Ceramic Water Filters
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INTRODUCTION

Dear Friends and Colleagues of SPOUTS,

We are delighted to introduce SPOUTS Filters, an effective and affordable WASH solution for all in East Africa. The lack of access to consistent clean drinking water has been a pressing issue in the region, and we are here to provide a solution. SPOUTS of Water, a US-based non-profit with business operations in Uganda, has been on the ground since 2012, making positive changes in the WASH section. We are working with various organizations on the ground today to:

1. Develop and implement WASH programs that utilize SPOUTS filters with partner development organizations
2. Provide sustainable micro-financing options to end-users to purchase SPOUTS filters through SACCOs, VSLAs, and micro finance institutions
3. Utilize small scale entrepreneurs to distribute filters to end users in hard-to-reach areas
4. Partner with various employers to directly provide financing options to employees

SPOUTS has also worked to install filters in public spaces such as refugee camps, clinics, schools and prisons. Ceramic water filter technology has been around for decades, and whether it is for household use or for larger institutions, SPOUTS Filters are an invaluable addition to what has been a very limited array of WASH products on the market.

Please continue reading ahead to read more about our products.

Here to serve your clean water needs,
John Kye and Kathy Ku
Co-Founders
SPOUTS of Water
EXECUTIVE SUMMARY

Addressing the Need for Lasting Water Treatment: SPOUTS ceramic water filters are an effective, sustainable, long-term approach to addressing bacterial diseases through the supply of clean drinking water. UNICEF has found that “locally produced ceramic pot-style filters have the advantages of being lightweight, portable, relatively inexpensive, chemical-free, low-maintenance, effective, and easy to use” (1).

“A clear negative association in diarrheal disease prevalence was observed in filter households compared to control households, indicating a strong protective effect of the intervention” - UNICEF (1)
# CURRENT WATER TREATMENT ALTERNATIVES

<table>
<thead>
<tr>
<th>Class</th>
<th>Treatment Alternatives</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Point of Use</strong></td>
<td>Boiling</td>
<td>High cost of carbon-based fuel source with concurrent deforestation risk and opportunity cost of collecting fuel; Potential incomplete water treatment if users do not properly boil (2)</td>
</tr>
<tr>
<td></td>
<td>Flocculant / Disinfection Powders</td>
<td>Higher relative cost of water; Multiple steps required for use; Instruction necessary; Requires two buckets, a cloth, and stirring device (2)</td>
</tr>
<tr>
<td></td>
<td>Chlorination Tablets</td>
<td>Lower disinfection effectiveness in turbid waters; Potential user taste and odor objections; Necessity of ensuring quality control of solution; Misunderstanding of chlorination byproducts (3)</td>
</tr>
<tr>
<td></td>
<td>Biosand Filters</td>
<td>Biological layer takes 20 to 30 days to develop to maturity; Filter must be used on a regular basis; Very heavy to transport, High turbidity (&gt;50 NTU) will cause filter to clog and requires more maintenance (4)</td>
</tr>
<tr>
<td><strong>Communal</strong></td>
<td>Boreholes</td>
<td>High levels of faecal contamination due to proximity to latrines and domestic or grazing animals; High bacteria rates; High lead levels (5); Even if borehole water is clean, transportation and storage in dirty plastic jerry cans can cause water to become nearly 2.5 times dirtier than water drawn from a contaminated well (6)</td>
</tr>
</tbody>
</table>

Please view Appendix A for an in-depth breakdown of these various interventions.
PRODUCT: CERAMIC WATER FILTERS

The SPOUTS Advantage

Ceramic water filters are a point-of-use treatment system used throughout the world (7). SPOUTS’ ceramic pot filter is housed in 20-liter plastic container which accommodates 10 liters of safe storage capacity. Contaminants are eliminated via physical filtration and chemical disinfection. The microscopic pore system--created from the combustion of sawdust within the clay pots--has been shown to physically filter E. coli and turbidity by>99.99% and >94%, respectively (National Water Quality Reference Laboratory Test Results). Filters are infused with silver nitrate to enhance bacterial removal through chemical disinfection. These filters produce 2 liters/hour and can serve the daily drinking and food needs of six people per WHO recommendations (5).

