Summaries of Reports and Studies of the Ceramic Water Purifier (CWP): A Colloidal Silver (CS) Impregnated Ceramic Water Filter

Since the inception of the Potters for Peace (PFP) model colloidal silver impregnated ceramic water filter, dozens of studies have been conducted to assess different aspects. This document summarizes studies, articles, and reports related to the performance and use of Potters for Peace ceramic water purifier (CWP).

In this report, the abbreviation "CWP" (ceramic water purifier) is used for the PFP colloidal silver impregnated ceramic water filter. The CWPs have been referred to in various studies as Filtrons, filters, ceramic filters, filter pots, CSPs, CWFs, CSFs and artisan-made filters (filtros artesanales). The filtros artesanales are the only models in this summary that were not made with a press but rather were thrown on a potters wheel.

Unless otherwise specified, a CWP is a product that has been fabricated using local clays and a combustible material screened to a specific size and mixed in an approximate ratio of 60:40; has been formed on a standardized filter press to produce a unit with a capacity to contain approximately 8 liters; has been fired to approximately 900°C (approximately 1650°F); has been coated with a mixture of 2mL of an approximate 3.2 solution of colloidal silver to 250 mL of filtered water; and has been placed inside a lidded clay or plastic receptacle with a faucet at the bottom.

This summary takes care to distinguish between the CWP (that includes the receptacle) and the CWP filter element.

All studies designated as "field" studies were conducted in communities where CWPs were in use and where water samples were taken directly from CWPs in the home (even if samples were tested in a lab). All studies designated as "laboratory" studies were of CWPs or CWP elements that were tested only in a laboratory setting (even if the filter elements were from a household).

This report does not include results of studies of production processes for the CWPs nor does it include studies of other water filter systems such as those produced by Katadyn. Studies were obtained from Potters for Peace Nicaragua coordinators, Potters for Peace website, from references provided in other papers, and from studies in the author's personal archives. Studies conducted as part of a master's thesis or doctoral dissertations are included.

Respectfully submitted,
Barbara Donachy, MPH (former US Coordinator of PFP)

Table 1: CWP PERFORMANCE: FLOW RATES, TURBIDITY, PORE SIZE, PARTICLE SIZE				
Author	Population/number	Study Description	Results	Conclusions/Recommendations
Lantagne 2001 Laboratory study See Tables 2,3,4	3 CWP elements made in PFP factory in Nicaragua.	Study of flow rates, flow mechanism, reactivation of flow, and pore size. Two new CWP elements were tested for flow rate at the factory and in the laboratory. One(1) old CWP element from a CWP-using household was tested for flow rate.	Pore size of CWF elements ranged from .6 to 3 microns. Flow rates for full CWP elements were between 1.6 and 2.2 L/hr. Water flows down the sides of the CWP element and drips from the bottom. Flow rate of old CWP element was .4 L/hr. Scrubbing with a toothbrush restored rate to 2.1 L/hr. No correlation was found between flow rate and silver concentration.	CWP element pore size is well within the range needed to filter *E.coli* without disinfection. Care should be taken to coat both sides of the CWP element with CS. Determine effect of CS concentration and microbial inactivation after repeated scrubbing to simulate a 24-month period. Scrubbing with a brush is needed. Met WHO criteria for family of 4.
Lantagne 2001 Field Study See Tables 2,3,4,5,6	24 households with poor quality water from 3 geographical regions of Nicaragua currently using the CWP.	Household survey of cleaning practices and water use was conducted. Flow rates were tested and reasons for slow flow rates examined.	Flow rates ranged from 0.13 to 3.5 L/hr (M=.98L/hr).Slow filtration rate was attributed to failure to keep the CWP element filled and to poor cleaning practices. 78% cleaned CWP receptacle with source water. Flow increased from .28 L/hr to 2.1 w/scrubbing.	Vigorous scrubbing with brush is needed to maintain flow rate particularly in areas where water has high turbidity. Users should keep CWP element filled. 14 of 24 CWPs did not produce sufficient water to meet WHO criteria.
Bielefeldt 2003 Laboratory tests See Tables 2,3	7 new CWP elements produced in Nicaragua, 2 without CS, and 3 CWP elements in use for 3 years in Nicaragua.	Turbidity removal was tested using constant flow rates of water sources varying from low to high turbidity. Effectiveness of brush scrubbing in restoring flow rate was assessed.	All CWP elements removed turbidity to levels below USEPA and WHO standards.	
Fahlin 2003 Laboratory study See Table 2	5 new CWP elements from the Nicaragua production workshop--4 coated with CS and 1 without.	Determine contact time of pathogens to CS. CWP elements were tested in U.S. lab for hydraulic conductivity and tortousity using 1) a constant flow of city tap water, 2) a bromide tracer breakthrough test.	Filtered water had higher total organic carbon load than source water. Water remained in CWP elements for 50 minutes at the highest flow rate. Tortuosity ranged from 4 to 19. CS penetration into CWP element was between 2.5 to 10 mm. Relationship between flow and surface area is not linear.	Hydraulic conductivity tests inconclusive due to clogging. New methods of CS application advised to better penetrate the CWP element to extend contact time with silver. Based on information from CS manufacturer, CWP elements provide adequate contact time with CS.
Campbell 2004 Laboratory Study See Table 2	6 new CWP elements with flow rates of 3 L/hr produced in Nicaragua.	Effect of flow rate on bacterial removal was tested using lab tests for coliforms, fecal coliform, fecal strep and *E.coli*.	CWPs elements with flow rates of 3 L/hr were not effective in removing three indicators of contamination but were effective in removing fecal strep.	Run non-contaminated water through CWP elements 3 times before taking samples. Turbidity and PH complied with WHO drinking water standards.
Campbell 2005 Laboratory Study See Table 2	8 CWP elements of 4 years of age with flow rates =<2 L/hr from two communities in Nicaragua. CS solution of 1%.	CWP elements were transported to Managua lab. Effect of flow rate on microbial removal was assessed and effect of scrubbing on flow rate.	Before scrubbing flow rates ranged from .3 to 1.8 L/hr and after from .2 to .7 L/hr. Scrubbing of CWP elements with a brush was effective in improving flow rates.	Flow rates can be restored using a brush (as compared to cloth). Turbidity and PH complied with WHO drinking water standards

