POLLUTED TO POTABLE:

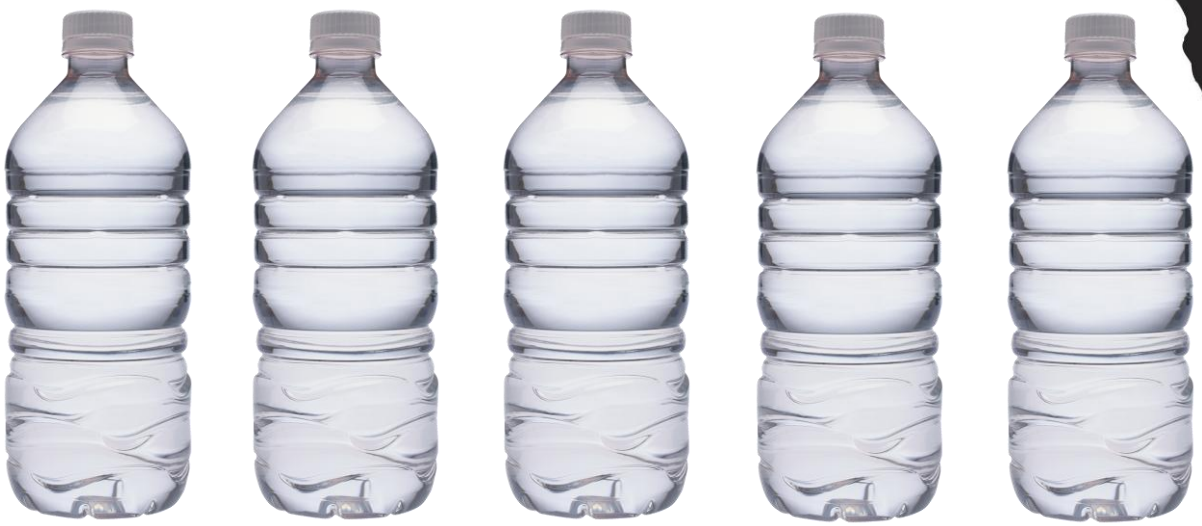
TRUSTED™ WATER FILTRATION METHOD

Everyday Solution to Global Killer

Discover how to use common wood charcoal, discarded plastic water bottles, and the sun to transform filthy water into clean, TRUSTED drinking water*

*Turbidity Reduction Unleashes Solar Technology to Eliminate Disease

By Kurt Dahlin and Caryl Sheehan
Water Wells for Africa
August, 2010



THE PROBLEM

The world faces a massive water crisis. There is no end in sight. Right now, more than 1 billion people on Earth do not have access to the most basic human necessity: safe clean drinking water.

- **1 out of 6 people in our world today lack safe drinking water**.
- Before the sun sets today 5,000 children will die from bad water, inadequate sanitation and poor hygiene. This is the equivalent to 20 jumbo jets full of kids crashing every day.
- According to a United Nations report issued in 2006 almost 2 million children will die each year from water-related diseases. The report called it a "silent emergency."
- Every 15 seconds a child dies from bad water.
- More kids die from diarrhea and than from malaria each year.
- It is estimated that half of the hospitals in the world are filled with people suffering sickness and misery from bad water.
- In the past 10 years, diarrhea from bad water has killed more children than all the people lost to armed conflict since World War II.
- The World Health Organization (WHO) estimates that 94% of these diarrheal cases are preventable through modifications to the environment, including access to safe water. http://en.wikipedia.org/wiki/Water_purification

A SOLUTION

Kurt Dahlin has combined two simple techniques for treating contaminated water at the most rural level. Reducing deaths from waterborne diseases is a major public health goal in developing countries. With just a hand full of wood charcoal, some recycled plastic bottles and a sunny day—almost anyone can have clean water in one day.

One billion people each day drink untreated and contaminated water. Each and every day on the calendar 5,000 children die from bad water. What is needed is a simple way that the poorest of the world can clean their own household water supply. The TRUSTED Water Filtration method that combines a homemade charcoal filter and the SODIS method is the micro solution to a global problem.

