Hydraid® Biosand Water Filter – Proven Technology to Address the Global Water Crisis

According to United Nations reports, lack of access to water that is safe for human consumption is associated with four billion cases of diarrhea and millions of other cases of illness each year. In 2008, the World Health Organization (WHO) estimated that the death of 2.2 million children per year could be prevented by reducing the diarrheal and malnutrition impacts related to unsafe water, inadequate sanitation or insufficient hygiene. For children under 15, this burden is greater than the combined impact of HIV/AIDS, malaria and tuberculosis. The U.N. estimates nearly 900 million people receive their water from an unimproved drinking water source. In places where homes or villages have no improved water or infrastructure for sustainable water sanitation, people have little choice but to get their water from the same sources in which animals drink and defecate, which leads to water-related diseases such as diarrhea, dysentery and cholera.

BioSand Technology

One of the world’s most effective, sustainable and proven water purification methods, BioSand filtration significantly reduces the leading causes of waterborne disease and death in the developing world through a combination of biological and mechanical processes. Users reduce contamination through the force of gravity alone by simply pouring surface or ground water through the filter to obtain water that is safe for drinking, food preparation, personal hygiene and sanitation. A typical system can treat up to 20 liters of water in about 30 minutes.

This family-sized, intermittent-use technology is based on a centuries-old slow sand filtration method and grew out of work conducted in Nicaragua in the early 1990’s by leading water expert Dr. David Manz of the University of Calgary, Alberta. It is estimated that today there are more than 400,000 BioSand filters in more than 70 countries in Africa, Europe, Asia, North, Central and South America, the Caribbean and the South Pacific. Many of these filters are made of concrete, which is prone to breakage and production consistency issues, and can be difficult to transport. In addition, cement production capacity is generally one to two filters per day per mold. These challenges aside, BioSand technology has been extensively tested in laboratories at the University of North Carolina, University of Calgary, and elsewhere, and the research consistently shows the filters to be effective, reliable and affordable. Health impact studies have demonstrated improved quality with a 95% reduction of E. coli and 44% reduction in diarrheal disease.

---

1 UN Progress on Sanitation and Drinking-Water: 2010 Update
2 http://www.manzwaterinfo.ca/fieldrpt.htm (1/6/2011)
3 http://www.manzwaterinfo.ca/ (1/6/2011)
4 Health Impact Study in Cambodia, 2007, Liang, K, Sosey, MD University of North Carolina
Hydraid® BioSand Water Filter

Triple Quest’s Hydraid® BioSand Water Filter involves the same, effective BioSand filtration technology developed by Dr. David Manz – using a lightweight plastic vessel instead of a concrete one. This technology is dramatically more portable, scalable (plastic production is upwards of 980 filters per day per mold) and low-cost compared to traditional concrete filters — all critical factors in implementing a safe water project for rural and highly remote areas of the world. Water project teams using the Hydraid® filter can spend more time assisting families with health, hygiene and sanitation issues than molding concrete filters. The unit’s medical-grade plastic is FDA approved for drinking water, UV resistant and projected to last beyond 10 years. To date, an estimated 50,000 plastic Hydraid® BioSand Water Filters have been distributed in a broad array of countries.5

Based on several factors such as: sustainability, water quantity produced, ability to treat a range of water qualities, ease of operation, time to treat, cost per liter, and supply chain requirements, Hydraid® BioSand Filter technology ranked as the best overall technology for the developing world according to industry expert Dr. Mark Sobsey of University of North Carolina.6

Hydraid® BioSand Product Specifications

- Height - .77m (30.5”), diameter - .42m (16.5”)
- Weight: Empty - 3.6kg (8 lbs.), Filled – 63.5kg (140 lbs.)
- No moving parts or parts to replace
- Intended Use: Point-of-use in homes
- Easy Installation: about 30 minutes (level and fill with sand)
- Power Source: Gravity (no electricity or plumbing required)
- Convenient: Operates on demand
- Filtering Capacity: 47 liters/hour
- Serves the needs of 8-10 people daily
- Prep Time: Surface biological layer forms naturally in about 2 weeks
- Low Maintenance: cleaned in place by user, instructions provided

Alternative Technologies

Household water treatment options for rural villages without electricity and piped water range from boiling, sedimentation, combined coagulant-chlorine disinfection systems, SODIS-transparent polyethylene terephthalene (PET or PETE) bottles exposed to solar UV and heat, ceramic filters and BioSand filters. Other manufactures have introduced hollow fiber membrane filters (e.g., Sawyer filters, Tata Swach). In some cases, “ad hoc” BioSand filters have been assembled from local plastic vessels, PVC pipe, sand and gravel, increasing the potential for inconsistent performance.

