exposure to sunlight. The organisms were tested on different days as indicated:

- 7/8/11-Poiovirus and rotavirus
- 7/9/11-*R. terrigena*
- 9/20/11-*Cryptosporidium parvum*

Table 2. Water and air temperatures, relative humidity and UV light intensity during testing

		Viruses		*R. terrigena*		*Cryptosporidium*	
Water Temps [^{o}C]		**7/8/2011**		**7/9/2011**		**9/20/2011**	
	Exposure Time (Hours)	0	4	0	4	0	4
General Case Water	**Replicate 1**	25	48	24.3	54.7	27.7	56
	Replicate 2	25.8	48	24.7	54	27.6	55.5
	Replicate 3	26	48	25	53.4	27.9	56.9
Worse Case Water	**Replicate 1**	25.4	48.4	26	53.4	28.5	60.2
	Replicate 2	25.7	47.9	25.3	54	27.7	59.9
	Replicate 3	25.4	47.9	24.2	53.6	27.8	60.7
Outdoor Temps [^{o}C]		31.8	41	28.4	43	35.3	36.6
Relative Humidity [%]		53	24	47	38.5	46	20
UV 280-400 nm [mW/cm^{2}]		31.4	27.8	24	19.5	30	35.2

Table 3 shows the reductions in poliovirus type 1 and rotavirus SA-11 within the SolarBags. Both viruses were reduced below detection or by greater than 99.9999% or 6 logs. The test bacterium was also reduced by greater than 6 logs (Table 4). *Cryptosporidium parvum* was reduced by almost 2 logs by filtration and another two logs by the sunlight exposure achieving from 3.3 to 4.10 log removals (Table 5).

Table 3: Log Reduction of Rotavirus and Poliovirus after filtration and 4 hour exposure to sunlight.

	Worse Case Water			General Water		
Virus	**Replicate 1**	**Replicate 2**	**Replicate 3**	**Replicate 1**	**Replicate 2**	**Replicate 3**
Poliovirus (PV-1)	> 6	> 6	> 6	> 6	> 6	> 6
Rotavirus (SA-11)	> 6	> 6	> 6	> 6	> 6	> 6

Table 4. Log Reduction of *R. terrigena* after filtration and 4 hour exposure to sunlight.

	Worse Case Water			General Water		
Bacteria	**Replicate 1**	**Replicate 2**	**Replicate 3**	**Replicate 1**	**Replicate 2**	**Replicate 3**
R. terrigena	> 6	> 6	> 6	> 6	> 6	> 6

Table 5: Log reduction inactivation of *C. parvum* after filtration and 4 hour exposure to sunlight.

	Worse Case Water			General Water		
Time (Hour)	**Replicate 1**	**Replicate 2**	**Replicate 3**	**Replicate 1**	**Replicate 2**	**Replicate 3**
0	1.72*	1.70	1.82	1.72	1.7	1.7
4	3.52	4.10	3.36	3.94	3.81	3.42

*loss in oocysts due to filtration

Conclusions

The Puralytics SolarBags exceeded the required reductions of the test organisms as required for microbiological water purifiers after a four hour exposure to sunlight.

References

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ISTANBUL TECHNICAL UNIVERSITY
ISTANBUL, TURKEY

SUMMARY of Testing
Istanbul Technical University | Istanbul, Turkey

The city of Istanbul required that they test the performance of the SolarBag before authorizing the product. Istanbul Technical University independently tested the SolarBag to their drinking standards for pathogen reduction. Water contaminated with E. coli and four strains of protozoa was tested in the SolarBag under normal operating conditions a resulted in a 99.875% reduction in E. coli and 99.99% reduction of protozoa. This test result allowed the city to approve sale of the SolarBags within Istanbul.

İSTANBUL TEKNİK ÜNİVERSİTESİ, İNŞAAT FAKÜLTESİ
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02-07-2012

MİKROBİYOLOJİK ANALİZ RAPORU

1. KONU: Puralytic SolarBag Ticari Marka Su Temizleme Torbalarının Bakteri ve Protozoa Giderim Verimlerinin Belirlenmesi.

NUMUNE HAZIRLANMASI: Testte kullanılacak bakteri kültürü olarak seçilen *Escherichia coli* (KUEN 101 Nolu Suş) İstanbul Tıp Fakültesi Mikroorganizma Kültür Koleksiyonları Araştırma ve Uygulama Merkezinden (KÜKENS) temin edilmiştir. *E. coli*'nin saf kültürü Plate Count Besiyerinde (PCA) çoğaltılmış, çoğalmasından sonra SolarBag Torbaya konulacak bakteri sayısı için Plate Count Agar plakalarına ekilerek stok besiyerindeki sayıları Koloni Oluşturan Birim (KOB) olarak tespit edilmiştir. Daha sonra uygun seyreltiler yapılarak farklı konsantrasyondaki bakteri numuneleri hazırlanmıştır. Her bir seyrelti için Plate Count Agar da ekim yapılarak sayıları tespit edilerek giriş konsantrasyonları belirlenmiş ve bu numuneler SOLARBAG Torbalarına toplam 3 Litre olarak aşılama yapılmıştır. Protozoa testleri için doğal ortamdan alınan örnekler besi maddeleri eklenerek protozoaların 1 hafta süreyle laboratuvar ortamında çoğaltılması sağlanmış, tanım ve sayımları Neubauer Chamber tip sayım lamında mikroskobik olarak belirlenmiştir. Geliştirilen bu kültür içerisinde *Paramecium* spp., *Lionotus* spp. ve *Colpidium* spp. türleri tespit edilmiştir. Her bir türün konsantrasyonları belirlenerek SolarBag torbalarına aşılamaları yapılmıştır.

2. BAKTERİ MİKTARI: Giriş seyreltme suyu olarak filtrelenmiş ve havalandırılmış çeşme suyu kullanılmıştır. Bu giriş seyreltme suyuna $3,2X10^5$ KOB/100 ml *Escherichia coli* olacak şekilde aşılanmıştır.

3. PROTOZOA MİKTARI: Filtrelenmiş havalandırılmış çeşme suyu Protozoaların giriş seyreltme suyu olarak kullanılmıştır. SolarBag giriş suyuna *Paramecium* spp. konsantrasyonu $6x10^3$ hücre/100ml, *Colpidium* spp. $2,5x10^3$ hücre/100ml, ve *Lionotus* spp. $1,5x10^3$ hücre/100ml olacak şekilde aşılama yapılmıştır.

4. METOD: Bakteri ve protozoalarla aşılanmış SolarBag torbaları açık havada güneş altında (İstanbul da hava sıcaklığı 32^0C olduğu açık ve bulutsuz bir günde ve saat $11\text{-}14^{00}$ arasında yürütülmüştür. SolarBag torbalar güneş altında zeminle 45 derece açı yapacak şekilde 4 saat süresince güneşe enerjisine maruz bırakılmıştır. 4 saatlik temas süresi sonucunda alınan torbalarda *Escherichia coli* analizleri Standart Metotlar (2005) da belirtilen Membran Filtreleme Metodu (9222 Numaralı) uygulanarak M-Endo besiyerlerinde 37 ^{0}C de 24 saat inkübasyona tabii tutulmuş ve plakalar koloni sayacı altında sayılarak analiz sonuçları belirlenmiştir. Protozoalar içinde aynı gün ve saatlerde aşılama ve 4 saatlik temas süresi sonucunda alınan örneklerde mikroskop altında Neubauer Chamber tipli sayım lamında incelenerek varlıkları araştırılmıştır.

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5. ANALİZ SONUÇLARI: Yapılan mikrobiyolojik analizler sonucunda elde edilen sonuçlar aşağıda tabloda verilmektedir.