WATER WELLS FOR AFRICA CONDUCTS WATER FILTRATION PILOT TESTS

Turbidity Reduction Unleashes Solar Technology to Eliminate Disease

The SODIS™ method (short for "solar water disinfection") involves exposing bad water to ultraviolet (UVA) radiation via sunlight to kill water-borne microbes that compromise human health. Water is placed in clear recycled plastic bottles and exposed to the sun for 6 hours. Over 20 years of research and implementation have proven the SODIS™ method to be an effective and inexpensive technique for treating contaminated drinking water in underdeveloped areas. Access to clean water is especially important because the number one killer of children in developing countries is water-borne diseases, which cause diarrhea and dehydration. However, the SODIS™ method is *ineffective* to kill bacteria and viruses in highly turbid or cloudy water, such as water collected from a lake, pond, swamp, river, or rain runoff. Millions and millions of people have nearby water sources, yet they still struggle for clean water every day because their water supplies are turbid far above the levels to utilize the SODIS™ method. What is needed is a first step prior to the SODIS™ technique to sufficiently reduce turbidity in order for the solar power to effectively sanitize the deadly pathogens. The goal is to provide a simple and TRUSTED way to purify water collected from polluted and murky water sources.

Kurt Dahlin, President of Water Wells for Africa has tested a simple water filtration device to decrease turbidity in contaminated water prior to treatment by the SODIS™ method. Using common wood charcoal from a fireplace, a handful of cotton, and an ordinary plastic (PET) water bottle, Dahlin produced a simple method to filter dirty water for free. Most water and soft drink plastic bottles are made of PET plastic. PET bottles can be identified by the number "1" inside the recycling symbol. His field work showed that the homemade filtration device significantly reduced water turbidity enough for the SODIS™ method to destroy the deadly bacteria E. coli. The filtration device also significantly improved appearance and decreased unpleasant odors enhancing drinkability.

Turbidity is cloudiness or haziness caused by individual particles, called suspended solids, floating in the water. Some suspended solids are large or heavy and settle quickly to the bottom of a container, but others may never settle. Viruses and bacteria can attach themselves to the suspended particles and use them like tiny shields against the healing power of UVA radiation. If the tiny suspended particles are removed, the deadly microbes can be more easily destroyed by UVA radiation. Turbidity is usually measured in nephelometer turbidity units (NTU). The World Health Organization (WHO) recommends that drinking water not exceed 5 NTU. UVA disinfection methods, including SODIS™, cannot successfully disinfect water with a turbidity level above 30 NTU.

Letting water settle for several days after collection can reduce turbidity. But the daily need for water is so great that few villagers will leave full buckets sitting around. In addition, unless the water is exposed to the sun's solar rays, the microbes may continue to live for several days. The mere action of scooping water out of a bucket is enough to stir up the still-living microbes that may have settled to the bottom. What is needed is a TRUSTED way to reduce turbidity in order for the sun's power to become effective in killing bacteria, parasites and viruses.

Dahlin produced a water filter using a discarded 32-ounce plastic bottle, cotton, and wood charcoal. Using a utility knife, Dahlin cut the bottom third off of the plastic bottle. The inverted bottle then becomes a funnel. He placed a handful of cotton in the neck of the bottle and overlaid it with about 3 inches of crushed wood charcoal from his fireplace. He wanted to test a water filtration method using only materials that could be reasonably available to even the most remote villages.

First Test Confirms Turbidity Reduction

On April 20, 2010, Kurt Dahlin collected water from a local storm water retention basin. The pond is home to a myriad of birds, fish, turtles, snakes, mosquitoes, ducks and also collects gritty runoff from city street gutters and sewers. The water had a greenish cast, brackish smell, and was slimy to the touch. No one

would want to drink the dirty green water, and the SODIS™ method would not work to disinfect such murky pond water (see photos). This was the *perfect* water to test with the charcoal filter to reduce heavy turbidity enough for the SODIS Technique to work.