Smith 2004 Field Study See Tables 2,4,5,6	69 households from 7 villages in Vietnam using a Vietnamese-made CWP or an IDE/Cambodia-made CWP. Water sources were canals, ponds and contaminated floodwater.	Household survey of CWP use and maintenance. Turbidity of pre-filtered water (from canals, ponds and contaminated floodwater) and of filtered water was tested. .	Majority of source water was highly turbid pond water (64.4%). Few households allowed sufficient time for settling. Most cleaned CWPs 1 or 2 times a week. Turbidity of pre-filter water ranged from 5-300 NTU. Turbidity of filtered water was always <5NTU.	Flow rate needs to be improved in order to reduce the need for frequent cleaning that contributes to CWP contamination and breakage. Highly turbid water needs longer periods of time for settling.
Donachy 2004 Field Study See Tables T2,5,6,	27 households in rural Nicaragua that had been using CWPs for at least 1 year.	Households were surveyed about CWP maintenance practices pre and post training. Flow rates were tested at baseline and monitored bimonthly for 10 months.	Flow rates varied from 1.5 to 3.5 L/hr (M=2.5). Seventy-five percent of the CWPs exceeded the recommended flow rate (1-2L/hr) and none were below. Average frequency of CWP element cleaning was 1.6 times/mo. No CWP element breakage was reported post training. Over 15% of the CWPs had faucets that broke over the study.	No correlation was found between flow rate and reported frequency of cleaning of element. Higher flow rate was not associated with reduced bacterial removal. Less frequent cleaning appears to reduce breakage. Self-reports may not be accurate. Households should keep a cleaning log.
Van Halem 2006 Laboratory Study See Tables 2, 3	A total of 24 CWP elements imported from Cambodia, Ghana, and Nicaragua. Manufacturing process “unknown.”	12-week study utilized filtered canal water to test CWP elements for pH, temperature, conductivity, pore size, and flow rates.Two (2) Nicaraguan CWP elements w/o CS were compared to 2 Nicaraguan CWP elements with CS for pore size.	Over the study period all CWP flow rates were reduced to <0.5 L/hr. Pore lengths varied from 16 and 25 µm. Variation in element pore size was similar in elements from all 3 production facilities. Effect of pore size on microbial removal was small. The 2 CWP elements with CS had fewer small pores (<1 µm) than the 2 elements w/o CS.	Scrubbing of CWP elements had only a temporary effect on flow rate. Flow rates were unacceptable for a family. To improve flow rate dose with chlorine, lemon, and/or backwash the CWP element to force out blocking particles. Further research is needed on how to increase flow rates.
Oyanedel-Craver 2007 Laboratory Study See Tables 2,3	12 hand-formed 6.5 cm diameter filter cylinders made by PI from commercial Redart clay (4); clay soil from Mexico (4); clay soil used by producers in Guatemala (4). Clay samples were mixed with flour and 48 mesh grog and fired to 900 C.	Filter cylinders were tested in three situations: w/o CS; w/CS applied by brush; and w/CS applied by submersion. Filter cylinders were tested in the laboratory with regard to flow rate and bacteria transport. Each clay was analyzed and compared.	Flow rate and pore-size distribution varied; more than 50% of the pores for each filter had diameters ranging from 0.02 to 15 μm. Median grain sizes for Redart, Guatemala, and Mexico soils were 6.3, 12.3, and 44.7 μm respectively. With these clays, projected flow rates for an lement would be 0.5 (Guatemala), 1.3 (Mexico), and 2.1 L/hr (Redart).	The particle size and clay content of the 3 clay materials differed greatly. Soil samples with uniform and fine-grained particle-size distributions will likely produce filters with better bacteria-removal efficiency.
Brown & Sobsey 2007 Field Study See Tables 2,4,5,6	80 households with children under 5 from 3 provinces in Cambodia using a CWP and 80 matched control households using the same water source.	203 water samples were collected from 160 households over 3 visits during dry season. Samples were compared for concentrations of *E.coli,* coliforms, and turbidity.	Anecdotal evidence suggests that low flow rates and rapid clogging are associated with use of water from deep wells.	
Al-Moyed 2008 Field Study/survey See Tables 2,4.5.6.	180 households in 4 villages in Amran governorate of Yemen using rain water from cisterns. CWPs produced in Yemen.	180 CWPs were distributed along with basic hygiene and maintenance instructions. Households were surveyed re flow rate over the 7-month period.	Amount of water filtered/day decreased over time. CWPs producing 3 to 5 L/day deceased from 71% at 1 month to 42% at 6 months; those producing <3 L/day increased from 5% at 1 month to 27% at 6 months.	Satisfaction with amount of water increased over time, however, CWP flow rate of CWPs decreased over time.