Mikroorganizma Çeşidi	Giriş Mikroorganizma Konsantrasyonu	Çıkış Mikroorganizma Konsantrasyonu	Giderim verimi (%)
Escherichia coli, (KOB/100ml)	$3,2x10^5$	$4x10^2$	99, 875
Paramecium spp. (hücre sayısı /100ml)	$6.0x10^3$	<1	99,98
Colpidium spp. (hücre sayısı /100ml)	$2,5x10^3$	<1	99,96
Lionotus spp. (hücre sayısı /100ml)	$1,5x10^3$	<1	99,93
Toplam Protozoa (hücre sayısı /100ml)	$1,0x10^4$	<1	99,99

DEĞERLENDİRME: Yapılan mikrobiyolojik analizler sonucunda elde edilen değerlerden Puralytic SolarBag Su arıtma torbalarının *Escherichia coli* bakterisinin KUEN 100 nolu suşunu yukarıda belirtilen giriş koşulları altında % 99,875 oranında, toplam protozoa hücrelerini (*Paramecium* spp., *Colpidium* spp., *Lionotus* spp.) % 99,99 oranında giderdiği tespit edilmiştir. Bu sonuçlar neticesinde elde edilen giderim verim değerlerinin giriş mikroorganizma konsantrasyonuna bağlı olarak değerlendirilmesi gerekmektedir.

Prof. Dr. İsmail KOYUNCU Doç. Dr. İbrahim DEMİR Doç. Dr. Süleyman ÖVEZ

İ.T.Ü.
İnşaat Fakültesi
Çevre Mühendisliği Bölümü
Öğretim Üyeleri

MINISTRY OF WATER & IRRIGATION KISUMU, KENYA

SUMMARY of Testing
Ministry of Water and Irrigation | Kisumu, Kenya

The government of Kenya required an in-house performance test to approve product distribution within their borders. The Ministry of Water and Irrigation was given the required number of SolarBags and they tested bacterial reduction in water from Lake Victoria through the water quality laboratory in Kisumu.

Lake Victoria was chosen for study as it is the largest tropical lake in the world and is located in a densely populated rural area. The lake has a high degree of pollution stemming from raw sewage, fertilizer and farm runoff, as well as the dumping of domestic and industrial waste.

Water was pulled from a commonly used drinking water source in Lake Victoria where the Nzoia river discharges at the lake. The sample was poured into the SolarBags through two layers of standard cloth to reduce the turbidity. The SolarBag was left under direct sunlight for 2 hours. After exposure there was no reproducing coliform detected in the product water, indicating a total kill of any bacteria initially present in the water source.

The ministry concluded that the SolarBag is a recommended treatment method for household drinking water.

MINISTRY OF WATER AND IRRIGATION
LAKE VICTORIA ENVIRONMENTAL MANAGEMENT PROJECT
WATER QUALITY LABORATORY- KISUMU

WATER QUALITY ANALYSIS REPORT

Lab. Ref: No **133/2011**

Submitted by: Hydro pack team (Keith)

Purpose of Sampling: **Quality Assessment** Analysis Required**: Bacteriological**

A raw water sample was brought to the lab by Keith and team collected from Lake Victoria where river Nzoi discharges at the lake.
The sample was filtered using a clean wet clothing, then filled into the two Solar bags then left for four hours after which analyzed for E.coli. The following results were obtained.

No.	Treatment method	E.Coli Colony count/100ml (dilution X 1)
1.	Raw sample	TNTC
2.	1st Solar Bag	NIL
3.	2nd Solar bag	NIL

Conclusion

From the findings, it is observed that the solar bag is a good treatment method for contaminated water at the house hold level.

George Ageng'o

Lake Victoria South Water Service Board
P. O. Box 3325 - 40100, Kisumu.
Tel: +254 57 2025128

CHEMIST LVSWSB **Date 21/01/2011**

MINISTRY OF HEALTH
REPUBLIC OF CAMEROON

SUMMARY of Testing
Ministry of Health | Republic of Cameroon

In recognition of the merits of the SolarBag, the Ministry of Health in the Republic of Cameroon provided authorization to market and provide SolarBags in all the territories of Cameroon.

Additionally, the Ambassador of the Republic of Cameroon to the United States recognized the importance of the SolarBag to fight water borne diseases and the need to treat cholera outbreaks and permitted SolarBags to be imported for humanitarian aid.

REPUBLIQUE DU CAMEROUN
Paix– Travail– Patrie
MINISTERE DE LA SANTE

REPUBLIC OF CAMEROON
Peace—Work—Fatherland
MINISTRY OF SANTE

N°/Réf /1950/RC/MIS/09/01/13

N° 0189/

AUTORISATION DE VENTE

Nous soussignés, Ministère de la Santé autorisons **Monsieur Victor TSAGUE** de nationalité Américaine résident aux Etats-Unis;

Adresse : HERMITAGE, TN37 076 SOLAR BAG à faire la livraison du filtre à eau dans toute l'étendue du territoire camerounais.

Nous lui délivrons cette autorisation pour servir et valoir ce que de doit.

Fait à Yaoundé le 09 Janvier 2013.

SECRÉTAIRE

M. FOUDA

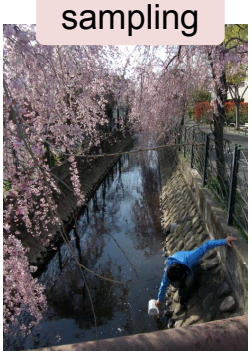
KANAGAWA ACADEMY OF SCIENCE KAWASAKI CITY, JAPAN

SUMMARY of Testing
Kanagawa Academy of Science and Technology
Kawasaki City, Japan

The SolarBag was investigated as a means to address water accessibility challenges in the wake of the April earthquake and tsunami. The Kanagawa Academy of Science and Technology (KAST) used its facilities to test the SolarBag in a controlled environment under a UV lamp to measure bacterial coliform inactivation and organic contaminant reduction.

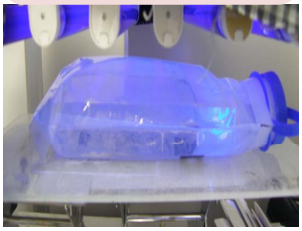
A SolarBag was filled with water from an outdoor canal that had been filtered through a simple cloth material. The bag was left under the lamp for 4 hours and sampled for coliform and total organic carbon (TOC). The results, while not demonstrating real-world sunlight conditions, demonstrated significant reductions in both bacteria and organic chemicals.

sampling



filtration

UV irradiation (2.0 mWcm^{-2}@ 310-380 nm)



CASCADE DESIGNS INC. SEATTLE, USA

SUMMARY of Testing
Cascade Designs Inc. | Seattle, Washington, USA

Cascade Designs Inc (CDI) is a company in Seattle, Washington that makes several water treatment and storage products for military and outdoor recreational use. Their microbiological laboratory tests various water purification products against EPA and military guidelines for performance.

Over a six month period, CDI performed a series of tests measuring chemical contaminant reduction and microbial inactivation on the SolarBag. The tests were performed outdoors in both the morning and afternoon sun, under both clear and overcast skies; ambient temperatures ranged from 15 - 30 °C. CDI also used specially formulated challenge water designed to represent developing world water supplies, as well as challenge water defined in EPA and NSF P248 protocols.

The tests showed that the SolarBag was able to reduce 99.9999% of all bacteria, 99.99% of all virus, and over 90% of the chemical contaminants in just 2 hours on warm sunny days while taking 4 hours in rainy overcast conditions.

DEPARTMENT OF SCIENCES + ENVIRONMENT MEXICO

SUMMARY of Testing
Federal Department of Sciences + Environment
Mexico

In 2014, the SolarBag has passed two certification tests in Mexico. The SALUD (Federal Department of Health) certification documented metal and chemicals removal. The CONACYT (Federal Department of Sciences and Environment) certification confirms the SolarBag's ability to remove pathogens and is reproduced on the following pages.