Many of these alternatives lack independent, scientifically sound lab and field studies documenting their ability to improve water quality and reduce waterborne infectious disease in real world conditions. Accurate independent studies are available for the following technologies.

5 Jim Gingrich, Business Unit Leader for Commercial Operations, Cascade Engineering, Inc.
TABLE 2. Diarrheal Disease Reduction by POU Technologies in Controlled Studies

<table>
<thead>
<tr>
<th>Technology</th>
<th>Diarrheal disease reduction estimate (95% CI)*</th>
<th>Compliance (estimates of self-reported and/or measured % user compliance)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SODIS (solar UV radiation + thermal effects)</td>
<td>31% (26%-37%) (5)a</td>
<td>78% compliance during study (24); however, post study compliance rates may drop as low as 9% (25)</td>
</tr>
<tr>
<td>Free chlorine and safe storage</td>
<td>37% (25%-48%) (5)</td>
<td>60-73% of households were self-reported users, but only approximately 30-40% of those who reported use had detectable free chlorine levels (27-29)</td>
</tr>
<tr>
<td>Coagulation/chlorination, i.e. Water Maker, PuR</td>
<td>31% (18%-42%) (5)</td>
<td>Usage rates may drop to as low as 10% after intervention ends (30)</td>
</tr>
<tr>
<td>Ceramic filtration through candle filters</td>
<td>63% (51%-72%) (50)</td>
<td>High until filter breaks; in a trial in Bolivia, compliance was 885 over 6 months (3)</td>
</tr>
<tr>
<td>Ceramic filtration through ceramic water purifiers</td>
<td>46% (29%-59%) (9)</td>
<td>Dependent on filter breakage rates, (10)</td>
</tr>
<tr>
<td>BioSand filtration</td>
<td>47% (21%-64%) (32)</td>
<td>85% post-implementation (33, 34)</td>
</tr>
</tbody>
</table>

* * Summary estimates stratified by type of intervention (from a meta-analysis of drinking water quality interventions and diarrheal disease reductions). Summary estimate from meta-analysis on POU chlorination (includes both free chlorine disinfection and combined coagulation-disinfection).

Multiple Health Impact Studies

Health impact studies have long been used to assess the impact of various technologies and investments in water, sanitation and hygiene interventions. Independent and scientifically sound studies are generally accepted as evaluation tools in understanding the interconnected necessity of water, sanitation and hygiene for health and development.

Two health impact studies have been performed and published on BioSand technology in the concrete filter format. In 2008, three health impact studies were performed specifically on the plastic Hydraid® BioSand Water Filter and involved 81 filters installed in Cambodian households, 89 in Honduran households and 115 in Ghanaian...

7 Environ. Sci. Tehcnol. 2008, 42, 4261-4267
households. The studies showed the following results for E. coli reduction,\(^8\) they have been published as abstracts and are currently in the peer review process.

<table>
<thead>
<tr>
<th>Location</th>
<th># of plastic BSFs installed</th>
<th>Date of installation</th>
<th>Geometric mean reduction E. coli direct from BSF outlet (N)*</th>
<th>Geometric mean reduction E. coli from BSF stored and treated (N)+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambodia</td>
<td>81</td>
<td>7/2008</td>
<td>92% (533)</td>
<td>89% (503)</td>
</tr>
<tr>
<td>Ghana</td>
<td>115</td>
<td>9/2008</td>
<td>97% (401)</td>
<td>85% (398)</td>
</tr>
<tr>
<td>Honduras</td>
<td>89</td>
<td>8/2008</td>
<td>62% (738)</td>
<td>46% (729)</td>
</tr>
</tbody>
</table>

Health impact studies in and of themselves and especially when presented outside the context of the necessity of sanitation and hygiene are not universally accepted. This may be the case when the studies are commissioned by the product founders or when the studies measure only diarrhea illness and not other water related measurable outcomes. Other contributing factors are individuals have different infectious dose thresholds, water related pathogens have different infectious doses and there are multiple contamination pathways for pathogens other than water.