Swanson 2008 Field Sudy/survey See Table 2	1) 6 new CWP elements manufactured in Northern Ghana. 2) 2 CWP elements--1 old, 1 new. 3) 59 rural households--24 lower class community (LCC), 35 lower middle class community (LMCC) using water from unprotected dams fed primarily by rain water.	1) New elements were tested, 3 with clean water and 3 with contaminated water; 2) Flow rates tested in 2 elements w/ turbid water. 3) 3-week study compared turbidity after CWP filtration and then after treatment with *Aquatabs.*	1) Flow rates varied from 1 to 3.1 L/hr clean water. 2) Old CWP element took 6.3 days to filter 7 liters, new took 2 days to filter 8 liters. 3) Average turbidity in LCC water samples decreased by 35% after *Aquatabs*. Average turbidity in LMCC increased by 135%.	Flow rates insufficient for average family size. Relation of flow rate to use of *Aquatabs* is unclear.
Duke 2009 Laboratory Study See Table 2	1 biosand filter made by Davnor, 1 CWP element made in Nicaragua. Source water from ponds in Victoria, BC.	Biosand filter and CWP element were compared for removal of turbidity, total and dissolved organic carbon, and for flow rate over a 30-day period.	CWP element produced 1-2 L/hr as compared to 18 L/hr for biosand. CWP flow rates decreased rapidly with turbid water requiring more frequent scrubbing over time. Both lowered turbidity, and organic carbon.	Turbid water raises need for frequent cleaning and possible breakage. Filtration rate of 1-2 L/hr not sufficient for family of four. Sand and CWP filtration possible solution.
Napotnik 2009 Laboratory Study See Table 2	6 CWP elements—4 flat bottom and 2 round bottom. Source water from creeks in Pennsylvania spiked with *E.coli*	Flat and round bottom CWP elements were compared for removal of turbidity and flow rate over a 6-week period. Compared effects of CS application before firing with application after firing.	All elements removed >90% of turbidity. Flow rates varied between CWP types and within CWP types. Flow rates decreased over time. Average flow rate was less than 0.6 L/hr.	Filtration rates not sufficient for a family except in one filter. Neither the shape of the CWP nor the CS application process were associated with performance. CWPs tested may not be representative of those in the field.

Table 2 FILTER PERFORMANCE: REMOVAL OF BACTERIA, VIRUS, PROTOZOA

Author	Population/number	Description	Results	Conclusions/Recommendations
AFAGUATEMALA 1996 Field Study See Tables 4,6	1-year study of 680 poor families using Guatemalan CWPs in 3 regions of Guatemala matched for level of water contamination, number of children under 5, socio-economic status, hygiene habits, and incidence of diarrhea.	Monthly sampling of filtered water for presence of fecal coliform and three analyses of source water. CWP users received training in maintenance and bi-weekly visits by health promoters.	Level of source water contamination varied by region: Southern coastal region--extremely high risk; Periurban Guatemala City--medium risk; and Central Highland--low risk. Source water varied seasonally. For the duration of the study approximately 91% of CWPs produced water free of fecal coliforms.	Plastic faucets and improper cleaning of receptacles were found to be primary sources of contamination. Contamination corrected by proper cleaning. Provide clear and repeated instructions.
Walsh 2000 Field Study See Table 6	13 households using CWPs in 2 communities in rural Nicaragua.	Source water, water from CWP spigot, and water from drinking cup were tested for presence of H_2S producing bacteria.	All source water tested positive for H_2S producing bacteria. All filtered water from the spigot and drinking cups tested positive for H_2S producing bacteria.	CWPs should be marketed for the purpose of removing turbidity but not for disinfection. Filter should be used as a complement to chlorination.
Lantagne 2001 Laboratory Study	3 CWP elements made in PFP factory in Nicaragua	Spiked raw water and filtered water were tested to determine removal of total coliform, fecal coliform, protozoa,	CWP elements removed 100% of total coliforms and fecal coliforms. CWP elements were not effective in removing viruses. Protozoa removal	Research needed to determine exact removal rates of protozoa and viruses. With an education component, CWP is an effective

See Tables 1,3		and virus.	was 99.99%.	and appropriate technology.
Lantagne 2001 Field Study See Tables 1,3,4,5,6	24 households with poor quality water from 3 geographical regions of Nicaragua currently using CWPs.	Water samples were collected in each household and tested before and after filtration for removal of total coliform, *E.coli* and H_2S producing bacteria.	Only 6% of CWPs removed total coliform; 25% removed H_2S producing bacteria; 53% removed *E.Coli*. Seven homes showed increases in total coliforms in filtered water.	Education needed re using clean storage containers. Use only recently collected water. Maintenance of a sterile receptacle critical to reducing contamination.
Bullard 2002 Field Study See Table 6	50 families using Cambodian CWPs in flood-prone areas of the Mekong Delta in Vietnam	Red Cross staff conducted training on clean water and correct use and maintenance of CWP. 15 filtered water samples were taken on 3 separate dates.	In 60% of samples highly polluted pond and river water achieved Ministry of Health standards for safe drinking water. One-third of CWPs tested showed post filtration contamination. In some samples contamination was higher after filtration.	Post-filtration contamination present. Need for effective social marketing, training in filter use and hygiene practices, and more stringent sample handling.
Bielefeldt 2003 Laboratory study See Tables 1,3	CWP elements from 5 randomly selected households in Nicaragua	Pathogen removal tested using CWP elements that were transported to U.S. lab.	CWP elements removed 99.5% of cryptosporidium and giardia.	Research needed to compare bacterial removal w/different concentrations of CS, characterize particle sizes removed; and to determine virus removal ability.
Fahlin 2003 Field Study See Table 1	5 randomly selected households in Nicaragua currently using CWPs.	Water samples were taken before and after filtration in Nicaragua and transported to U.S. lab for testing.	Fecal coliform removal in all filtered samples was >85%. Three samples met WHO criteria for intermediate or low risk. Two samples from households with highly contaminated water exceeded the criteria for very high risk water.	Education about CWP maintenance may improve removal rates of bacteria.
Roberts 2003 Laboratory Study	100 CWPs made in the IDE Cambodia workshop. Water source Mekong River.	New CWPs were tested for removal of *E.coli* and total coliforms.	Under lab conditions all CWPs removed 100% of fecal *E.coli* and total coliforms.	
Roberts 2003 Field Study See Tables 4,5,6	686 randomly selected households with IDE-Cambodia CWPs located in 12 villages in 2 provinces of Western Cambodia. Water sources were contaminated tube wells, open well, ponds, and rivers.	936 CWP filtered water samples were collected over a year from randomly selected households and analyzed in the laboratory for levels of *E.coli* and total coliform.	98 to 99% of CWPs produced water of low risk or better according to WHO criteria. Results were constant over a year regardless of risk level of input water. CWP time in use was not associated with changes in water quality. Water quality appeared better in female-headed households.	Filtered water from IDE-Cambodia CWPs meets WHO guidelines for low risk water regardless of level of water contamination.
Campbell 2004 Laboratory Study See Table 1	6 new CWP elements with flow rates of 3 L/hr produced in Nicaragua.	Assess association of flow rate to removal of coliforms, fecal coliform, fecal strep and *E.coli* in new CWPs and same CWPs after 30 days.	First samples showed 100% removal. After 30 days CWP elements were not effective in removing three indicators of contamination but were effective in removing fecal strep.	Removal rates declined over time. First runs of filtered water contained residual CS. Water samples should be tested after at least 3 runs.
Campbell 2004 Field Study See Table 1	1) 8 CWP elements in use for 4 years from 3 Nicaraguan communities, w/ flow rates =<2 L/hr, some w CS concentration of	1)CWP elements were transported to Managua lab and tested for ability to remove fecal and total coliforms. Relationship of flow rate to removal	1) Reduction of levels of fecal and total coliforms ranged from 0% to 100%. Higher flow rate was associated with greater microbial removal.	CWP performance varied greatly. Research needed to determine association between presence of organic material and contamination; bacterial removal over time in