CIATEJ

Informe de Resultados

CONACYT

Fecha de emisión: **2014-09-02** **US 1402162/2014**

Tercero Autorizado como Laboratorio de Prueba con COFEPRIS
No. de Autorización TA-69-13

Unidad de Servicios Analíticos y Metrológicos
Área de Química Analítica

Cliente

Razón Social:	**Lic. Luis Alberto Zepeda**
Domicilio:	**Guadalajara, Jalisco, México**
Teléfono / Fax:	**33-13-82-30-21**
Correo electrónico	**licenciadozepeda@gmail.com**
Atención:	**Lic. Luis Alberto Zepeda**

Muestra

Identificación:	**Agua (Purificada)**
Descripción:	**Muestra en envase de plástico.**
Muestreo:	**Proporcionada por el cliente.**
Procedimiento:	**No proporcionado.**
Fecha de muestreo:	**No proporcionado.**
Fecha de recepción:	**2014-08-21**
Fecha de ensayo:	**2014-08-21 al 2014-09-02**

Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, A.C.
Avenida Normalistas 800 Guadalajara, Jalisco, 44270 México A.P. 2-191
Tel. (0133) 3345-5200 fax: 1001 http//www.ciatej.mx e-mail: informes@ciatej.mx

Informe de Resultados

Fecha de emisión: **2014-09-02** **US 1402162/2014**

Tercero Autorizado como Laboratorio de Prueba con COFEPRIS
No. de Autorización TA-69-13

1. Método.

Referencia Analítica:

CCAYAC-004/8 Método de prueba para la estimación de la densidad microbiana por la técnica del número más probable (NMP), detección de coliformes totales, coliformes fecales y Escherichia coli.

2. Resultados.

Agua Purificada Con Bolsa

Determinación	Unidad	Resultado
Coliformes totales	(NMP/100 mL)	No detectado
Coliformes fecales	(NMP/100 mL)	No detectado
E coli	(NMP/100 mL)	No detectado

3. Observaciones.

* El informe de resultados sólo afecta a las muestras sometidas a ensayos.
* El informe de resultado no debe reproducirse en forma parcial, únicamente podrá reproducirse en su totalidad con autorización por escrito del CIATEJ, A.C.
* El signo decimal es una coma "," sobre la línea de acuerdo a la norma NOM-008-SCFI-2002.
***Cualquier duda o aclaración deberá solicitarse dentro de 20 días hábiles.**

Q.T.I. Danya Lizeth Cázares Luna.
Realizó: Analista del Laboratorio de Microbiología.

Q.F.B. Lilia de Anda Trujillo.
Responsable del Laboratorio de Microbiología.

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LABORATORIOS QUIMICOS INDUSTRIALES
QUIMICOS PROFESIONALES

INFORME DE ANÁLISIS

EMPRESA	PURIFICADORA SEATLE
CLIENTE	MARIA ESTHER ARELLANO ARELLANO
DOMICILIO	EPIGMENIO PRECIADO # 2489-B
COLONIA	SEATLE
CIUDAD	ZAPOPAN, JALISCO.

ORDEN DE TRABAJO **14/12982**
FECHA DE EMISIÓN DE REPORTE
02 de septiembre de 2014
FECHA DE RECEPCIÓN DE MUESTRA
27 de agosto 2014
PERIODO DE ANÁLISIS
27 – 30 de agosto de 2014

OBSERVACIONES DE MUESTRA

TIPO DE MUESTRA: Agua purificada. **RECIPIENTE:** Botella de plástico de 1 L
PUNTO DE MONITOREO: Producto terminado **# LOTE:** Sin numero.
MUESTREADOR: Muestra recolectada y transportada por Laboratorios Químicos Industriales.

RESULTADOS DE ANÁLISIS

ESPECIFICACIONES DE ANÁLISIS Y RESULTADOS:
NOM-201-SSA1-2002, Productos y Servicios. Agua y Hielo para consumo humano, envasados y a granel. Especificaciones Sanitarias

DETERMINACIÓN	RESULTADO	LIMITE MÁXIMO	UNIDADES	METODOLOGÍA
COLIFORMES TOTALES	1.1	< 1.1	NMP/100 ml	CCAYAC-M-004/8

De acuerdo con el resultado del análisis realizado, la muestra se encuentra **fuera** de los límites de las especificaciones de la norma.

CCAYAC-M-004/8, Método de prueba para la estimación de la densidad microbiana por la técnica del Número Más Probable (NMP), detección de Coliformes Totales, Coliformes Fecales y *Escherichia coli* (COFEPRIS).

NOTA:

Los resultados amparan a la muestra analizada.
Para uso exclusivo de las partes involucradas, se prohibe su reproducción total o parcial.
De acuerdo con la Norma Oficial Mexicana NOM-008-SCFI-2002, se muestra el punto (.) o coma (,) para la indicación de signo decimal. Para efectos de este resultado se utiliza el punto para separar decimales.

Implementando NMX-EC-17025-IMNC-2006
Sin mas por el momento, quedamos como sus mas seguros servidores
¡NOS PREPARAMOS PARA SERVIRLES!

ATENTAMENTE

M.D.E.C. BLANCA SARAI AGUILAR SALCEDO
Ced. Prof. 3749866
Director de Laboratorio

LABORATORIOS QUIMICOS INDUSTRIALES
QUIMICOS PROFESIONALES

MATRIZ: Jitomate # 3879 Col. La Nogalera C.P. 44470 Guadalajara, Jal. Tels. (33) 3675-3845, 3675-3855 y 3124-8232
Asesoría: 044 33 3667-8597 E-mail: laboratoriolqi@gmail.com www.laboratoriolqi.com.mx
SUCURSAL MICHOACAN: Av. Morelos Poniente s/n Riva Palacio, Michoacán. Tel. (767) 672-2341

WORLD HEALTH ORGANIZATION PROTOCOLS

Rating	Bacteria Log_{10} Reduction	Virus Log_{10} Reduction	Protozoa Log_{10} Reduction	SolarBag Minimum Time Requirement (Allow 2x for cloudy days or turbid sources)
WHO Highly Protective	4 LRV	5 LRV	4 LRV	**4.5 hours**
EPA Purifier Guidelines	6 LRV	4 LRV	3 LRV	**3 hours**
WHO Protective	2 LRV	3 LRV	2 LRV	**2 hours**
WHO Interim	Achieves "Protective" target for two classes and results in health gains			**1.5 hours**

LRV = Log Reduction Value, a scientific shorthand for the percentage of contaminant reduction:

1 log reduction = 90% reduction
2 log reduction = 99% reduction
3 log reduction = 99.9% reduction
4 log reduction = 99.99% reduction
5 log reduction = 99.999% reduction
6 log reduction = 99.9999% reduction

SUMMARY of World Health Organization (WHO) qualification

In most latitudes, the SolarBag meets 'interim level safety' for the World Health Organization (WHO) in as little as an hour and WHO 'highly protective safety' in 2-3 hours.

The SolarBag can deliver 10.5 liters of WHO's highest safety level per day, or over 20 liters/day of interim safe levels.

It is the only portable, non-powered water purifier that meets and exceeds the World Health Organization (WHO) standards for a highly protective device.

SUMMARY of Field Trials
GS Malawi | Bolero / Mzuzu, Malawi

Many regions in Malawi, Africa are struggling with access to safe drinking water. Urban areas are subject to tap water supplies of little to no water treatment while the surrounding rural communities are forced to drink from untreated and poorly maintained wells and bore-holes.

GS Malawi, an aid organization with an established presence in the Bolero and Mzuzu regions of Malawi, works on projects to empower residents with access to safe drinking water by introducing new methods of water acquisition and treatment. Puralytics and GS Malawi partnered to distribute and monitor SolarBags to the Malawians participating in GS Malawi's programs. The SolarBag is a reusable water purification device that uses a nanotechnology coated mesh insert to destroy waterborne contaminants with the power of sunlight.