- Health Benefits
  Studies have shown a 60-70% reduction in diarrheal disease among user of ceramic water filters (7). Due to this reduction, Ren et al. found that there is a 0.083 reduction in Disability Adjusted Life Years (DALYs) per year for the general population as well as finding a cost-effectiveness of 84 USD/DALY averted when using ceramic water filters (8).

- A Lasting Way Forward
  SPOUTS filters are a sustainable and long-term point-of-use solution for East Africa. Ceramic water filters have the benefit of reducing deforestation, creating a culturally acceptable water taste, and are cost-effective. They should be considered for use during the recovery phase of relief efforts as a sustainable, long-term measure for treating drinking water in situations like bacterial disease outbreaks and natural disasters.

- Filter Specifications
  • Filtration rate: 2L / hour
  • Life span: 2 year guarantee
  • Pathogens removed: Bacteria and protozoa
  • E. coli reduction: >99.99%
  • Turbidity reduction: >94%
  • Container capacity: 20L
Previous Success Stories

As long-term solutions in relief settings
- Flooding in Dominican Republic: 16 months after ceramic water filter distribution, 48.7% of households visited reported having a working filter. (9)
- Tsunami in Sri Lanka: 2 years after ceramic water filter distribution, 71% of households self-reported filter use that day or the day before. (9)

As emergency response products
Ceramic water filters have also been used in relief responses by organizations such as USAID, UNICEF, Oxfam, Action Against Hunger, and the Red Cross.
- Sri Lanka Indian Ocean Tsunami 2004: 12,000 Filters (10)
- Ghana Flooding 2007: 1,000 filters (11)
- Myanmar Nargis Cyclone 2008: 115,000 filters (12)

In addition to their use in relief and emergency settings, ceramic water filters have been utilized as a tool to increase the access to clean drinking water sustainably in many developing countries by various international development organizations including but not limited to:
- UNICEF
- FAO
- Oxfam
- World Vision / Vision Fund
- Save the Children
- Plan International
- Red Cross
- Care International
- PCI
- ACF International
PRODUCT: NEXT STEPS

Basic product

High-end product

Diagram showing different sales channels for water filters: CASH SALE, NGOS, DISTRIBUTORS, DIRECT SALES, POOREST CUSTOMERS (<$1/DAY), DONATION OR SUBSIDIZED SALE, PRIMARY CUSTOMERS ($1 - $5 /DAY), SALE REIMBURSED BY MFI, MFI PARTNER, MICROLOAN.
Marketing Materials

THE SMART CHOICE
Use a SPOUTS Filter

BOIL NO MORE
Use a SPOUTS Filter

PROTECT YOUR FAMILY
Use a SPOUTS Filter
PRODUCT RECOMMENDATIONS

Dr. Ian Clarke’s Recommendation

Dr. Ian Clarke, the Mayor for Makindye Division of Kampala, has been a supporter of SPOUTS Of Water. He wrote for Sunday Vision on February 15, 2015 on the two directors of SPOUTS and suggests that the use of SPOUTS Filter can improve access to clean drinking water in Uganda.
Partner Organization and Testimonies

SPOUTS of Water is currently collaborating with a vast array of international organizations, NGOs and government bodies to ensure that our filters are getting to the people that need them. We’re continuing to grow these connections in the clean water space. These partners and supporters include but are not limited to:

- Uganda Prison Services
- Uganda Ministry of Water and Environment
- VisionFund Uganda
- PRIDE International Uganda Ltd.
- Living Goods
- POPOW
- JESE Joint Effort to Save the Environment
- Besania SACCO
- Clinton Health Access Initiative
- Plan International
- Save the Children
- ACM Ministries
- OXFAM GB South Sudan
- PAH Polish Humanitarian Action
- Embassy of the Republic of Korea in Uganda
- KOICA
- Uganda Healthcare Federation
- SURGE for Water
One family said that since they started taking [SPOUTS] filtered water their family has not had diarrhea and they are very happy and grateful. Another one said they had like the clean water and it even comes out cooler and they are all doing fine now.