	only 1%.. 2) 6 households with CWPs in rural Nicaragua with contaminated source water	was assessed. 2) Presence of H_2S producing bacteria was tested at homes before and after filtration. Elements were cleaned and receptacles sterilized before testing	2) All post-filtration water samples were free of H_2S producing bacteria.	CWP elements with 3.2% concentration.
Donachy 2004 Field Study See Tables 1,5,6	127 households using CWPs for at least 1 year. Households were served by 1 of 4 participating Nicaraguan NGOs.	Filtered water samples were collected before and after training by rural health promoters, then bi-monthly for 9 months and tested for removal of H_2S producing bacteria.	Presence of H_2S producing bacteria in filtered water was 9.5 times more likely to occur pre-training as compared to a post-training ($p<0.000$). This trend continued over the course of 9 months.	Removal of bacteria was associated with training on correct use of CWPs. A plan for standardized training should be a requisite for NGOs wanting to implement CWP projects.
Smith 2004 Field Study See Tables 1,4,5,6	69 households using a Vietnamese-made CWP (Viet-CWP) or an IDE/Cambodia-made CWP (IDE-CWP) from 7 villages in Vietnam. Water sources were all high risk from canals, ponds and contaminated floodwater.	Pre-filtered and filtered water samples were analyzed for level of fecal coliforms and total coliforms. Effectiveness of Vietnamese and Cambodian CWPs were compared.	13% of Viet-CWPs produced water of low risk or better as compared to 14% of IDE-CWPs. 64% of IDE-CWPs produced water of intermediate risk or better as compared to 29% of the Viet-CWPs. No IDE-CWPs produced very high risk water as compared to 8.3 of the Viet-CWPs. Two Viet-CWPs produced water more contaminated than pre-filtered water.	IDE CWPs were more effective than Vietnamese-made CWPs. Contamination likely due to contamination of receptacles. Microbiological testing should be conducted every 6 months to monitor effect of hygiene promotion.
Campbell 2005 Laboratory Study	19 CWP elements in use for 1 to 6 years in rural communities in Nicaragua. Source water was Managua sewer water	CWPs elements were transported to Managua lab and sterilized before testing. Filtered water samples were tested for levels of total coliform and *E.Coli*.	All but 2 of 19 CWP elements removed 100% of *E.coli* and total coliform. All 5-year old CWP elements removed 100% of both. 6-year old CWP elements removed 100% of *E.coli* and 94% of total coliforms.	CWP elements have a life span of up to 5 years as compared to 2 years as previously recommended. Receptacles and elements should be sterilized before testing.
Van Halem 2006 Laboratory Study See Table 3	24 CWP elements imported from Cambodia, Ghana, and Nicaragua. Manufacturing process "unknown."	12-week study utilized filtered canal water to test CWP elements with and w/o CS for removal of bacteria, clostridium, and MS2 bacteriophage (viruses).	93% of the 144 samples showed no presence of total coliforms. Log reductions values (LRV) from 4-7 were achieved with *E.coli.* Clostridium spores were successfully removed by all CWP elements both w/ and w/o CS. Viruses were partially removed (LRV 0.5-3.0).	Both CWP elements with and w/o CS removed coliforms. CWPs with CS removed more *E.coli* but removal was satisfactory for both. Bacteriophages were better retained by CWP elements w/o CS.
Brown 2007 Field Study See Tables 1,4,5,6	80 households from 3 provinces of Cambodia with children under 5 currently using CWPs and matched control households using the same water source.	203 water samples were collected from 160 households over three visits in February-April (the dry season). Samples from case and control households were compared for concentrations of *E.coli,* coliforms, and turbidity.	Effectiveness was not correlated with time in use. A 98% reduction in the level of *E.coli* was observed in CWP households. 66% of CWP treated water samples were low risk and, of these, 40% conformed to WHO guidelines for safe drinking water. 62% of control households had *E.coli* levels that were high risk as compared to 14% of CWP households. At some point, 50% of CWPs produced bacteria concentrations greater than the untreated water.	CWPs were as effective as boiling in reducing bacteria. Further testing is needed to examine seasonal and regional variation and to assess viruses and protozoa removal before recommending that CWP users not boil water. Presence of bacteria in filtered water is attributed in large part to improper handling and cleaning. Education and support may reinforce proper use and hygiene behavior.