114 SolarBags were distributed into the communities using GS Malawi's network and infrastructure in November 2012. Usage and performance information was relayed back though GS Malawi to Puralytics every month into May 2013. The results were overwhelmingly positive:

- Training users was very successful, resulting in only 4 reported cases of improper use
- The SolarBags were used 1-2 times per day throughout the 6 month trial and 92% of the SolarBags were continued to function normally.
- 82% of the users said they drank more water after receiving their SolarBag
- 89% claimed they felt sick less frequently
- 91% acknowledged boiling less water for treatment, reducing their expenses for fuel
- 96% said their water tasted and smelled better after using the SolarBag

Currently, GS Malawi is working to provide 5000 more SolarBags to these areas to build small businesses and meet the safe water need.

Roll of Participants

Entrant – Puralytics

Puralytics, a Beaverton, OR, USA company, builds water purification equipment using light activated nanotechnology. The SolarBag, which uses sunlight to activate a nanotechnology coated mesh, removes both pathogens and toxins from water. A field use trial examining the suitability of this technology over a six month period was conducted with GS Malawi community partners.

Partnering Participant – GS Malawi

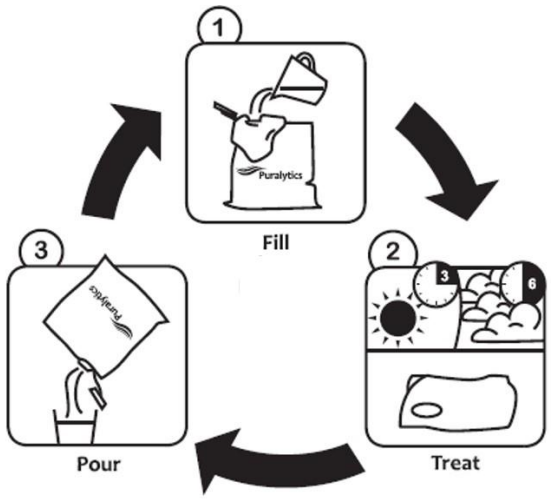
GS Malawi has established a presence in the areas surrounding Mzuzu and Bolero in Malawi. Projects focused on providing education, access to safe water, and sustainable microbusinesses are implemented by community leader and GS Malawi staff. Their US staff worked closely with Puralytics to acquire, ship, and distribute SolarBags to five peri-urban communities. Following training and distribution of the SolarBags to the community, local leaders of GS Malawi monitored user response and adoption as well as long term performance of the SolarBags, and coordinated with Puralytics over the internet to ensure the project's success.

Project Discussion

Originality of the Hardware: Puralytics SolarBag

The SolarBag is a transparent 3 L bag that encloses a nanotechnology coated mesh insert. When the SolarBag is placed in sunlight, five photochemical processes are activated which destroy a wide range of contaminants; including pathogens, heavy metals, and chemical toxins.

The SolarBag is easy to use. Users need only fill the SolarBag with water and leave it exposed to the sun for a few hours, meaning it can be used multiple times per day. The simple pictorial instructions shown in the figure below, are provided on the front of the SolarBag.



Step 1 – Fill the SolarBag
Fill the SolarBag with 3 liters of water. A sock filter is provided to remove particulates.
Step 2 – Treat the water
Leave the SolarBag outside under the sky for a few hours: a sunny day will take 3 hours, while a cloudy day will take closer to 6.
Step 3 – Pour
After treating the water it is safe to drink either from the SolarBag or any sterile container.

Figure 1 - Pictorial instructions on the front of each SolarBag.

SolarBags will last for 500 uses and do not require any technical skills or consumable materials to operate, making it ideal for massive distribution to communities with minimal education or infrastructure. A water quality monitoring tool called 'Pur-Blue' was provided to track the ongoing performance of the SolarBags throughout the field trial. This was done by adding a drop of Pur-Blue to the SolarBag and seeing how long it takes the blue color to go away in sunlight.

Complexities in Providing Water Treatment to Peri-urban Communities

The project was divided into two main phases. The challenges associated with the first phase were distribution and proper training. Challenges identified in the second phase were assessing adoption of the technology and quantifying water treatment performance.

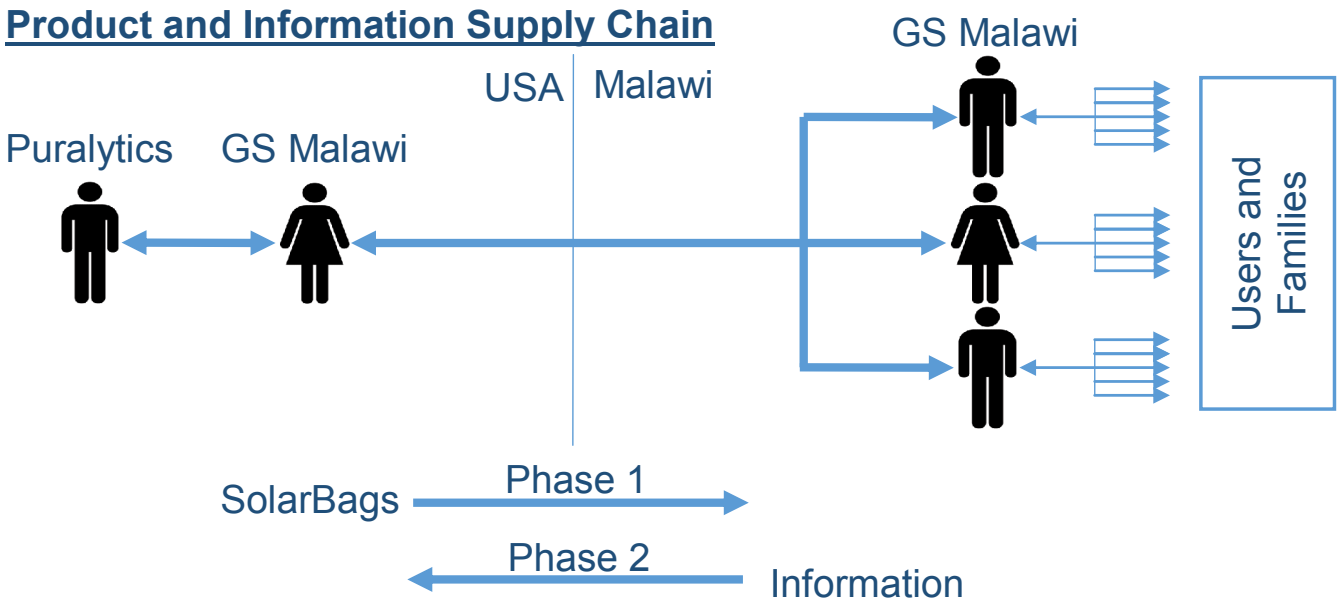


Figure 2 - Visual representation of the flow of products and information for each phase of the project between Puralytics, GS Malawi staff, and the end users.

Phase 1 – Distribution

Puralytics avoided confiscation and theft of the SolarBags by leveraging GS Malawi's established presence in Bolero and Mzuzu. GS Malawi received 200 SolarBags through $8,000 of donor funds. The US members of GS Malawi securely transferred the SolarBags to their Malawian staff members in Bolero and Mzuzu. The Malawi staff oversaw distribution of 114 SolarBags to community leaders, who in turn managed distribution to selected heads of household who agreed to participate in the training and monitoring program. The local GS Malawi staff then tracked the status of all the SolarBags they distributed by user name and serial number from Nov2012 to May2013- without any SolarBags being reported stolen.

Phase 1 – Proper Training and Use

Puralytics prepared a set of picture based training materials to provide to the GS Malawi team along with the SolarBags. These training materials were used anytime the SolarBags changed hands to ensure the latest recipient understood what they were doing when they used the SolarBag.

After the end-users were trained and received their SolarBag, they were free to take it home to use. Each month, users would bring their SolarBags to regular GS Malawi meetings, have the bags tested for performance, and fill out questionnaires addressing the following parameters:

1) How often they were using the SolarBags
2) How much water they were consuming compared to before they had the SolarBag
3) Whether or not they felt sick as frequently

4) How often they were still boiling their water for treatment
5) How the SolarBag affected the taste and odor of their water
6) The functional status of their SolarBag
7) If there is anything they would change about the SolarBag

The information gathered at these meetings is the basis for which the results of this field trial are determined.