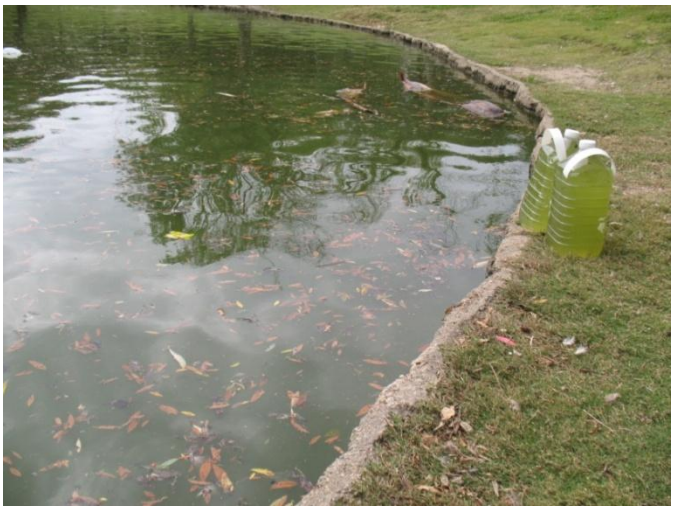


Figure 1 Storm Retention Pond Water

Figure 2 Sample Collection

Dahlin poured the pond water into the inverted plastic bottle and funneled it through the charcoal and cotton into a glass container. The charcoal began to float in the dirty water, so he placed a piece of cotton material on top of the

charcoal and secured it with a small rock. The cloth material also screened out larger debris, feathers and leaves.

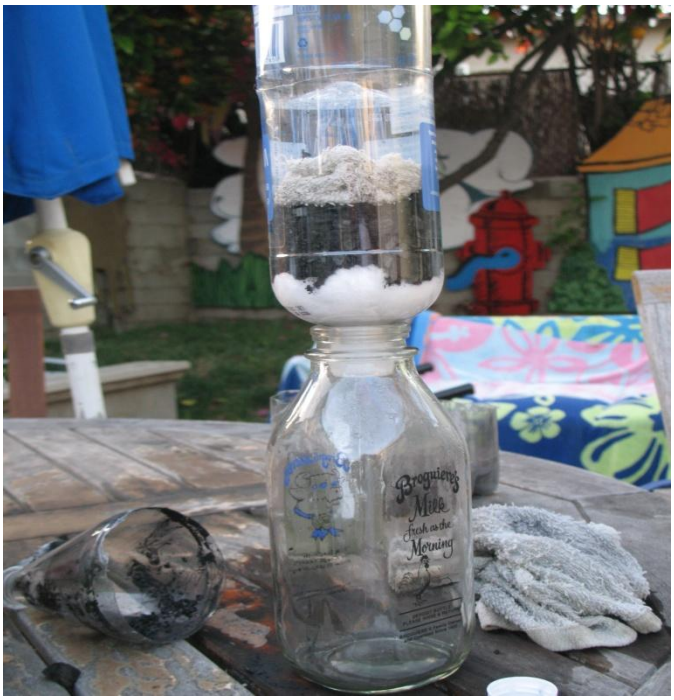


Figure 3 Close Up Of the Filtration Device

Figure 4 Untreated Greenish Water On The Left, Filtration In Process On The Right

Just one pass though the do-it-yourself charcoal filter and the filthy green retention pond water became crystal clear. The enormous reduction in turbidity was unexpected and extraordinary! The charcoal filter could partner with the

SODIS technique to clean water enough to reduce the major cause of sickness in the world.

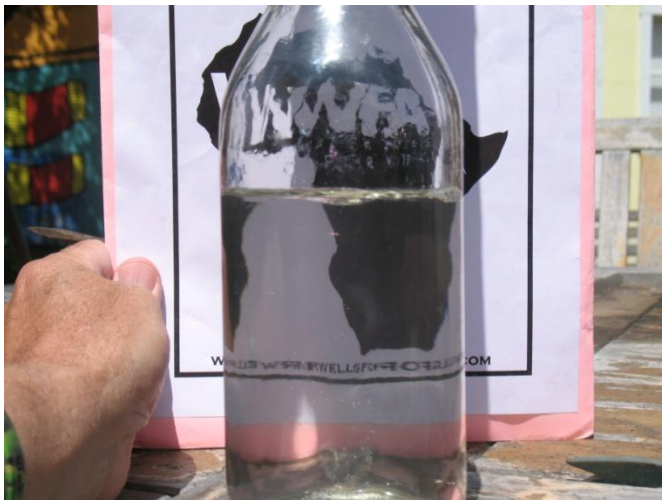


Figure 3 Visual Test For Turbidity

The filtered water came out sparkling, bright and odorless. In just a few minutes the dirty water was transformed by the amazing properties of charcoal.

