

# PureMadi

The intersection of **water**, **societal**, & **human health** disciplines

## 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.

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*Eat, Drink, and Be Giving.*

**You are formally invited to PureMadi 7.**

**The event returns to Alumni Hall.**

**We hope to see you on February 23, 2018.**

**Tickets can be bought at our website: <http://www.puremadi.org>**

## Dertig Filter Facility

2016/2017 has been a productive year for the PureMadi Dertig Filter Facility. With 10 dedicated staff members (7 women and 3 men), the facility has seen itself grow in many aspects.

**Filter making.** Ceramic water filters are made every weekday and the workers are now well versed in the whole filter making process. The workers use clay, sawdust and grog as raw materials in making the water filters. Processed clay is ordered from Johannesburg whilst sawdust is purchased in nearby wood industries. Grog refers to fired filters that have failed the quality tests and are crushed into very small particles. Reusing grog by adding it to the mixture improves the drying of the clay body as well as the flow rate test of the water filters.

**Facility Improvements.** A new mixer was purchased and has helped in reaching a suitable consistency of the clay, sawdust and grog mixture as compared to hand mixing that was previously done. A kiln fan was also installed and has aided the air circulation from the room and directly from the kiln. A flood light was mounted at the back of the factory to improve illumination and for security purposes. The Dertig staff has planted a new lawn and beautiful flowers to improve the aesthetic value of the facility.

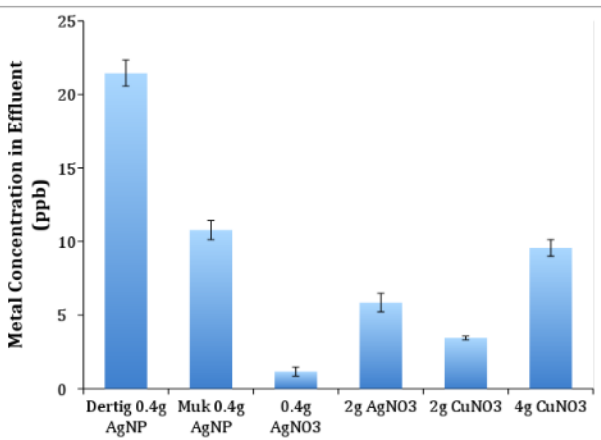
**Marketing and sales.** Marketing and sales efforts have since been carried out and a positive response has been seen from around Dertig, Hammanskraal, Pretoria and Johannesburg areas. In the near future, the Dertig Filter Facility hopes to continue making more filters as well as to engage more in the marketing and selling of ceramic water filters not only in the Dertig area but to the rest of South Africa.

-- Nkosi Ndebele, Dertig Manager

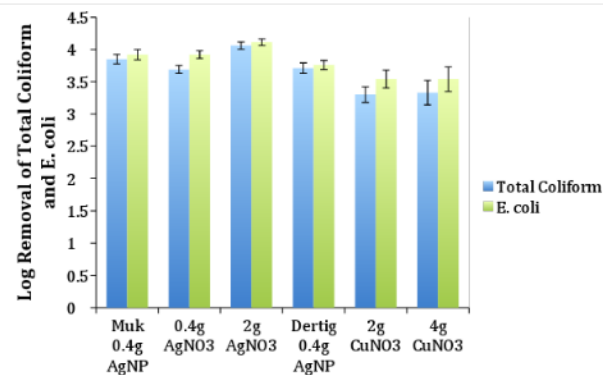
## PureMadi Research Update

This past fall, we conducted an investigation on incorporating a new method of silver and copper application to ceramic filters. Ceramic filters were produced at the PureMadi Mukondeni Pottery Cooperative in Limpopo Province, South Africa and at the new Dertig facility. With the help of local potters and UVA student Evan Lesmez, filters were made using the new silver method at Mukondeni with 0.4 g Ag (the same silver mass used currently) and 2.0 g Ag. Potters in Dertig produced two sets filters with the new copper (Cu) method with 2.0 g Cu and 4.0 g Cu in each filter. Copper was chosen since it is less expensive than silver and has been shown to be more effective against viruses

Graduate student Kathryn Nunnelley tested filters in Louis Trichardt, South Africa. Filters produced by the current method of painting on 0.4 g AgNP from both factories were also tested to compare the new methods. Mukondeni and Dertig filters were compared over 36 and 17 days, respectively, for coliform bacteria removal efficiency. 4L of borehole water spiked with a nonpathogenic *E. coli* strain was poured into the top reservoir of each filter. Samples were collected and tested for total coliform and *E. coli* removal using membrane filtration. To calculate results, the log of the effluent concentration (C) was divided by influent concentration (C<sub>0</sub>) and averaged over the period of the study. Results are displayed in Figure 1. The error bars represent a 95% confidence interval above and below the mean.