Phase 2 – Adoption

Risk of rejection was mitigated in the project because of three main factors.

1) The SolarBag was easy to use
2) The user base was well trained
3) There was a strong need for it in the community

Once residents had a proper understanding of how to use the SolarBag and saw that it was making a difference in their lives, interest spread virally through the community – increasing interest in the SolarBag. All SolarBags were in full use throughout the trial.

Phase 2 – Meaningful Impact

The impact of the SolarBags were evaluated and quantified at the monthly meetings via the questionnaire described in 'Proper Training and Use'.

Technical Performance of the SolarBag Hardware

Pur-Blue water quality tests and taste/odor assessments were periodically carried out to track the long term performance of the SolarBags. After six months of use, the following data was collected:

- 96% of the SolarBags were also reported to have eliminated any smell the water had
- 77% of the SolarBags were still fully functional - taking 4.5 hrs to clear the blue color on a partly cloudy day
    - 15% took between 5.0 – 5.5 hrs
    - 8% were performing to original specs in less than three hours
- Only 4 SolarBags were reported to have failed due to leaks developed in the bag
    - 3 cases were associated with improper use
    - 1 case due to standard wear and tear

At the conclusion of this trial, it is estimated that over 600 people were able to drink more than 90,000 liters of purified water using the 114 SolarBags distributed in the Mzuzu and Bolero communities.

Social and Economic Benefits – and – Overall Sustainability

Social Benefits

With less than 76% of the Malawian population having access to '*improved*' drinking water, the SolarBag was a well suited water treatment option for these communities because it is reusable and requires no – power, consumables, or significant training; and it shows in the results. When asked how the SolarBag impacted their lives, users reported the following

- All SolarBags were used 1-2 times per day throughout the field trial
- 89% of users felt sick less frequently
- 82% drank more water
- 91% did not boil as much water for drinking
    - Saving money on fuel for boiling water

Economic Benefits

When used properly, the SolarBag lasts 500 uses. This brings the cost per liter treated with the SolarBag to roughly $0.03; cheaper than the estimated $0.05 it costs for fuel to boil 1 liter of water and significantly lower than the $0.50 people will pay for a liter of bottled water at their local market.

This opens the opportunity for the SolarBag to compete with available treatment methods as a microbusiness, selling treated water or SolarBags. There are two key benefits to this model:

1) Business owners can make a profit and sustainably replace SolarBags
2) The capital cost of the SolarBag can be amortized to the per liter cost for end-users

Overall Sustainability

This project has demonstrated that the SolarBag offers a very sustainable solution to peri-urban water treatment from several facets including the following:

Access – SolarBags were successfully distributed using the infrastructure of an aid agency with an existing presence in the area.

Economics – SolarBags can foster small businesses and amortize the SolarBag cost to the end user, building an economically sustainable business model.

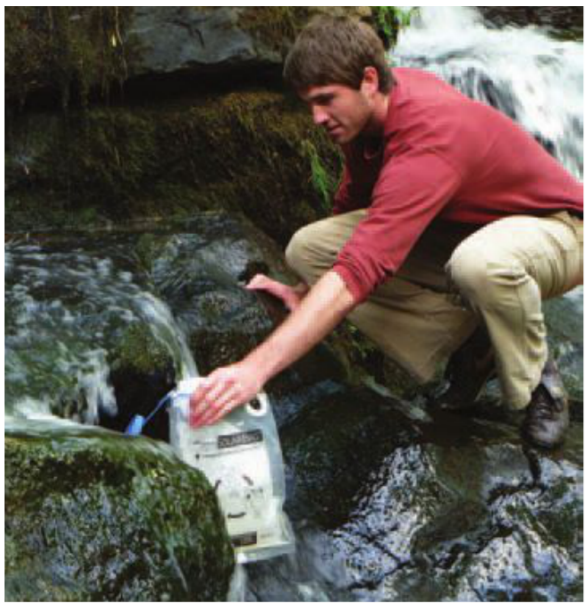
Performance – Throughout the six months of monitoring and use, the SolarBags remained mechanically stable and chemically active, purifying the water from harmful pathogens and toxins.

Pollution – The SolarBag is made of recyclable plastics, while the insert is composed of environmentally stable materials commonly found in sand. At the end of life, the SolarBag can be recycled and the insert (<50 g) disposed of at a waste center – mitigating waste generated by expired SolarBags.

COUNTRIES WHERE SOLARBAGS ARE IN USE

Afghanistan
Australia
Azerbaijan
Bangladesh
Belgium
Belize
Cameroon
Canada
China
Cuba
Democratic Republic of Congo
Denmark
Ecuador
Egypt
El Salvador
Equatorial Guinea
Ethiopia
France
Germany
Ghana
Guatemala
Haiti
India
Indonesia
Iraq
Ireland
Japan
Kenya
Kazakhstan
Korea
Kuwait
Malawi
Malaysia
Marshall Islands
Mexico
Netherlands
Nicaragua
Nigeria
Pakistan
Peru
Philippines
Rwanda
Seychelles
Singapore
South Africa
South Sudan
Spain
Sudan
Switzerland
Taiwan
Tanzania
Thailand
Turkey
UAE
Uganda
UK
USA
Vietnam

WORLD WATER MAGAZINE ARTICLE
JAN-FEB 2013



SolarBag delivers clean water in emergencies

The SolarBag, developed by Puralytics, a clean tech startup company in Beaverton, Oregon, USA, is a water purification system that uses sunlight-activated nanotechnology to produce multiple quarts of safe, fresh water several times a day. The three-liter SolarBag is the first non-powered, non-chemical system to exceed the requirements set by the US Environmental Protection Agency's (EPA) Standard and Protocol for Water Purifiers. The award-winning SolarBag technology from Puralytics is the only retail filter available that removes bacteria, viruses, heavy metals, and chemical contaminants to full EPA standards.

Mark Owen, founder and CEO of Puralytics, commented, "The SolarBag is becoming an essential addition to any home disaster readiness kit. It eliminates the need for power, chemicals, pumping, or filters and provides clean, safe water all through the day." In the past, public health authorities recommended boiling water when supplies became contaminated. Boiling removes bacteria and viruses from water, but it does not remove chemicals or heavy metals.

The SolarBag is the only water purifier that's proven it can remove virtually every lethal toxin found in contaminated water, including gasoline, diesel fuel, pesticides, herbicides, toxic heavy metals like lead, arsenic, cadmium, and mercury, and pharmaceuticals like artificial hormones and animal antibiotics. The nanotechnology is activated by sunlight, but it works on both sunny and cloudy days. The empty bag can be stored for up to seven years, and can be reused hundreds of times, making it ideal for emergency situations.

Puralytics' patent-pending, light-activated nanotechnology water purifiers won numerous awards in the past year, including National Grand Prize at the Cleantech Open, selection as a Global Water Intelligence "Best Investment," the Zino Green Fund "Best Cleantech Investment," was listed by Inc Magazine as one of the top eight water investments of 2012, and finalist for both the ImagineH2O Water Energy Nexus Award and for TechCrunch cleantech award. Puralytics was also named a Top 50 Water Technology Company by The Artemis Project, and placed on the Global Cleantech 100 – a list of the top 100 private companies in clean technology as evaluated by the Cleantech Group LLC.

COMPREHENSIVE LIST

The SolarBag has been tested extensively for its ability to remove specific contaminants from fresh water. The following is a comprehensive list of approximately 700 known contaminants that have been shown to be removed by the SolarBag's technology. Ongoing testing continues to reveal additional contaminants that will be added to this list.

