Annual Newsletter Issue 8— 2020

PureMadi

The intersection of water, societal, & human health disciplines

OUR MISSION: To prevent waterborne diseases through educating, training, and empowering resource-limited communities to produce and distribute an innovative point-of-use water treatment technology.

Featured Stories:



Did you know...

PureMadi has distributed 3,500+ filters around the world, giving over 13,000 people access to clean water. PureMadi has also provided water and hygiene education to 350+ children.

You are cordially invited to PureMadi 9!

When:
Friday, February 21, 2020

Where:
Alumni Hall
221 Emmet St N
Charlottesville, VA 22903

Tickets may be purchased at our website: http://www.puremadi.org.

(l. to r.) PureMadi Officers Thy Nguyen, JC Panagides, Molly Tyeryar, and Rebecca Kelly pose for a picture during PureMadi 8, February 2019.

PureMadi 8 Recap

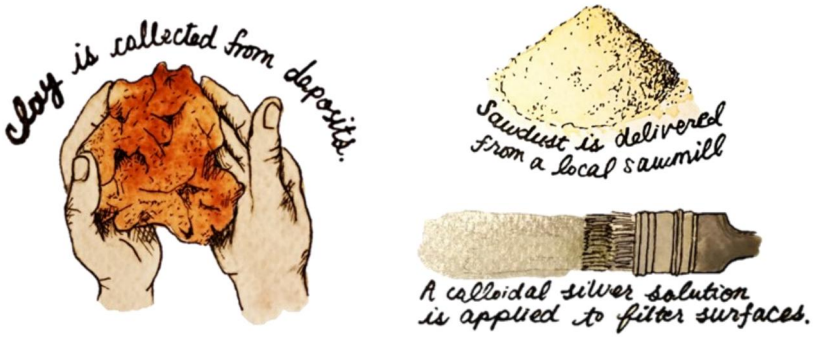
PureMadi 8 was held on Friday, February 22nd in the Jefferson Ballroom of Alumni Hall on the Grounds of the University of Virginia (UVA). It was a celebratory night, as the PureMadi Board and Officers reported on completion of our new flagship Dertig Facility's completion. The facility has 10 full-time workers who have become proficient at manufacturing ceramic water filters. The event included over 200 guests, many who have faithfully supported our activities for many years. Music was provided by Hoos in Treble (a UVA a cappella group) during the cocktail hour and by 180 after dinner. Guests enjoyed a delicious meal during our technical program and were able to bid on items from our silent auction with more than 100 items, including many artisanal ceramic pieces of artwork donated by local Charlottesville potters.

Support from the UVA community was particularly strong, with table donations coming from the School of Engineering and Applied Science, the College of Arts and Sciences, and the Schools of Medicine and Nursing, along with multiple individuals and Departments. This event is our primary fundraiser each year and helps us to continue to deliver PureMadi water filters to schools and other residents of South Africa. PureMadi 9 is scheduled for Friday, February 21st, 2020, and we hope you will get even more excited for our Tenth Anniversary Celebration in early 2021!

What are the PureMadi filters?

PureMadi uses a simple, yet effective method to manufacture ceramic water filters. Each filter effectively provides safe drinking water for a family of five for 2-3 years, and can remove up to 99.99% of bacteria from untreated water. Our methods use low-cost materials that are readily available and a manufacturing process that can be performed with local labor. This empowers local communities and helps minimize filter production costs and pricing.

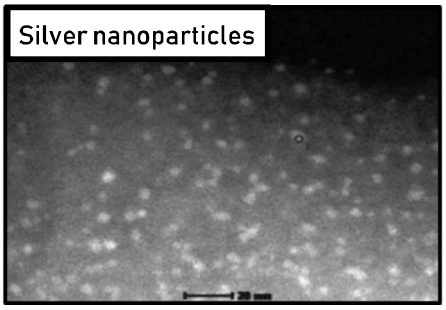
How are the PureMadi filters made?



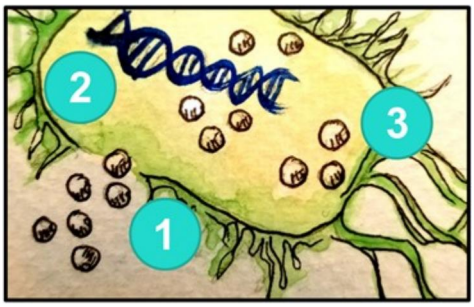
1. Clay from a local deposit is collected, dried, and grounded into a fine powder using a hammer mill.
2. Sawdust is delivered from a local sawmill. Like the clay, the sawdust is free and we only pay a modest delivery charge.
3. Clay, sawdust, and water are mixed together in a precise ratio. The mixture is pressed into the shape of a pot using a filter press. The press does not require electricity.

How do the PureMadi filters work?

The air-dried filters are placed in a kiln and fired at 870 °C. The clay particles harden into ceramic and the sawdust combusts, leaving behind a pore space that will allow slow water percolation through the filter.



The filters are subjected to a pressure test and flow rate test to ensure quality. Filters that pass both tests are painted with a colloidal silver solution. Silver nanoparticles lodge into the filter pore space.