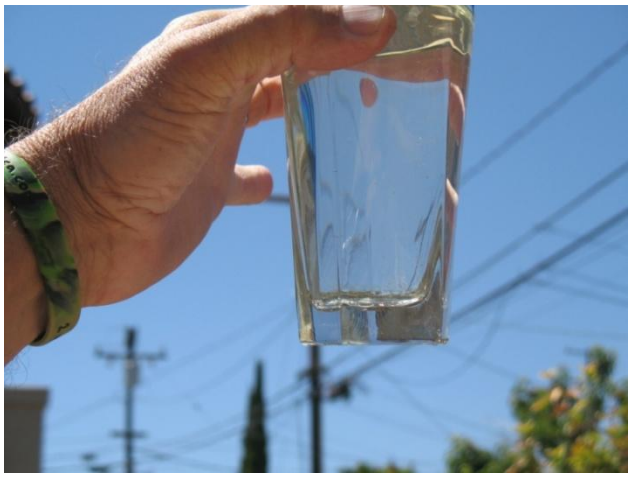


Figure 4 Charcoal Filtered Water

The charcoal filter worked great. It was difficult to tell the difference between the filtered pond water in the glass on the left and the city tap water on the right.

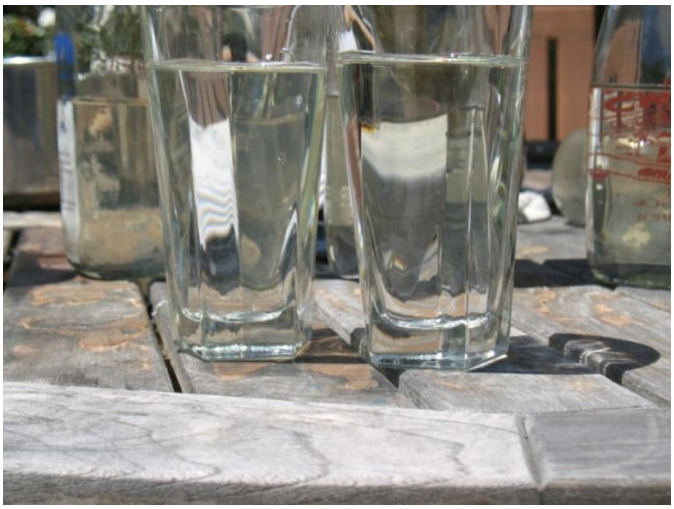


Figure 5 Filtered Pond Water On The Left, Tap Water On The Right

The results certainly *looked* promising, but Dahlin wanted an analytical laboratory to measure and confirm the reduction in turbidity as a result of the charcoal filter. Kurt Dahlin submitted two water samples to Test America in Irvine, California, a state-certified environmental laboratory. One sample was raw water taken directly from the storm retention pond; the other sample was pond water that had been passed through the charcoal filter poured into PET plastic bottles and exposed to UVA radiation for one sunny day. The water samples were analyzed for general minerals, metals, organic compounds, color, turbidity and odor.