1,1,1,2-Tetrachloroethane
1,1,1,2-Trichloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2,2-Trichloroethane
1,1,2-Trichloroethane
1,10-Dichlorodecane
1,1-Dichloroethane
1,1-Dichloroethane
1,1-Dichloroethylene
1,1-Dichloropropene
1,2,3-Benzenetricarbolxylic acid
1,2,3-Trichloropropane
1,2,4,5-Benzenetetracarboxylic acid
1,2,4-Benzenetricarboxylic acid
1,2,4-Trichlorobenzene
1,2,4-Trihydroxybenzene
1,2,4-trimethylbenzene
1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dichloroethane
1,2-Dichloroethylene
1,2-Dichloropropane
1,2-diphenylhydrazine
1,3-Butadiene
1,3-dichloropropane
1,3-dichloropropene (Telone)
1,3-Dihydroxybenzene
1,3-Dinitrobenzene
1,4-Dioxane
1,4-Diphenyl-1,3-butadiene
17-Oestradiol
1-Butanol
1-Butylamine
1-Octanol
1-Propanol
2 or 3 or 4-Halobenzylalcohols
2 or 3 or 4-Hydroxyacetophenone
2-, 3-, or 4-Chlorobenzoic acid
2-, 4, or 6-chloroquinoline
2, 4-dichlorophenoxyacetic acid
2,2,6,6-Tetramethylpiperidone
2,2-dichloropropane
2,2-Dichloropropionic acid
2,3,6-Trichlorobenzoic acid
2,3-dichlorophenol
2,3-Dimethyl-1,3-butadiene
2,4,5-TP (Silvex)
2,4,6-trichlorophenol
2,4,6-trinitrotoluene
2,4-D
2,4-dichlorophenol
2,4-Dichlorophenoxyacetic Acid
2,4-Dihydroxybenzoic acid
2,4-dinitrophenol
2,4-dinitrotoluene
2,4-Hexadienes
2,5-Dimethyl-2,4-hexadiene
2,6-Dichloroindophenol
2,6-Dimethylphenol
2,6-Dinitrotoluene
2,6-Di-tert-butyl-4-methylphenol
2,6-Di-tert-butylphenol
2-Chlorobiphenyl
2-Chlorophenol
2-Methoxyethanol
2-Methylbenzoic acid
2-methyl-Phenol (o-cresol)
2-naphthol
3,4-Dihydroxybenzoic acid
3,5-Di-tert-butylphenol
3-aminophenol
3-Bromoquinoline
3-Chlorophenol
3-Methoxybenzylalcohol
3-Nitrophenol
4-(2-Pridinylazo)resorcinol
4,4'-Methylenedianiline
4,6-Dichlororesorcinol
4-Aminophenylarsonic acid
4BS Azo Dye

4-chloro-2 nitrophenol
4-Chloro-2-methylphenoxyacetic acid
4-Chloro-3-methylnitrobenzene
4-Chloro-3-methylphenol
4-Chlorobenzenesulfonamide
4-Chlorobenzoic acid
4-Chlorocatachol
4-Chlorophenol
4-Chlorophenoxyacetic acid
4-Chlororesorcinol
4-Ethylaniline
4-Hydroxyazobenzene
4-Hydroxybenzyl Alcohol
4-Methoxyphenol
4-nitroaniline
4-Nitrobenzoic acid
4-nitrophenol
4-Nitrosoimidazole
4-Nitrosopyrazole
4-Nonylphenol
4-Nonylphenolpolyethoxylate
4-tert-butylphenol
4-tert-butylpyridine
6-Chlorovanillin
6-Methyluracil
9,10-Anthraquinone
9-Acetylanthracene
Acanthamoeba
Acephate
Acetaldehyde
Acetamide
Acetaminophen
Acetaminophenin
Acetic Acid or acetate ion
Acetone
Acetone semicarbozone
Acid Blue 80
Acid Blue 9
Acid Blue 92
Acid Chrome Blue K
Acid chrome blue K
Acid fuchsin
Acid Green 16
Acid Orange 7
Acid Red 27
Acid Red 4
Acid Red 88
Acid rosaniline
Acid Yellow 36 (AY-36)
Acridine Orange
Acrinathrin
Acrylamide
Active Red X-3B
Adenine
Adeno Virus Type III 3
Adenoviruses
Agrobacterium lumefaciens
Alachlor
Alachor
aliphatic acids
Alizarin
Alizarin Red S Biological Stain
Amaranth
Aminophenol, 2, 3, or 4
amleic hydrazide herbicide
Ammonia
Ammonia and Butyric Acid
Amoxicillin
Anatoxin-a
Androstenedione
anionic azo-dye
Aromatic Alcohol
Aromatic chlorinated compounds
Arsenic
As(III)
Aspergillus amstelodami
Aspergillus flavus
Aspergillus glaucus
Aspergillus niger (breed mold)
Atrazine
Auramine
Azo Dyes
Azobenzenes (various)
Bacillus anthracis (anthrax veg.)
Bacillus anthracis Spores (anthrax spores)*
Bacillus megatherium Sp. (spores)
Bacillus megatherium Sp. (veg)
Bacillus paratyphosus
Bacillus subtilis
Bacteria Bacillus subtilis spores
Bacteria
Bacteria and fungi
Fibroblasts/Fungi/Pollen
Bacteriophage
Baker's Yeast
Benzaldehyde
Benzene
Benzo(a)pyrene (PAHs)

Benzoic Acid
Benzoquinone
Benzyl phenylacetate
bichlorobiphenyls
biphenyls (PCBs)
bis-(2-Dipyridyl)disulfide
Bisphenol A
Bisphenol A in the Montmorillonite KSF
Blue s-3RF Wastewater
Blue-green Algae
Brewer's Yeast
Brilliant
Brilliant Green
Bromacil
Bromate
Bromoxynil
Bacteria Burkholderia cenocepacia
But-1-ene
But-2-ene
Butanoic
C.I. Acid Blue 9
Cadmium
Caffeic Acie
Caffeine
Caliciviruses
Campylobacter jejuni
Fungi Candida albicans (yeast)
Carbamate pesticides
Carbamazepine
carbamazepine, clofibric acid, iomeprol and iopromide
carbendazim fungicide
Carbofuran
Carbon dioxide (reduction)
Carbon monoxide
Carbon tetrabromide
Carbon tetrachloride
Carbonate
Cationic blue X-GRL
Cerium
Cetylpyridinium chloride or bromide
Chloramines (as Cl2)
Chloramphenicol - pharmaceutical
Chlorate
Chlordane
Chlorella vulgaris (algae)
Chlorinated Aromatic
Chlorinated Hydrocarbons
Chlorinated Phenols and Pesticides
Chlorobenzene
Chloroform
Chlorophenols
Chlorsulfuron
Chrome black T
Chromium (hexavalent)
Chromium (total)
cis-1,2-Dichloroethylene
Citric acid
Clofibric acid
Clostridium botulinum
Clostridium tetani
Cobalt
colloidal Q-CdS
Common Yeast Cake
Congo Red
Copper
Corynebacterium diphtheriae
Coumarin
Rickettsiae Coxiella burnetti
Coxsackie
Coxsackievirus (A-9)
Coxsackievirus (B-1)
Cr(VI)
Cryptosporidium
Cryptosporidium parvum
Crystal violet
Cyanide
Cyanide (as free cyanide)
Cyanide and Complexes
Cyanuric acid
cyclohexyl alcohols
Cymoxanil
Cytosine
Dalapon
DDT
Decane
DEET
Di(2-ethylhexyl) adipate
Di(2-ethylhexyl) phthalate
Diazepam
Dibenzo-p-dioxines, various
Dibenzothiophene (DBT)
Dicamba
Dichloroacetic acid
Dichloroacetyl Chloride
Dichloromethane
Dichromate
Diclofenac