Aurora Castillo, Director (ACM)

60,000 UGX is the best price point I have heard. The other water products in the area go way above 100,000 UGX and seem unreasonable to even middle class Ugandans.

Ted Pantone, Director (Mango Fund)

The [1000] students here get sick all the time from drinking dirty water. But the water from the pots is very excellent. The parents traveled far just to see them and want to take them even home.

Charles M., Headmaster (Nyero Primary School)
TEST RESULTS

Uganda Ministry of Water and Environment

NATIONAL WATER QUALITY REFERENCE LABORATORY

PERFORMANCE ASSESSMENT OF THE CERAMIC WATER FILTER

1.0 Introduction
This report provides test results for performance assessment of the Ceramic water filter No. 2 delivered to the National Water Quality Reference Laboratory (NWQRL) by staff from Spouts of Water Limited located in Busiro Block 376, Plot 895 Wakiso.

The ceramic water filter is intended to provide household low cost water treatment that removes up to 99.9% germs to provide safe and clean water. The treatment unit comprises of two components; the ceramic pot and the bucket fitted with a drain tap. Raw Water is poured on to the ceramic pot which is then filtered at a rate of 1.8L/hr and collected in the reservoir (the Bucket). The filtered water can then be collected for drinking through the tap.

The assessment of the performance of the ceramic water filter to remove unwanted contaminants in water to produce acceptable clean water that meets the drinking water standards at the rate of 1.8L/hr has been conducted.

2.0 Methodology
The filtrate was collected through the tap and tested for bacteriological, physical and chemical constituents for good drinking water requirements as show in the table 1. The raw water was also tested for similar drinking water constituents. The final volumes of water filtered were measured and the filtration rate determined. The percentage removal rates of the problematic constituents were then calculated. And finally the sustainability of the filtered water measured against the drinking water standards.

3.0 Drinking water requirements
Good drinking water must have acceptable physical appearance and organoleptic characteristics. The drinking water must also be free of disease causing organisms and chemicals that have potential health risks must be within the safe levels. Acceptability of drinking in terms of physical and chemical aspects is measured against the National Standards for drinking water.
NATIONAL WATER QUALITY REFERENCE LABORATORY

PERFORMANCE ASSESSMENT OF THE CERAMIC WATER FILTER

4.0 Laboratory results and discussions

<table>
<thead>
<tr>
<th>Parameters</th>
<th>% removal</th>
<th>Test Results</th>
<th>US 2011-2008 Drinking water Standard class 1</th>
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</thead>
<tbody>
<tr>
<td>Total Coliforms (CFU/100mLs)</td>
<td>99.99</td>
<td>&lt;1</td>
<td>Not Detected</td>
</tr>
<tr>
<td>E. coli (CFU/100mLs)</td>
<td>99.99</td>
<td>&lt;1</td>
<td>Not Detected</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>46.30</td>
<td>1.96</td>
<td>5</td>
</tr>
<tr>
<td>pH (Units)</td>
<td>6.9</td>
<td>7.6</td>
<td>5.5-8.5</td>
</tr>
<tr>
<td>Colour (PtCo)</td>
<td>88.00</td>
<td>3.00</td>
<td>15</td>
</tr>
<tr>
<td>Conductivity (μS/cm)</td>
<td>39</td>
<td>208</td>
<td>1500</td>
</tr>
<tr>
<td>Flow rate (L/hr)</td>
<td></td>
<td>1.8</td>
<td>NS</td>
</tr>
</tbody>
</table>

Table 1: Laboratory test results on an average

4.1 Physical characteristics

The physical characteristics refer to properties of water that may be determined by physical methods. Such properties include conductivity, pH and turbidity measurements. Physical characteristics mainly have aesthetic affects such as taste, smell and appearance to water.

The physical Characteristics of the filtered water showed in table 1 above show water that is within the recommended standards. The Ceramic filter can remove Turbidity, Colour on average of 67%. However, there was an observed increase of 39% in the mineralization of the filtered water.