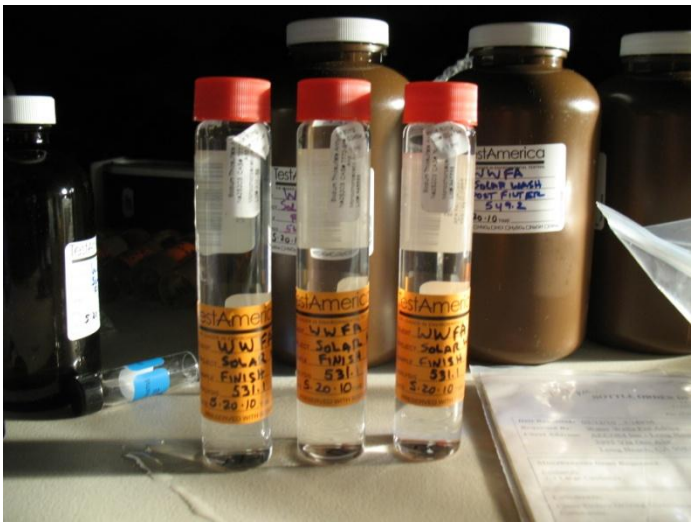


Figure 6 Samples Prepared For Analysis

Water color and odor have no direct consequence to health, but discoloration and bad odor make polluted water hard to drink. Color is measured in True Color Units (TCU). A TCU of less than 15 is usually considered acceptable. Odor is measured by Threshold Odor Number (TON). The TON is the number of dilutions needed to reduce odor to imperceptible levels. A TON of 3 or less is considered an acceptable water quality standard.

The unfiltered raw pond water sample indicated potentially unhealthful levels of certain metals, and displayed turbidity, color and odor characteristics that were not acceptable for drinking water. The filtered sample indicated improved levels of iron and manganese, and *significantly* improved turbidity, color and odor. The unfiltered pond water sample indicated a turbidity of 70 NTU; the filtered sample indicated a turbidity of 3.8 NTU, a 95% reduction! The unfiltered pond sample indicated a color index of 25; the filtered sample indicated a color index of 10, a 60% reduction. The unfiltered pond sample indicated an odor TON of 50; the charcoal treated water indicated a TON of less than 1, a 98% reduction.

The laboratory data confirmed that the campfire charcoal filter successfully reduced turbidity to levels acceptable for the SODIS method. The data also indicated that the filter was highly effective in improving the color and odor of the morbid green pond water.

However, the filtered sample also indicated increased pH and alkalinities. It was determined that these increases were possibly the result of some of the wood ash leaching into the filtered water sample. Alkaline water is not dangerous to human health, but can have an unpleasant taste.

Second Test Confirms Two Step Pairing with SODIS™ to Kill E. Coli

In the second round of testing on May 21, 2010, Kurt Dahlin broke the charcoal into pea-size pieces instead of pulverizing it, and rinsed the white ash from the charcoal prior to placing them into the plastic bottle filter. This was done to reduce the pH and alkalinity of the filtered samples caused by the presence of white ash. For the second round of testing, one unfiltered raw pond sample, one filtered sample that had not undergone the SODIS™ method, and one sample that had both been charcoal filtered and had undergone the SODIS™ method were submitted for analysis. This time the samples were also tested specifically for the presence of the deadly E. coli bacteria, a global mass murderer.

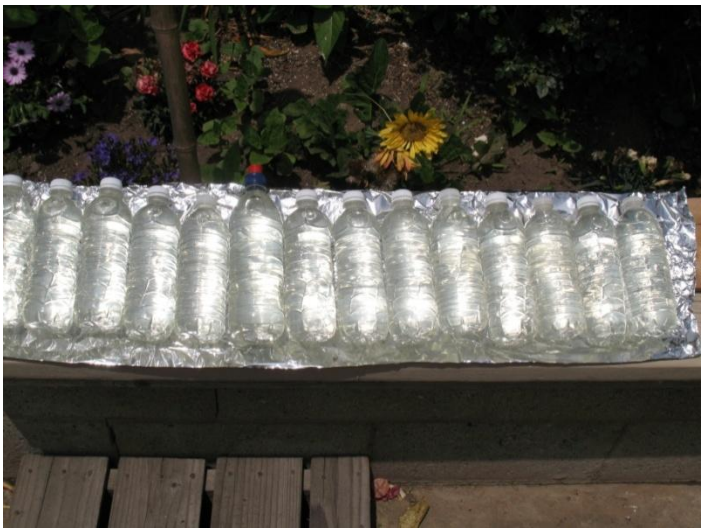


Figure 7 TRUSTED Filtered Water Is Exposed To The Sun For One Day (SODIS Method)

As Dahlin predicted, the filtered sample indicated acceptable alkalinity levels and an improved pH. The unfiltered raw sample and the filtered non-SODIS™ sample both indicated the presence of the E. coli bacteria. However the water sample that had both been charcoal filtered for turbidity reduction and undergone the SODIS™ technique indicated no detectable E. coli. The testing done by Test America showed the *absence* of E. coli in the two step process of turbidity reduction and solar disinfection.