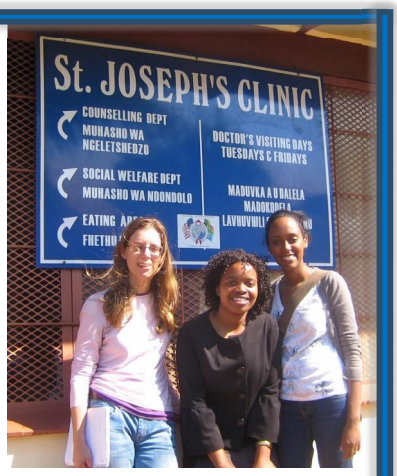
Turbidity and microbial pathogens are removed by physical filtration and chemical disinfection. Silver is a highly effective disinfectant for waterborne pathogens via 1) disruption of the membrane/cell wall, 2) inhibition of bacterial DNA replication, and 3) disruption of bacterial respiration.

Girl Scouts Donate Filters to South Africa

Students from Matsheko Primary School receiving one of the PureMadi filters donated by Camp Evening Shade.

PureMadi is excited to accept a donation from Camp Evening Shade, a Girl Scout camp held in Hanover, Virginia. Every year this camp chooses a different theme along with a related service project that is carried out by the scouts. Inspired by hearing about the work done by PureMadi from Meredith Sutton, a past student team member and camp alumni, the camp chose to raise money to donate filters to schools in South Africa. The Girl Scout camp donated 45 filters with the specification that they be donated to schools so that children attending would all have equal access to clean water. According to UNICEF, nearly 570 million children around the world lack adequate drinking water in schools which can have very serious effects on education and health outcomes. After learning about these disparities and how the PureMadi filters could help children in rural, South African schools, the girls were excited to help fundraise as well as educate others about issues in water and sanitation worldwide. The filters donated by Camp Evening Shade were distributed in November, 2019 to three rural primary schools in the Moretele District in the North West Province of South Africa by Nkosi Ndebele, manager of the Hammanskraal facility.

Checking in with Dr. Lydia Abebe



(l. to r.) Sophia Narkiewicz, Alukhethi Singo, and Lydia Abebe outside the St. Joseph's Clinic in Venda, South Africa, circa 2010.

Before there was a PureMadi, Lydia Abebe, a doctoral student in Civil and Environmental Engineering at the University of Virginia, was curious about silver-ceramic filter technologies. In particular, she wanted to know if these filters could improve human health of users. For her doctoral research, she decided to test this hypothesis in the Venda region of South Africa. Working with Julia Brant from the UVA School of Medicine, Sophia Narkiewicz from the University of Rhode Island, and Alukhethi Singo from the University of Venda, she launched a field study in rural South Africa to test this hypothesis. The study involved 100 participants who were HIV-positive. This cohort was chosen because people living with AIDS have weakened immune systems and are more susceptible to infections from waterborne pathogens. The results of the study were published in the Journal of Water and Health in 2013 (doi: 10.2166/wh.2013.185) and showed that people using the silver-ceramic filter were less likely to have diarrheal diseases. Based on these encouraging results, PureMadi was formed to provide as many people in South Africa as possible with this potentially life-saving technology.

Dr. Abebe's already-impressive career has continued along the path of water and health. She conducted research with Drs. Mark Sobsey and Jamie Bartram at the University of North Carolina, Chapel Hill as a Carolina Postdoctoral Fellow for Diversity. She then served for two years as an AAAS Science and Technology Policy Fellow in Washington, D.C. with USAID in the Global Health Bureau in Maternal Child Health and Nutrition. Most recently, she has accepted a position in Geneva, Switzerland with the World Health Organization. Specifically, she is working in their Department of Public Health. We are excited to see all the great things Lydia is accomplishing. Her work at the University of Virginia was instrumental in the creation of PureMadi.

Spotlight:
Nkosi Ndebele

Nkosi Ndebele is the facility manager for the new filter factory in Dertig. Nkosi has a BA degree in Environmental Science and is currently pursuing her MS in Hydrology at the University of Venda. Her research is on the development and testing of better silver application methods for the manufacturing of PureMadi ceramic water filters.

A day in the life at Dertig

A typical day at the PureMadi Dertig Filter Facility begins with greetings in the local Tswana language "Dumelang, le kai?" which translates to "Hello, how are you?". The workers chat shortly and check up on how their families are doing. They then get ready to commence their daily duties by getting suited up in Personal Protective Clothing such as work suits, dust masks, goggles and hand gloves.

The day's work then begins. A duty roster-type rotation system is used, depending on each worker's physical strong points. For example, Lydia, the eldest of the workers is assigned easier tasks such as sieving sawdust and crushing grog. The physically capable like Sinah and Delinah handle the more demanding tasks such as operating the filter press and the electric mixer. In between duties we have tea breaks. The Dertig team surely loves their tea!

The working environment at the Dertig Facility is fun and so easy going. Take for example, when a customer visits the facility we ululate and sing a local feel at home song "We welcome you our visitors" and one of the workers takes them for a tour around the facility. During lunchtime, the norm is to have "Pap" (made using mealie meal and boiled water). Pap is one of the most popular foods in South Africa. The people here love their pap and meat! Usually we share meals and eat collectively. The culture of unity is clearly evident here!