Diclofenthion
diclofop-methyl
Dicofol and Pyrethrum
Diethylamin
dihydroxybenzene
Dilantin
Dimethoate
Dimethyl Methylphosphonate
Dimethyl-2,2-dichlorovinyl phosphate
Dimethylaminoborane
Dimethylarsinic acid
Dimethylglyoxime
Dimethylmethylphosphonate
Dimethylsulfide
Dinoseb
Dioxin (2,3,7,8-TCDD)
Diphenamid Herbicide
Diquat
Diquat and Paraquat
Direct Red 23
Direct scarlet 4BS
Direct Yellow 12 dye
disulfonated anionic surfactants
Diuron
DMSO
DNA and RNA
Dodecane
Dodecyl sulfate, sodium salt
Dodecylbenzenesulfonate, sodium salt
Dodecyldecaoxyethylenephosphates
Dyes
Dysentery bacilli
E. hystolytica
Eberthella typhosa
Echoviruses
EDTA
Endothall
Endrin
Bacteria Enterobacter cloacae
Epichlorohydrin
EPTC (s-ethyl-dipropylthiocarbamate)
Erythromycin-H2O
Escherichia coli (0157)
Estradiol
Estriol
Estrogenic chemicals
Estrone
Ethanol
Ethanol amine
Ethinyl estradiol
Ethmylestradiol
Ethyl amine
Ethyl bromophos
Ethyl parathion
Ethylbenzene
Ethylene
Ethylene dibromide
Ethylenediaminetetraacetic acid and metal complexes
Explosives
Fenamiphos
Fenitrothion
Ferrate (VI)
Flavobacterium
Fluoxetine
Flutriafol
Formaldehyde
Formamide
Formic Acid
Formic acid or formate ion
Furfural
Furfuryl alcohol
Galaxolide
Gasoline
Gemfibrozil
Geosmin
Giardia lamblia
Glucose
Glycerol
Glycerol trioleate
Glycolic acid
Glyphosate
Gold
Guanine
H2S
Halide ion
Haloacetic acids (HAA5)
Heptachlor
Heptachlor epoxide
Herbicide
Heterotrophic plate count
Hexachlorobenzene
Hexachlorocyclopentadiene
Hexaconazole and Dimethomorph
Hexavalent Chromium and Di-N-Butyl Phthalate
Humic Acids
Humic Substances

Hydrazine
Hydrocodone
Hydrogen Phthalate
Ibuprofen
Imidacloprid
Imidacloprid
Imipramine
Indanthrene BR Violet Dye
indole
Infectious Hepatitis
Influenza
Iopromide
Isoprene
Isoproturon
Ketoprofen
Lactobacillus acidophilus
L-Alanine
L-Ascorbic acid
Laurylsulfate, sodium salt
Lead
Lead dioxide
Leather Dye
Legionella
Legionella bozemanii
Legionella dumoffill
Legionella gormanil
Legionella longbeachae
Legionella micdadei
Legionella pneumophila
Leptospira canicola-Infectious Jaundice
Leptospira interrogans
Levulinic acid
Lignin
406 Lincomycin
407 EPA 66/NSF Lindane
Lopromide
L-Phenylalanine
L-Serine
Lufenuron
Malachite Green Dye
malathion, isomalathion, malaoxon
Maleic anhydride
Malic acid
Manganese
Manganese Oxide
Mecoprop
Mefanamic acid
Meprobamate
Mercury (inorganic)
Meso-Tetraphenylporphyrin
Metalaxyl
Methamidophos
Methane
Methanol
Methomyl
Methoxychlor
Methyl bromophos
Methyl oleate
Methyl Orange
Methyl parathion
Methyl perfluoro-2-propyl ether
Methyl perfluoroethyl ether
Methyl Red Dye
Methyl stearate
Methyl tert-butyl ether
Methyl violet
Methyl viologen
Methylene Blue
Metolachlor
Micrococcus candidus
Micrococcus sphaeroides
Microcystin-LR or YR or YA
m-Nitrocynnamic acid
Monochloroacetic Acid
Monocrotophos
Mucor mucedo
Mucor racemosus (A & B)
Murine Norovirus
Musk Ketone
Mycobacterium parafortuitum
Mycobacterium tuberculosis
Myocytin toxins
N,N-diethyl-m-toluamide (DEET)
Naphthalene
Naphthol blue black
Naproxen
Napthol ASBS dye
Natural Organic Matter
Neisseria catarrhalis
Nematode Eggs
Nickel
Nitrate (measured as Nitrogen)
Nitrates/nitrites
Nitrite (measured as Nitrogen)
Nitrobenzene
Nitrocelluose
Nitrogen oxides
Nitrotoluene, various

N-Methylpyrrolidinone
non-steroidal anti-inflammatory drugs
NPE-10 surfactant
o-Chloroaniline
o-Chlorobiphenyl
o-Cresol
Octadecane
Octadecanoic acid
Octan-1-ol
o-Dichlorobenzene
Ofloxacin
Oil/Petroleum
Oleic acid
Oospora lactis
Orange G
Orange I, II, III, or IV
Organic Dyes
organochlorine pesticide and dyes
oryzalin pesticide
Oxalic acid or oxalate ion
Oxamyl (Vydate)
o-xylene
Palladium
Palmitic (hexadecanoic) acid
Paracetamol
Paraffin, liquid
Paramecium
Paraoxone
Paraquat
Parathion
Paroxetine
p-chlorobenzoic acid
p-Dichlorobenzene
Penicillium chrysogenum
Penicillium digitatum
Penicillium expansum
Penicillium roqueforti
Pentachlorophenol
Pentoxifylline
Perchlorate
Permanganate
Pesticides - unspecified
pharmaceuticals and cosmetics
phenanthrene
Phenol
Phenol-4-sulfonic Acid
Phenolics
Phenylarsonic acid
Phenyltrifluoromethyl ketone
Phenylurea Herbicides
Phenytrifluoromethylketone
Phorate
Phthalic acid
Phthalocyanine
p-hydroxybenzoic acid
Phytomonas tumefaciens
Picloram
Pirimicarb
Pirimiphos-methyl
plasmid DNA
Platinum
p-nitropheno
PNP
Poliovirus
Poly Vinyl Butyral
Polyacrylamide
Polycarboxylic Benzoic Acid
Polychlorinated biphenyls (PCBs)
Polychlorinated Dibenzo-p-dioxins
dibenzofurans
polycyclic aromatic hydrocarbons
Polyethoxylene alkyl ethers
Polyvinylchloride (PVC)
Polyvinylpyrrolidone
Power station effluent
Progesterone
Prometryn
Propane
Propanil
Propene and Benzene
Propionamide
Propoxur
Propranolol
Propylene sulfide
Propyne
Proteus vulgaris
Pseudomonas aeruginosa
Pseudomonas aeruginosa (Lab. Strain)
Pseudomonas fluorescens
Pseudomonas maltophilia
Pyrene 1
562 Pyridine 1
563 Pyrimethanil 1
564 Pyrimethanil 1
565 Pyrrole-2-carboxylic acid 1
566 Pyrrolidone 1
567 Ranitidine 1
568 Reactive black 5 1