The laboratory data confirmed that the charcoal filter in combination with the SODIS™ method had successfully destroyed the deadly E. coli bacteria!

Summary

The effectiveness of the simple charcoal filter can be TRUSTED in reducing turbidity, color and odor. Combined with the SODIS™ technique the results are extraordinary, and the implications for world health are momentous. A billion people depend on polluted surface waters such as rivers, lakes, ponds, pits and swamps for their daily water needs. Their murky water contains deadly microbes and should not be used for human consumption. However, if billions of people, flood disaster victims or people in a water crisis or shortage could be taught to construct a simple charcoal filter, utilizing common material, they could clean contaminated surface waters sufficiently for the SODIS™ method to work. It is critically important to note that the charcoal water filter does not destroy all bacteria or viruses, and should be used *in combination with the SODIS™ method* to effectively sterilize water for human consumption.

It is also important to note that two drops of unscented liquid bleach in a liter of filtered water will effectively remove most deadly microbes including cholera. Since 1785 chlorine has been used as a disinfectant to kill bacteria. It is strong enough to prevent the spread of diseases like cholera when it is added to drinking water. Chlorine bleach will kill off the bacillus of tetanus, cholera, typhus, carbuncle, hepatitis, entero virus, E. coli and Campylobacter, Salmonella, streptococcus, staphylococcus, dysentery, influenza virus, swine influenza A (H1N1), and Legionnaires' disease. Chlorine bleach can efficiently kill most microorganisms during water treatment without affecting the quality of our drinking water.

Where bleach is available anyone can have hygienic water in 30 minutes when combined with the TRUSTED charcoal filter. Even the worst water can be cleaned, attractive, odor free and sanitized with nothing more than wood charcoal, recycled plastic bottles and a sunny day.

Kurt Dahlin calls the two step charcoal filter process the TRUSTED Water Filtration Method. TRUSTED is an acronym for:

- **T**urbidity **R**eduction through charcoal filtration
- **U**nleashes the **S**ODIS™ **T**echnique **E**liminating **D**eadly pathogens

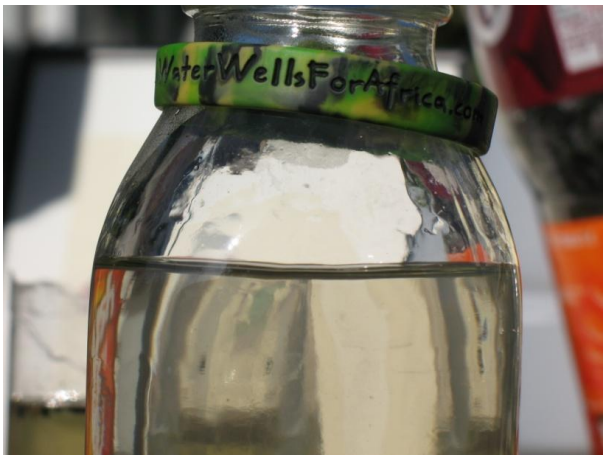
A Call to Action

Kurt Dahlin is calling all people interested in clean water for global health to continue the research and promote rural education on the benefits of the TRUSTED Water method. There are millions and millions of children that have no choice, but to drink filthy water every day. Their water is polluted, dangerous and diseased. However, with a few common materials anyone can improve their water quality—anywhere in the world.

Would you like to participate in the further development of the TRUSTED Water Filter Method? Our goal is not to produce some high-tech plastic device to sell to villagers. Instead, we want to empower them to work with *resources they already have* to build simple filters to transform dangerous water into water that can be TRUSTED and safely consumed.

For more information contact Kurt Dahlin at 310-995-7079

Website: www.waterwellsforafrica.org



ABOUT THE AUTHORS

Kurt Dahlin is the President and Founder of WWFA. Beyond providing clean water sources in Central Africa, Dahlin has spent the past few years trying to discover and promote easy solutions for filtering water.

Caryl Sheehan is a Professional Geologist with over 20 years of experience in environmental issues. She has been involved with Water Wells for Africa since 1997 and currently serves on the Board of Directors.