Oyanedel-Craver 2007 Laboratory study See Table 1	12 hand-formed filter cylinders.	Cylinders were tested for bacterial removal in three situations: w/o CS; w/ CS applied by brush; and w/ CS applied by submersion.	Filter cylinders removed 97.8% - 100% of the bacteria. The quantity of CS applied per filter was more important to bacteria removal than the method of application.	CS treatments significantly improved the quality of the filtered water.
Al-Moyed 2008 Field Study See Tables 4,5,6	180 households with CWPs produced in Yemen from four villages in Amran, Yemen using rain water from cisterns.	180 CWPs were distributed along with basic hygiene training. Twenty water samples were collected from each of 20 randomly selected CWP households during 3 follow-up visits.	At baseline, all water samples had levels of total and fecal coliforms too numerous to count (TNTC). At the third follow-up visit, no filtered water samples had detectable levels of total or fecal coliform bacteria.	No contamination was observed 3 and 6 months after filter introduction indicating that the continuous health education campaign was successful.
Swanson 2009 Field study See Table 1	59 lower (LC) and lower middle class (LMC) rural households in Ghana .	3-week study compared total coliform (TC) after CWP filtration and after filtration and treatment with *Aquatabs* (chlorine tablets) added to post-filtration containers.	Post-filtration TC count in LC averaged 2,220 CFU (56% reduction from stored water) and in LMC averaged 2900 CFU (52% reduction). Post *Aquatab* TC count in LC averaged 2039 (7% reduction, 90% w/o outlier) and 874 in LMC (70% reduction). Percent of households with <100 CFU increased after *Aquatab*s from 44 to 64%.	Contamination of post-filtration container suspected. Although water quality measured by microbial removal was improved both after filtration and after Aquatabs, product water is still highly contaminated.
Westphal 2008 Laboratory study See Table 6	24 CWP elements from Honduras (15 with CS and 9 w/o CS). Source water was spiked with bacteria.	CWP elements were tested for removal of bacteria and viruses. Three CWP elements were tested for removal of protozoa.	LRV of bacterial were 3.22 and 6.06. Ability to remove viruses was minimal. All trials showed removal of protozoa over 99.7%. Only one CWP element removed microspordium	CWP elements reached or approached USEPA levels for point-of-use water treatment system.
Westphal 2008 Field Study See Table 6	50 CWP households using Nicaraguan CWPs for 1 to 4 years in the Northern Atlantic Region of Nicaragua.	Water samples were collected from 50 households and tested for *E.coli* .	Of CWPs in use, 53% removed 100%, and 78% removed >95% of *E.coli.* 9% had more *E.coli* in filtered than in unfiltered water. Based on WHO standards the CWP is a "poor" water system.	Failed to meet WHO criteria for water treatment system quality for populations <5,000. Test for pathogen removal across CWP production sites.
Dundon 2009 Field Study See Tables 4,5,6	58 CWP households and 58 control households with a child under 5 randomly selected from a community in Peru. Source water was from tanker trucks.	A total of 85 water samples were collected from CWP and control households over 3 rounds of sampling and tested for levels of fecal coliform.	1st round--85% of CWP samples were low risk as compared to 20% of controls. 2nd round--30% of CWP samples were low risk compared to 40% of controls. 3rd round--69% of CWP samples were low risk compared to 36% of controls.	Poorer water quality at 2nd and 3rd sampling attributed to poor cleaning practices.
Duke 2009 Laboratory Study See Table 1	1 Davnor biosand filter, 1 CWP made in Nicaragua. Source water from ponds in Victoria, BC.	Biosand filter and CWP were compared for removal of *E.coli*, and total coilforms over 30 days.	CWP elements removed 99-100% of bacteria in 73% of samples, and 90% in 97% of samples. 30% of biosand samples removed 90% or more.	CWP more effective than biosand in removing bacteria.
Napotnik 2009	4 flat bottom CWPs and 2 round	Flat and round bottom CWPs and CS	All CWPS reduced *E.coli* and total coliform	All CWP elements reduced bacteria levels to

Laboratory Study See Table 1	bottom CWPs. Source water from creek in Pennsylvania spiked with *E.coli.*	application before and after firing were compared for removal of *E.coli* and total coliform over 6-weeks.	concentrations to zero.	zero. Shape of CWP elements and method of CS application was not associated with removal of bacteria.
Brown 2009 Laboratory Study	5 batches of low-fire kaolite clay amended with oxides and fired. Source water was lake water or groundwater, both spiked with bacteriophage (virus).	Electropositive iron oxides (goethite, magnetite, hematite) or alumina oxides were mixed with clay batches at 1:6 ratio (dry mix by weight). Inactivation of virus was compared.	Clays modified with goethite, hematite and alumina showed a significantly higher sorption of bacteriaphages as compared to unmodified clay. Iron amendments were most effective. Total inactivation was observed w/goethite clay.	Some iron and aluminum oxide amendments to ceramic materials increased inactivation of viruses. Results may vary depending on base clay composition. Goethite most effective.