569 Reactive black SRE 1
570 Reactive Blue 19 1
571 Reactive Blue 221 1
572 Reactive Blue 222 1
573 Reactive blue 4 1
574 Reactive Orange 4 1
575 Reactive Red 120 1
576 Reactive Red 22 1
577 Reactive Yellow 14 azo dye 1
578 recalcitrant organic contaminants 1
579 Remazol Black B Dye 1
580 Remazol Brilliant Blue R 1
581 Remazol Turquoise Blue G 133 1
582 Virus Reovirus Type 1 1
583 Resorcinol 1
584 Rhizopus nigricans (cheese mold) 1
585 Rhodamine B 1
586 Rhodospirillum rubrum 1
587 RO Effluent 1
588 Rose Bengal 1
589 Rotavirus 1
590 Saccharin 1
591 Saccharomyces cerevisiae 1 1
592 Saccharomyces ellipsoideus 1
593 Saccharomyces sp. 1
594 Salicylic Acid 1
595 Salmonella 1
Salmonella enteritidis
Salmonella paratyphi (Enteric Fever)
Salmonella Species
Salmonella typhi (Typhoid Fever)
Salmonella typhimurium
Sarcina lutea
Scacchoromyces cerevisisas
Selenium
selenium(VI)
Serratia marcescens
Shigella dysenteriae - Dysentery
Shigella flexneri - Dysentery
Shigella paradysenteriae
Shigella sonnei
Silver
Simazine
Sirius yellow
Sodium anthracene-1-sufonate
Sodium dodecylbenzene sulfonate
Soluble dye 4BS
Spirillum rubrum
Squalene
Staphylococcus albus
Staphylococcus aureus
Staphylococcus epidermis
Stearic acid
Streptococcus cricetus
Streptococcus faecalis
Streptococcus hemolyticus
Streptococcus lactis
Streptococcus mutans
Streptococcus natuss
Streptococcus pyrogenes
Streptococcus sobrinus
Streptococcus viridans
Styrene
Sulfachloropyridazine
Sulfadimethoxine
Sulfamerazine
Sulfamethizole
Sulfamethoxazole
Sulfate
Sulfathiazole
Sulfisoxazole
Sulfite
Sulfomethazine
Sulforhodamine B
Sulforhodamine B Dye
Sulfosalicylic acid
Sulfur oxides
Surfactants - unspecified
TCEP
t-Cinnamic acid
Terbufos
Testosterone
Tetrachlorocarbon
Tetrachloroethylene
Tetracycline
Thallium
Thifensulfuron Me
Thiocyanate
Thiophene
Thiosulfate
Thymine
TNT
Toluene
Tordon
Total Coliforms (including fecal coliform and E. Coli)
Total Organic Carbon (TOC)
Total Trihalomethanes (TTHMs)

Toxaphene
Trans-1,2-Dichloroethylene
Dihydrocaffeic Acids
Triadimefon
Trichloroacetic acid
Trichloroethylene
Trichloromethane
Triclosan
Triethanolamine
Trifluoroacetic acid
Trifluoroacetyl chloride
Trimethorprim
Trimethylamine
Trimethylene sulfide
Triphenylmethane dye (gentian violet)
Turbidity
Uracil
Uranium
Urine
Vibrio cholerae
Vibrio comma (Cholera)
Vinyl chloride
Viruses
Viruses (enteric)
Volatile Organic Chemicals (VOCs)
Xylenes (total)
Zinc

CESIUM AND STRONTIUM

Cesium is a soft, silvery white metal that may be stable or radioactive. The most common radioactive form of cesium is cesium-137, a significant environmental contaminant. Cesium-137 is used in various industrial applications and was discharged into the environment during the 2011 Fukushima nuclear disaster.

Strontium is a mineral that occurs naturally in the environment. Non-radioactive or "stable strontium" is very common in soil and bedrock and may dissolve entering groundwater. Trace exposure to stable strontium does not seem to pose a significant health threat. However, exposure to high levels of naturally-occurring strontium during infancy and childhood can create bone deformities and dental changes. Radioactive strontium does not occur in nature and is usually associated with nuclear power plants or nuclear weapons testing. Exposure to radioactive forms of Strontium can lead to bone diseases including bone cancer.

The following documents findings from EXOVA in Sante Fe Springs, California where lab tests that confirm the SolarBag's ability to remove Cesium and Strontium were performed.

Exova, Inc.
9240 Santa Fe Springs Road
Santa Fe Springs
California
USA
90670

T : +1 (562) 948-2225
F : +1 (562) 948-5850
E : info400@exova.com
W: www.exovachemist.com

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October 14, 2013

Puralytics
15250 NW Greenbrier Pkwy
Beaverton, OR 97006-5764

Attn: Colin Hildebrandt

Exova Job No: 151738
Purchase Order: CREDIT CARD
Project Name: Hoping Feed and Prod
Samples Received: Two (2) Sample(s)
Date Received: 09/30/2013 JWL

Analysis	Page
Cesium and Strontium by SOP 7040, Rev 12	2

Michael Shelton
Technical Director

Samina N. Hussain
Senior Chemist

Cesium and Strontium by SOP 7040, Rev 12
Inductively Coupled Plasma-Mass Spectrometry

Sample preparation: The sample was prepared with a 10 g weighed portion mixed with 0.2 mL nitric acid and internal standard solution to produce a clear solution for ICP-MS analysis.

Parts Per Billion (ng/g)

Sample ID	Cesium	Strontium
Feed	34.1	12.2
Prod	30.1	2.46
Prod Duplicate	30.3	2.50
Detection Limit:	0.01	0.01

Date Analyzed: 10-09-13

Quality Control Summary

Sample: Prod

Analyte	Sample Result	Duplicate Result	Sample RPD	Spike Conc	Spike Result	Spike % Rec
Cesium	30.1	30.3	1	100	134	104
Strontium	2.46	2.50	2	100	100	98

Date Analyzed: 10-09-13

Sample: Laboratory Fortified Blank (LFB)

Analyte	Blank Result	Spike Conc	Spike Result	Spike % Rec
Cesium	ND	100	104	104
Strontium	ND	100	98.9	99

Date Analyzed: 10-09-13

UNSUITABLE WATER SOURCES

The SolarBag offers the broadest contaminant removal of any portable water purifier. It does not, however, desalinate water (turn salt water into fresh water).

Extremely cloudy or turbid water (darker than tea color) inhibits sunlight, slowing the purification process. Generally speaking, if you cannot see through the water in the SolarBag, it is probably too turbid to use. If another water source is not available, pour the turbid water into a separate container and allow suspended solids to settle. Once the solids have settled, try pouring the water back into the SolarBag.

Fine, suspended inorganic particles (clay, sand, silica) are primarily unaffected by the technology.

Lipids (fats, oils) float on the water and do not come into contact with the nanotechnology mesh.

The nanotechnology is a non-toxic, FDA-approved, food-safe material. Accidental ingestion of the mesh has no adverse health effects.

PATENT + TRADEMARKS

PATENT

ULTRAVIOLET PHOTOREACTOR FOR THE PURIFICATION OF FLUIDS: allowed US Patent Application No. 12/665,003, filed December 16, 2009, claiming priority to U.S. Provisional Application No. 60/936,642, filed June 20, 2007; scheduled to issue as U.S. Patent No. 8,506,886 on August 13, 2013.

a. Continuation of U.S. Patent Application No. 12/665,003; entitled ULTRAVIOLET PHOTOREACTOR FOR THE PURIFICATION OF FLUIDS; Application Ser. No. 13/931,667, filed June 28, 2013.

TRADEMARKS

1. App. SN 77/861,438 filed October 30, 2009 for PURALYTICS covering Waste water purification units; Water purification and filtration apparatus; Water purification units in Class 11.

2. App. SN 85/557,334 filed March 1, 2012 for PURALYTICS covering Portable sunlight activated water purification units in International Class 11 matured into Trademark Registration 4217809 on October 12, 2012.

3. App. SN 85/557,785 filed March 1, 2012 for SOLARBAG covering Portable sunlight activated water purification units in Class 11; matured into Trademark Registration 4280961 on the supplemental register on January 22, 2013.

LIST OF AWARDS

Oregon Entrepreneurs Network • 2014 Game Changer Award
Securing Water for Food (USAID, SIDA, MFA-NL) • Innovator 2014
Blue Tech Research • Most Innovative and Distruptive Water Technology 2014
US Tech H2.0 Exemplary Technology • World Water Day 2014
International Water Association • Global Honour Award 2013
Inc. Magazine • Top 8 Best Water Investment in 2012
The Artemis Project • Top 50 Water Technology Company in 2011
Zino Green Fund • Best Cleantech Investment 2011
Clean Tech Open • National Grandprize Winner 2010
Global Water Intelligence • Water Investment Idol 2010
ImagineH2O • Double Finalist for Water and Energy Efficiency
TechCrunch Award • Finalist in the Cleantech Category

IWA the international water association
GLOBAL HARDWARE INNOVATION AWARD

TEDx x = independently organized TED event

CLEAN TECH OPEN
GRANDPRIZE WINNER

Water Top 50

Global Cleantech 100

Inc.

Global Water Intelligence

IMAGINE H_2O

ZINC Green INVESTMENT FORUM

www.purehealthwater.com