4.2 Microbiological Characteristics

Microbiological characteristics refer to pollution in water by pathogens commonly determined from of total Coliforms and E. coli. Total Coliforms is derived from the environment as a result of decomposing organic matter while E. coli is derived from faecal matter from warm blooded animal. Presence of E coli indicates recent contamination.

DIRECTORATE OF WATER RESOURCES MANAGEMENT

Page 2 of 3
NATIONAL WATER QUALITY REFERENCE LABORATORY

PERFORMANCE ASSESSMENT OF THE CERAMIC WATER FILTER

The filtered water samples test results show microbiological characteristic that meet the required drinking water standard. The filter can effectively remove problematic constituents of microbiological nature in the water to up to 99.99% removal as shown in table 1.

5.0 Conclusion
The treated water from the ceramic water filter is efficient and effective to produce water that meets the recommended standard of water for human consumption.

6.0 Recommendations
- The company should think of increasing the size of the filtration unit for large communities such as schools etc.
- Regularly carry out cleaning and maintenance of the ceramic water filter to avoid clogging as instructed every after 14 days.

Issued by
Principal Water Analyst
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Result</th>
</tr>
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<tbody>
<tr>
<td>Flow Rate (l/h)</td>
<td>1.8</td>
</tr>
<tr>
<td>Conductivity (μS/cm)</td>
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</tr>
<tr>
<td>Colour (Pt Co)</td>
<td>0.00</td>
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<tr>
<td>pH (Units)</td>
<td>7.6</td>
</tr>
<tr>
<td>Turbidity (NTU)</td>
<td>6.9</td>
</tr>
<tr>
<td>E.coli (CFU/100ml)</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Coliforms (CFU/100ml)</td>
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</tr>
<tr>
<td>Removal</td>
<td>69.9</td>
</tr>
<tr>
<td>Standard class 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Sample Type: Treated Water**

**Client Address:** Busia Block 376, Plot 699, Wako

**Product:** Ceramic Water Filter

**Client Name:** Spouts of Water Ltd

** alas of Analysis**

**Analysis Completion Date:** 12/5/2015

**National Reference Water Quality Laboratory - Entebbe**

**Ministry of Water & Environment**

**Form A**
APPENDIX

A: Analysis of Drawbacks of Alternative Water Treatment Methods

(a) Point of Use: Boiling
Boiling water uses resources like firewood which are scarce in many areas of East Africa (13). The WHO estimates that 1 kilogram of wood is needed to boil 1 liter of water (14). A ceramic water filter manufacturer in Cambodia claims that “[b]y eliminating the need to burn firewood to boil water, each filter in circulation saves about 2 tons of firewood each year, according to conservative estimates” (2). Boiling this water takes time from other productive activities, often for women (6). Another potential issue related to boiling water occurs if the water is not brought to the full boiling temperature, in which case the harmful bacteria would remain alive (15). Even when bacteria in the water have been boiled, the suspended material in the water remains and is unappealing to the user (6).

(b) Point of Use: Chlorination Tablets
Chlorine tablets are problematic as they need to be handled carefully or else risk skin and respiratory irritation (3). As a consumable, they incur ongoing costs, the concentration of tablets may deteriorate over time, and the dosage depends on water quality (6). Users often complain of the taste and odor of chlorine in their drinking water (15).

(c) Point of Use: Flocculant/Disinfection Powders
Flocculant/disinfection powders like P&G PuR Packets have drawbacks of being a multi-step process for removing the material that has dropped to the bottom of the container and they are more expensive per liter of water treated than ceramic water filters (15).

(d) Point of Use: Biosand Filters
Biosand filters are designed to remove pathogens found in water which can take 20 to 30 days to fully develop to produce clean water. Regular use of the filter is required to maintain the biofilm layer. The systems weight makes it difficult to transport. Water with high turbidity will clog the filter (4).