Table 3 FILTER PERFORMANCE: COLLOIDAL SILVER CHARACTERISTICS/ LEACHING and REMOVAL OF TOXIC METALS

Author	Population	Description	Results	Conclusions/recommendations
Lantagne 2001 Laboratory Study See Tables 1, 2	3 CWPs made in PFP factory in Nicaragua	CWP elements tested to determine leaching of CS and removal of pesticides, arsenic and VOCs.	Silver concentration in filtered water decreased substantially after the first use. Concentration after first use was below WHO and EPA limits. CS is needed for complete removal of microbes. Effectiveness of CS may be indefinite. Steep decrease observed in removal of arsenic. Pesticides, VOC study indicated a trend toward a decrease in removal.	CWP is not recommended for use with VOCs, arsenic, or pesticides. Ingestion of CS in filtered water does not pose a health risk. Do not use first un of filtered water due to CS residual. Research needed to assess microbial inactivation after repeated scrubbings.
Lantagne 2001 Field Study See Tables 1,2,4,5,6	24 CWP houses w/ poor quality water in 7 communities in rural Nicaragua.	Water samples were collected and examined for CS levels in US lab and with Rapid Silver test kit in homes.	No filtered water sample approached the WHO or EPA limits. Due to high turbidity Rapid Silver test was ineffective in Nicaragua.	Ingestion of CS in filtered water in households does not pose a health risk.
Bielefeldt 2003 Laboratory Study See Tables 1,2	7 new CWP elements produced in Managua.	Leaching of CS tested in over 20 batches of influent water.	CS in water stabilized at <20 ppb after approximately 12 runs. Even first runs did not exceed USEPA limits.	CS leaching decreased and stabilized after 12 runs. Ingestion of CS in filtered water does not pose a health risk.
Van Halem (2006) Laboratory Study See Table 2	24 CWP elements imported from Cambodia, Ghana, and Nicaragua. Manufacturing process "unknown." Source water was canals in Holland.	CWP elements were tested as part of a certification process. CWP elements were tested for release of metallic elements using canal water.	Aluminium, antimony, arsenic, barium, copper, manganese, silicon and silver were observed in higher concentrations in the filtered water than in the source water. All except arsenic were within WHO limits. First run mean concentration of arsenic for the Cam-CWP element was 200 µg/L. All subsequent samples exceeded WHO limits for arsenic (10ug/L).	If arsenic is known to be present in a region, the clay used to make the CWP elements should first be tested. Recommendation for a Dutch Declaration of Performance could not be made due to lack of knowledge of the manufacturing processes.
Oyanedel-Craver 2007 Laboratory Study	12 hand-formed filter cylinders.	Filter cylinders were tested in 3 situations: without CS; with CS	CS concentrations in filtered water were initially greater than the regulatory limit of 0.1 mg/L, but	Release of CS from the filters may depend on water chemistry, amount of CS applied, and

See Tables 1,2		applied by brush; and with colloidal silver applied by submersion.	dropped below this value after 200 minutes of continuous operation.	pore structure. Ingestion of CS in filtered water does not pose a health risk.
Tun 2009	46 CWPs from 9 production plants in Myanmar	Arsenic-free river water was filtered through CWPs and tested for levels of arsenic. First liter samples were tested, then one liter samples were tested every ten liters. Aggregate samples were tested from 10 and 20 liter batches up to 150 liters.	46% of first litre samples exceeded WHO limits for arsenic (<50ug/L) but average concentrations were well below limits. Significant differences in arsenic concentration were observed between CWPs in first litre samples. First litre concentrations were 2-5 times greater than the first 10 litre concentrations. Leaching of arsenic was not associated with presence of CS. Arsenic does not leach at a constant rate.	Based on WHO standards for arsenic in "countries most affected by arsenic" (<50ug/L), author concludes that exposure to arsenic leached from CWPs does not pose a significant health risk to users. First 20 litres should be discarded. Source of arsenic was not tested but is suspected to be rice hulls.
Larimer 2010 Laboratory study	Fired ceramic tiles made from kaolitie clay and sawdust.	Clay tiles were soaked in a CS solution, dried, and scanned to determine depth of penetration.	No silver nanoparticles were observed below 50 um. Silver was concentrated in near surface pores. Flow from surface evaporation drives water and associated silver nanoparticles away from interior of clay.	Alternative means of silver impregnation/drying is needed for more uniform spatial distribution however these methods are cost prohibitive.

Table 4 HEALTH IMPACT/POPULATION STUDIES

Author	Population	Description	Results	Conclusions/Recommendations
AFA Guatemala (1996) Field Study Spanish/English See Tables 2,6	680 poor families from 3 regions of Guatemala matched for level of water contamination, number of children under 5, socio-economic status, hygiene habits, and incidence of diarrhea.	Study participants were randomized to four observation groups; received CWP; received CWP and health course; received health course; received neither (control). Families were surveyed for incidence of diarrhea. CWP users received training in maintenance and bi-weekly visits by health promoters.	A statistically significant difference was observed in all regions in the incidence of diarrhea between the CWP and control group and between the control group and the CWP/education group. In 2 regions, significant differences were observed between the CWP group and the education group. Diarrhea was observed in 5.3% of controls; 4.2% of education; 2.5% in CWP group; and 1.8% in CWP/education group. CWP use reduced the duration of an episode of diarrhea.	AFA recommends the combined use of CWP and education as a means of combating diarrheal disease. The CWP has a greater effect than the health education alone.
Lantagne 2001 Field Study See Tables 1,2,3,5,6	24 CWP households with poor quality water in 7 communities in Nicaragua.	Household survey of CWP users and incidence of diarrhea.	No family with a CWP that removed microbial contamination had a child with diarrhea in the last month.	Use of CWP in reducing diarrhea is promising but not conclusive.
Roberts (2003) Field Study	100 CWP users including Always Users (AU) and Sometime/Never Users (SNU) and 101 matched	Households were surveyed regarding hygiene practices and incidence of diarrhea. CWP recipients received	82% of CWP AU reported no incidence of diarrhea in the prior month as compared to 65% of SNU and 62% of Always Boil, and 40% of Never Boil water	CWP reduced incidence of diarrhea. CWP may be more effective than water boiling in the prevention of diarrhea. The majority of