**Figure 2.** This plot shows the metals concentrations in the effluent from the filters averaged over the experiment.



**Figure 1.** Plot of the average log removal of total coliform bacteria and *E. coli* by conventional filters manufactured by painting on 0.4 g of silver nanoparticles produced at Mukondeni and Dertig, and filters fired after mixing with new silver method (0.4 and 2.0 g as Ag and 2.0 and 4.0 g as Cu).

Effluent samples were also taken to test for silver and copper concentrations. Figure 2 shows how much less silver and copper is being released by the new method. All levels are safely below the drinking water standard of 100ppb for silver and 1300ppb for copper. This is promising as lower silver levels, with the same or better performance with regards to microbial removal efficacy, could mean a longer effective lifespan of the filters.

The new method is easier to manufacture as the painting step is omitted and the new silver or copper could be purchased in country, rather than shipping (which is necessary for silver nanoparticles) at a much lower cost. The use of copper is particularly promising with the higher safe drinking water standard, higher efficacy against viruses and lower cost.

## Teaming up with Malcolm Brogdon

My idea of what "basic needs" was shaped by a family trip I took as a 10-year old to Ghana. On that trip I saw families just like mine made up of kids my own age and younger going without basic needs such as food or clean water. Fifteen years later and 683 million people around the world still do not have access to clean water. During my time at the University of Virginia I had the pleasure of working with PureMadi and learning about their efforts to decrease that number. Not only did they seek to provide a sustainable source of clean water, they are dedicated to educating and empowering local villages on the water crisis and including them as part of the solution. I am very excited to continue to work with PureMadi in their efforts to solve the water quality issue in South Africa and to provide basic needs to those who have gone without them for so long. -- Malcolm Brogdon, *Guard for the Milwaukee Bucks, UVA CLAS '15, UVA Batten '16*





## Meet Grace and Poulina

Meet Grace (69) and Poulina (79). These two sisters, born in a family of 10, have always been inseparable and do almost everything together. Grace has worked at Jubilee Hospital before, whilst Poulina once worked as a store operator at a factory in Hammanskraal. “The two gogo’s”, as they are affectionately known, have also been involved in other community projects such as brick making and bead making. They both are hands-on individuals who enjoy working with people.

Grace and Poulina have been with PureMadi since 2012 and have seen the growth of the PureMadi Dertig Facility from construction phase up to date. The two gogo’s have been invaluable members of PureMadi who pride themselves in filter making!



## PureMadi’s Jim Smith receives Fulbright Fellowship for Filter Research in South Africa



Jim Smith, PureMadi co-founder and Board Member, has received a Fulbright Research Fellowship from the U.S. State Department to conduct research on silver-ceramic water purification technologies in South Africa (S.A.). The award was coupled with the sabbatical leave program at the University of Virginia, allowing him to be in residence in Makhado, S.A. from July 2017 to January 2018.

The Fulbright Program provides participants who have been chosen for their academic merit and leadership with the opportunity to study, conduct research, exchange ideas, and contribute to finding solutions to shared international concerns.

Jim’s academic partner for this endeavor is the University of Venda in Thohoyandou, South Africa. During his stay in South Africa, Jim has worked to advance the PureMadi filter production facilities at Dertig and Mukondeni, he has worked with his doctoral student, Katie Nunnelley to develop and test a new method of silver application to our filters, and he has continued working to advance the MadiTrial, a 400-household

intervention study that is evaluating the technological performance and human health effects of the PureMadi ceramic water filters and MadiDrops.