After lunch we continue with the day's work till 4pm and make sure all daily targets have been met. We then clean up all equipment that has been used on that particular day. The Filter Press and Mixer are usually the dirtiest. The workers then return all protective clothing and working aides to their respective lockers and knock off.

By 6pm the night watchmen Abiot reports for duty. He takes the night shift and ensures that the facility is secure and safe all night.

The workers at the Dertig Facility surely enjoy making ceramic water filters!

Our favorite meal: pap + meat and chakalaka soup

A New Electrolytic Method for Household Water Purification

Faculty and students at the University of Virginia are continuing to develop new technologies for household, or point-of-use, water purification. The latest innovation comes from the laboratory of Professor Jim Smith in the Department of Engineering Systems and Environment. PhD candidate Courtney Hill is working in conjunction with a team of undergraduate students led by Kathryn Wason from the Department of Electrical and Computer Engineering. The team has developed an electrolytic method to purify household water (Figure 1). To use the technology, the user just pushes a button and drops the device into their household water container. Within minutes, the device precisely releases silver ions into the water to initiate disinfection of the water. Each day, the user just repeats the same process (refill the container, press the button, and drop the floating electrolytic device into the water). Unlike the PureMadi filter or Silivhere Technologies MadiDrop+, this electrolytic device instantaneously creates the optimal concentration of silver in the water, causing much faster disinfection. Like our filters and the MadiDrop+, the device does not change the taste of the water and is inexpensive and simple to use.

The technology applies a constant direct current (derived from a 9-volt battery) across a pair of silver-wire electrodes (Figure 2). The current remains constant regardless of the ionic strength of the water, insuring a repeatable silver concentration. Laboratory testing shows that the electrodes last at least one year of daily use and are highly effective at disinfecting the treated water. Field testing of this technology will begin in early 2020 in the rural village of Tshibvumo, South Africa in conjunction with Dr. Joshua Edokpayi from the University of Venda.

Figure 1. A prototype electrolytic water purifier. The device floats in a water storage container and has silver-wire electrodes on the bottom that disinfect the water.

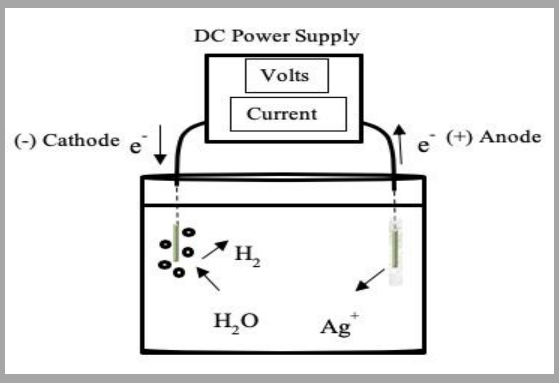


Figure 2. Schematic diagram of the electrolytic water purifier shows the electrochemical reaction that delivers silver ions to the water.

Update on Nkosi's Research

In 2018, Nkosi commenced her Masters' Degree research which focused on finding an appropriate method for silver application to produce ceramic water filters that eliminate microorganisms and provide clean drinking water. The research continued throughout 2018 and was completed in 2019.

Table 1: Percentage coliform removal for total coliform and E.coli by 3 filter types over a thirteen-month period.

Filter type	Total coliform removal	*E.Coli* removal	Average removal
1g silver nitrate	95.55%	98.94%	97.23%
2g silver nitrate	88.67%	99.50%	94.09%
Silver nanoparticles	71.72%	99.13%	85.43%

Silver nitrate and silver nanoparticle-impregnated ceramic water filters were manufactured at the Dertig Filter Facility, South Africa. Thirty households in the Dertig area received filters impregnated with silver nitrate and ten of those households were given an extra filter impregnated with silver nanoparticles. Water samples of both raw and ceramic filtered water from each household were collected and analyzed over a 13-month period. Silver nitrate impregnated ceramic water filters had a high removal efficiency for total coliforms (94.7%) and *E.coli* (99.3%).

A comparison of the performance of silver nitrate and silver nanoparticles filters in the provision of potable water was carried out. The results showed that the different filters had similar levels of total coliform and *E.coli* removal, although the silver nitrate filters produced the highest average coliform removal of 97.23% while silver nanoparticles filters produced the lowest average removal of 85.43%.

Reasonable silver levels were obtained in effluent from all filters. Silver nitrate filters resulted in the lowest effluent silver concentrations and this could potentially increase the effective life span of the filter.

A cost analysis of the process proved that it was cheaper to produce ceramic water filters using silver nitrate as the chemical. Furthermore, the filters can be purchased locally and labor-related costs can be eliminated.

In conclusion, ceramic water filters made using silver nitrate in filter production could potentially improve performance, reduce production costs, and increase safety of production for workers.

Contact Us!

PureMadi
P.O. Box 44
Earlysville, VA 22936

e-mail: *info@puremadi.org*
Follow us *@puremadi.*