See Tables 2,5,6	controls w/o CWPs in 2 villages in Western Cambodia using pond or open wells.	training in CWP maintenance and monthly follow-up visits from field trainers.	controls. CWP users reported fewer cases of diarrhea, lower treatment expenses, and fewer work/school days missed.	those surveyed followed hygiene recommendations
Smith 2004 Field Study See Tables 1,2,5,6	69 households using a Vietnamese-made or an IDE Cambodia-made CWP. Water sources were canals, ponds and contaminated floodwater.	Survey of households using CWPs regarding incidence of diarrhea in children in the prior 2 weeks.	One of 69 households had a child with diarrhea in the 2 weeks prior to the survey. Users connected better health with cleaner water.	Conduct microbiological testing of both types of CWPs every 6 months to monitor effect of hygiene promotion.
Brown & Sobsey 2007 Field Study See Tables 1,2,5,6	80 households with children under 5 currently using CWPs and matched control households using the same water source. Three provinces in Cambodia.	The incidence of diarrhea in CWP households was compared to non CWP households over a 2-month period of time during dry season.	The risk of diarrhea in households using the CWP was 46% of that observed in households not using the CWP. A reduced incidence of diarrhea was observed in CWP users regardless of age, gender or province.	CWP households had reduced risk of diarrhea. More research needed using randomized, controlled, blinded intervention trials. Surveys should be done in the rainy season.
Al-Moyed 2008 Field Study See Tables 2,5,6,	180 households in 4 villages in Amran governorate of Yemen using rain water from cisterns. CWPs produced in Yemen.	CWPs households received hygiene training and maintenance instructions and were surveyed re incidence of diarrhea over 7 months.	Diarrheal episodes in children decreased from 64% to 14% after 1 month of use and remained consistent over the next 6 months. Adult frequency decreased from 25% to zero at 1 month and 7% at 6 months.	Improved health status was observed. Episodes of diarrhea decreased
Dundon 2009 Field Study See Tables 2,5.6	58 CWP households and 58 control households with a child under 5 randomly selected from one community in Peru. Source water was from tanker trucks.	Households slated to receive a CWP and control households were surveyed for incidence of diarrhea at baseline and at one-week intervals.	At baseline 39% of CWP group and 42% of the control group reported a case of diarrhea. At week 8 only 6% of CWP households reported a case of diarrhea and 13.5% of the control group.	CWP households had reduced incidence of diarrhea.

Table 5 EDUCATION/TRAINING/PROMOTION

Author	Population	Description	Results	Conclusions/Recommendations
Lantagne 2001 Field Study See Tables 1,2,3,4,6	24 households with poor quality water from 3 geographical regions of Nicaragua currently using CWPs.	Households were surveyed regarding water source, CWP usage, and family health.	78% of CWP users reported cleaning their filter with source water. Most families did not use any disinfection agent for cleaning. A lack of education about safe water sources and correct cleaning and maintenance of CWP was observed. Monthly visits by local NGO partner or community was strongly correlated with continued use.	Information should be presented to local NGOs before CWPs are purchased. CWP success is directly correlated to follow-up. Education needed about filter use and maintenance, cleaning, preventing breakage, maintaining head pressure, and sanitation.
Roberts 2003 Field Study	1000 adult women from 1000 households in 12 villages in 2 provinces in Cambodia trained in	Field trainers received training in the operation and maintenance CWPs. After distribution, field trainers	Compliance with recommended hygiene practices was high	Training resulted in compliance with hygiene practices.

See Tables 2,4,6	CWP use and maintenance by field trainers.	conducted 2-hour training sessions with CWP recipients. Field trainers made regular monthly follow-up visits.		
Smith 2004 Field Study See Tables 1,2,4	69 households using a Vietnamese-made CWP or an IDE/Cambodia-made CWP from 7 villages of the Takeo province of Vietnam. Water sources were canals, ponds and contaminated floodwater.	Household survey of CWP benefits and problems, cleaning and maintenance practices. Focus group discussion/community meetings with CWP users and village leaders re filter distribution, training and health messages, follow up, benefits and problems, and perceptions about disease.	Majority of households cleaned their CWP with a soft cloth or brush. Most washed the CWP with pond or rainwater and did not use soap. Of the households using soap, most washed the outside of the CWP element and not the inside of the receptacle. A small number washed hands with soap before cleaning the CWP. Frequency of cleaning was inconsistent with observations of CWP condition.	Need for ongoing monitoring by village water committees to evaluate effects of hygiene promotion. Training in CWP care and maintenance should include assembly, sedimentation of turbid water, cleaning of CWP receptacle and element, and hygiene habits around the use of CWP.
Donachy 2004 Field Study See Tables 1,2,6	108 households in rural Nicaragua that had been using CWPs for a least one year. See Table 2	NGO staff, health promoters, and CWP users received training and instruction manuals for the use and maintenance of CWPs. Water samples were collected before and after training and then bimonthly.	Presence of H_2S producing bacteria in filtered water was 9.5 times more likely to occur pre-training as compared to post-training ($p<0.000$). This trend continued over the course of 9 months.	Removal of bacteria was associated with training on correct use of CWPs. A plan for standardized training should be a requisite for NGOs wanting to implement CWP projects.
Brown & Sobsey 2007 Field Study See Tables 1,2,4,6,	80 households with children under 5 currently using CWPs and matched control households using the same water source. Three provinces in Cambodia.	203 water samples were collected from 160 households over 3 visits. Samples from case and control households were compared for concentrations of *E.coli,* coliforms, and turbidity.	At some point, approximately 50% of CWPs produced bacteria concentrations greater than the untreated water.	Recontamination of CWP and storage receptacle occurred likely through improper handling. Education may reinforce proper use and hygiene behavior. Proper use of the technology is critical.
Al-Moyed 2008 Field Study See Tables 1,2,4,6	180 households with CWPs in four villages in Amran governorate of Yemen using rain water from cisterns.	180 CWPs were distributed along with basic hygiene training. Twenty water samples were collected from 20 randomly selected CWP households at 3 follow-up visits.	At baseline, all 20 water samples had levels of total and fecal coliforms too numerous to count (TNTC). At the third follow-up visit, no filtered water samples had detectable levels of total or fecal coliform bacteria.	No contamination was observed 3 and 6 months after filter introduction indicating that the continuous health education campaign was successful.
Dundon 2009 Field Study See Tables 2,4,6	58 CWP households with a child under 5 randomly selected from one community in Peru. Source water was from tanker trucks.	CWP households were surveyed at week 7 about their understanding of CWP use and maintenance.	Survey revealed that CWP users cleaned receptacles with source water. After review of verbal and written instructions on correct maintenance, the water quality showed improvement at next sampling.	Clear and repeated instructions on maintenance needed. Avenues of contamination should be included in training.