(e) Communal Solution: Boreholes
Boreholes can serve as a source of water but this water can be contaminated from faecal matter from humans and animals (5). Even if the water in the borehole is initially clean, studies have shown that transportation and storage of water in dirty containers can substantially degrade the quality of the water (8).
B: References (Annotated)


The filter’s demonstrated effectiveness in improving water quality and health, over a wide range of conditions, makes it an attractive option for household water treatment in Cambodia. Results suggest more work is needed in order to ensure the intervention’s continued effectiveness and sustained use in households. Filters maintain effectiveness when used properly. Where possible, filters should be integrated into a comprehensive WSH intervention program. More research is needed on the health impacts of the CWP.

(2) Daniele Lantagne, PE and Thomas Clasen, JD, PhD. Point of Use Water Treatment in Emergency Response. London School of Hygiene and Tropical Medicine. With support from USAID . London, UK. October 2009.

Document recent experience in point of use water treatment in emergency response, identify lessons learned and develop a set of recommendations. A literature review and a survey were performed and the results were summarized.


(5) Brian Reed and Bob Reed. Technical Notes on Drinking-Water, Sanitation and Hygiene in Emergencies. WEDC for World Health Organization. 2011

Technical notes prepared for WHO regarding how much water is needed in emergencies, 2.5 to 3 liters per day for survival (drinking and food).


Preliminary results from a study performed in Uganda beginning in July 2011 regarding the effect of storing and transporting water from wells to the point of use. Found high levels of contamination from dirty containers despite original clean water sources.


Overview of effectiveness, health impact, benefits, drawbacks, appropriateness, implementation examples, and economics and scalability for ceramic filters


A study evaluating the social, economic, and environmental sustainability of ceramic filters impregnated with silver nanoparticles for point-of-use drinking water treatment in developing countries. LCA analysis against a centralized water treatment and distribution system over 10 years. Results indicate that ceramic filters averted 0.083 DALYs per year for the general population and is cost effective at 84 USD/DALY averted when considering diarrheal diseases. It also performed better in 4 out of 5 environmental categories including energy usage, water usage, global warming potential, and PM10 generation than a centralized water distribution system.

Determining best practices for household water and treatment and safe storage in response to disasters such as the 2010 Haiti Earthquake. Suggests that interventions such as water trucks and chlorination tablets effective during acute phase of disaster but ceramic water filters may be appropriate for the recovery phase. Funded by UNICEF, Oxfam Great Britain, and Oxfam America.

Description of the Red Cross’s distribution of ceramic water filters in Sri Lanka in 2004. Proportion of reported continued users was high at 76% of the 452 households that had received filters. Mean flow rate was 1.12 liters per hour and filters were shown to continue to improve water quality, reducing Escherichia coli for households.


UNICEF study shows that after initial flushing of Myanmar-made filters, arsenic levels in effluent are at acceptable drinking water levels.

Doi:10.1371/journal.pone.0039337

A Canadian company that specializes in water purification solutions and support reviews waterborne disease, bacteria, viruses, and cysts and reviews common methods of water purification.
C: Literature - CWFs for Water Treatment

Evaluating the Sustainability of Ceramic Filters for Point-of-Use Drinking Water Treatment

Dianjun Ren, Lisa M. Colosi,* and James A. Smith

ABSTRACT: This study evaluates the social, economic, and environmental sustainability of ceramic filters impregnated with silver nanoparticles for point-of-use (POU) drinking water treatment in developing countries. The functional unit for this analysis was the amount of water consumed by a typical household over ten years (37,960 L), as delivered by either the POU technology or a centralized water treatment and distribution system. Results indicate that the ceramic filters are 3–6 times more cost-effective than the centralized water system for reduction of waterborne diarrheal illness among the general population and children under five. The ceramic filters also exhibit better environmental performance for four of five evaluated life cycle impacts: energy use, water use, global warming potential, and particulate matter emissions (PM10).

For smog formation potential, the centralized system is preferable to the ceramic filter POU technology. This convergence of social, economic, and environmental criteria offers clear indication that the ceramic filter POU technology is a more sustainable choice for drinking water treatment in developing countries than the centralized treatment systems that have been widely adopted in industrialized countries.

For more on this paper, please follow the link below.
http://pubs.acs.org/doi/abs/10.1021/es4026084