Conclusion

The World Health Organization (WHO) recommends household water treatment as an effective and affordable solution to waterborne disease.

The Hydraid\(^8\) BioSand Water Filter is founded on proven, patented technology. It is a simple, lightweight household point-of-use filter powered by gravity. It is extremely durable, has no parts to replace and projected to last beyond 10 years, making it the most sustainable filter available. Most importantly, it reduces parasites, bacteria and viruses found in contaminated water – and is improving the health and lives of families who use it as a part of an overall program of hygiene and sanitation. The collaboration of many different organizations – each with their own approach and sphere of influence –can bring these innovative filters to families, save lives and help lift entire communities out of poverty.

Triple Quest

Triple Quest is a collaborative social enterprise between Cascade Engineering and The Windquest Group, a West Michigan private investment fund. Cascade Engineering is a multi-business manufacturer and marketer with more than 30 years of experience and expertise in large-part injection molding in the automotive, solid waste & recycling, furniture, material handling and renewable energy markets. Cascade Engineering focuses on making a positive impact on society and the environment, and on being financially successful. Triple Quest is a social

---

\(^8\) Field performance of the plastic biosand filter in Cambodia, Ghana and Honduras. C.E. Stauber, E. Printy, A.M. Fabiszewski, C.C. Kominik, A.R. Walters, K.R. Liang, and M.D. Sobsey, Georgia State University, Institute of Public Health, Atlanta, GA, University of North Carolina, Dept. of Environmental Sciences and Engineering, Chapel Hill, NC
enterprise business unit focused on sustainable development and enterprise. Triple Quest holds the only U.S. license to manufacture and market the commercial version of the patented Hydraid® BioSand Water Filter technology. Additional information is available at our website www.Triplequest.com or by calling 616.254.4114.
Other Studies

See Appendix A for a listing of studies completed on BioSand filter technology.

Appendix A

3. Stauber, Christine E., Gloria M. Ortiz, Dana P. Loomis and Mark D. Sobsey. “A Randomized Controlled Trial of the Concrete Biosand Filter and Its Impact on Diarrheal Disease in Bonao, Dominical Republic.” American Journal of Tropical Medicine Hygiene 80(2), 2009, pp 286-293

Abstracts and Posters
10. Fabiszewski, Anna M., Christine E. Stauber, Adam R. Walters, Rony E. Meza Sanchez and Mark D. Sobsey. “A Randomized Controlled Trial of the Plastic-Housing BioSand Filter and its Impact on Diarrheal Disease in Copan, Honduras.” 2011 DRAFT
13. MacDonald, Laura, Bill Ball, Erica Schoenberger. “Aid Efficacy for Point-of Use Water Treatment: Following Interventions from Origin through Implementation to Evaluation.” Johns Hopkins University


Health Impact Studies


Other Research


21. Manz, P. Eng., Dr. David H. “BSF Community Scale Drinking Water Supply Station V 1.0 Using Concrete Ring and Base Construction.” July 17, 2005

22. Manz, P. Eng., Dr. David H. “BSF Community Scale Drinking Water Supply Station V 1.0 Using Concrete Ring and Base Construction.” July 22, 2005


24. BioSand Water Filter Removal, Treatment Capabilities and Specific Accreditation and Regulatory Approvals


26. Aiken, Benjamin A. “Sustainability Assessment of the Biosand Filter in Bonoa, Dominican Republic.” A technical report submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Masters of Science in Public Health in the Department of Environmental Sciences and Engineering, Chapel Hill 2008

28. Stauber, Christine E. “The Microbiological and Health Impact of the Biosand Filter in the Dominican Republic: A Randomized Controlled Trial in Bonao.” A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Environmental Sciences and Engineering, Chapel Hill 2007


Evaluations


International Certified Lab Results


33. Certified Lab Results commissioned by Mr. Vinod Ready. “Care Labs - AP Government Registered No. 2461/05” Erramanjil, Hyderabad, India. October 29, 2010.

World Health Organization