Against the backdrop of the Smithsonian Museum of American History, PureMadi had the privilege of being selected to represent the University of Virginia as an exhibitor in the inaugural ACC:elerate Creativity and Innovation Festival in Washington, D.C. PureMadi was selected through a peer-review process as one of 48 projects within the ACC member institutions that demonstrated cutting-edge transdisciplinary innovation and a commitment to addressing the most prevailing global issues.

With the opportunity to present on a national stage, PureMadi shared conversations with the general public, industry experts, and students about the impact and implications of our work in South Africa. We received overwhelmingly positive feedback about our mission to design a smart, sustainable technology that provides an economic stimulus to local communities. A young school-child made the astute connection that this technology could be used to save lives. The event occurred a few days after Hurricane Maria, and the child provided us with the suggestion to use the filters for disaster relief efforts. This is one of many examples of the incredible potential of the ACC Festival to shape the intellectual future and instill a fascination of science, arts, and technology in our leaders of tomorrow.

The success of PureMadi’s participation in the event was, in no small measure, attributable to the Provost of the University of Virginia, Professor of Architecture William Sherman, and Matthew Slaats, who all supported our involvement in the effort, as well as the students, leaders, and alumnae who worked tirelessly to prepare for the exhibition and engage with the public over the course of the three-day festival: Helena Gallagher, Margaret Lambert, J.C. Panagides, Chloe Rento, Molly Tyeryar, Lizzy Watkins, Rupa Nallamothu., and Thy Nguyen.

## Attending the ACC Festival





## Student Summer Update



In the summer of 2017, our team of undergraduates, Helena Gallagher, Lizzy Watkins, and Rupa Nallamothe, and graduate student Margaret Lambert from the University of Virginia had the extreme privilege to travel to Dertig, near the larger city of Hammanskraal in South Africa.

On our first day on the ground at the PureMadi Facility, we were greeted with a welcome song and a traditional feast of cake, cookies, chips, and “juice” (soda). We were overwhelmed by the hospitality and genuine warmth of the PureMadi employees we met.

Each school day, we taught 2-3 lessons to the “learners” (students) in grades 3-7 at the primary school nearest the facility. Our goal with the designed curriculum was to use a series of 6 lessons to teach the fundamentals of water sanitation. The topics of the lessons were: the water cycle, sanitation/disease spread, hand-washing, sources of clean

water, water conservation, and how PureMadi filters work. At the end of our lessons, two filters were donated to each classroom, for a total of 16 filters.

One lesson that stands out to us involved teaching the learners about global water disparity and the water cycle. In a water drinking challenge, 10 learners lined up at the front of the room and were given a paper cup. A teacher walked down the line with a jug of water and asked each learner how much water they wanted. Learners filled up their cups one after the other until the end of the line was reached. One of the lessons that surprised us as Americans was that 90% of the time, the South African children took less water than we would have and reached the end of the line without emptying the water jug (which was designed to hold less than 10 full cups worth of water). The hidden lesson for us was that South African children are much more aware of how to share water in a community so as to make sure everyone gets something. The sense of community and sharing was a cornerstone of life in rural South Africa and something that humbled us as outsiders.

Our time spent at the school and water filter facility culminated with a Community Water Day. The learners started lining up outside the facility half an hour before the event began and eagerly participated in the activities. Important community figures, such as the principal of the school, teachers, and the local pastor were present. There was traditional South African dishes of beef stew, tomato gravy, and pap (corn meal) for everyone to enjoy. We sold two water filters, marking the first sales of the Dertig Facility! The day was a huge success and was filled with fun, laughter, and dancing.

By the end of our 1.5 months in South Africa, we were all reluctant to return to the grind of our lives back in the States. Our hearts were filled with the sounds of children laughing, PureMadi women signing, and yellow-billed hornbills and jackals crying in the fading light. We will be touched forever by our time in Hammanskraal and the many hearts and hands we were so fortunate to work with.



### To Donate to PureMadi:

Please visit [www.PureMadi.org](http://www.PureMadi.org) and click on our “Donate” link. All donations are fully tax deductible. PureMadi is operating as a 501(3)(c) not-for-profit organization under the umbrella of the UVA Fund managed by the University of Virginia Alumni Association. All donations go to PureMadi’s activities in South Africa.

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