Table 6 MARKETING/PROMOTION/ACCEPTANCE				
Author	Population	Description	Results	Conclusions/Recommendations
AFAGuatemala 1995 Field Study/Survey See Tables 2,4	One-year study of 680 poor families using CWPs from 3 regions of Guatemala matched for level of water contamination, number of children under 5, socio-economic status.	Families were surveyed for incidence of diarrhea, acceptance of CWP, sanitary conditions, quality of source water.	CWP had a high level of acceptance. Percent of children drinking filtered water in CWP households varied from 87% to 93%. Use of CWP dropped when maintenance or repairs were needed.	Regular maintenance and repairs are needed. CWP is more effective when combined with health education. Bronze spigots worked better than plastic. CWPs were well-accepted.
Walsh 2000 Field Study/Survey See Tables 2	130 households in 3 communities in Nicaragua served by 3 NGOs.	Households surveyed to determine acceptance of and willingness to pay for CWP.	91% of those surveyed regarded their CWP as effective. 88% were still using the CWP. 12% cited breakage and dissatisfaction as reasons for discontinued use. 67% considered the CWP the best method of purifying water. 60% would recommend to others. 67% of people liked using chlorine.	Chlorine more widely accepted than expected. Need for subsidizing the cost of CWP. Results were contradictory on amount of water used and filtered. Filters do not provide adequate amount of water for a family.
Nims (2000) Field Study/Survey	53 women from 3 communities in 3 regions Nicaragua using the Nicaraguan CWP.	Seven focus groups were conducted. Households were surveyed with regarding water source, attitudes toward CWP compared to other treatments, barriers to adoption, price of CWP, knowledge about waterborne disease, and marketing.	Percent of continued use ranged from 70% to 20%. Lowest use was in the community with lack of NGO follow-up, state distributed chlorine pills, and leaking spigots. Respondents reported slow filtration rate, malfunction, and fragility of unit. Majority agreed that water source was contaminated. Most preferred CWP over chlorination.	Spare parts storage facility in each location where filters are distributed. Continuing health monitoring. Plastic spigots worked better than bronze. Credit should be provided for purchasing.
Valerio 2001 Field Study/Survey	Survey Nicaragua		Continued usage was correlated with education and training. 60% cleaned filter with source water. Common problems were slow filtration, broken spigots and broken elements.	Training and continued follow-up is indispensable to filter success.
Lantagne (2001) Field study/Survey See Tables 1,2,3,4,5	33 households with poor quality water from 3 regions of Nicaragua currently using CWPs.	Households were surveyed regarding water supply, CWP usage and family health.	Of 33 homes visited 24 were still using the CWP. Breakage was primary reason for discontinued use. Continued usage was correlated with regular monthly follow-up visits. 59% believed their water source was clean. No correlation existed between water contamination and beliefs.	On-going follow-up and hygiene promotion is recommended to improve results. NGOs should purchase extra CWP elements to distribute as replacements for broken ones. CWPs should be secured to a wall. Storage containers need to be addressed as sources of contamination.
Bullard 2002 Field Study/Survey See Table 2	50 families using IDE CWPs in flood-prone areas of the Mekong Delta in Vietnam	Focus groups were conducted to assess acceptance, use, and savings.	CWPs were easy to use, improved taste of water, provided enough water for all family members, provided savings in fuel, and current price was acceptable.	CWPs were well-accepted and provided sufficient water for a family. Develop comprehensive social marketing program.

Roberts 2003 Field Study/Survey See Tables 2,4,5	1000 CWP rural households in 12 villages in Kampong Chhnang and Pursat provinces in Western Cambodia.	Trainers surveyed households prior to and 3 months after receiving their CWP regarding water related expenses, volume of water filtered, hygiene practices, and satisfaction.	95% of households reported a high degree of satisfaction, 99% liked the water, and 97% found CWP easy to maintain. Savings in time and costs of boiling water were reduced enough to pay for a filter in 6 months.	
Roberts 2003 Field Study/Survey See Tables 2,4,5	100 CWP recipients in two villages in Western Cambodia using pond or open wells	Groups were surveyed regarding water source, boiling, reasons for discontinued use, cleaning practices, savings.	40% of CWP households had never used or only sometimes used the CWP. Most stopped because breakage of plastic spigots or elements. Breakage rate was 1.6% a month. CWP element cleaned an average of 2.4 times/wk. CWPs provide adequate water for an average household.	Provided sufficient water for family. Provide affordable CWP element replacement and more durable spigots. Households should pay full or partial price. Clean CWP elements and receptacles no more than once a month or when filtration rate drops.
Donachy 2004 Field study/Survey See Tables 1,2,5	27 households using CWPs for at least one year in rural Nicaragua.	Households were surveyed about CWP maintenance practices and breakage.	No breakage of CWP elements was reported. 15% of spigots broke over the course of the study. Elements were cleaned an average of 1.6 times per month.	Bi-weekly (rather than semi-weekly) cleaning of CWP element is recommended to reduce breakage. Replacement parts need to be accessible and more durable faucets should be used.
Smith 2004 Field Study/Survey See Tables 1,2,4,5	69 households from 7 villages of the Takeo province of Vietnam using a Vietnamese-made CWP or an IDE/Cambodia-made CWP Water sources were canals, ponds and contaminated floodwater.	Household survey/interviewer observation of water sources and use, sedimentation practices, CWP benefits and problems, and maintenance practices. Focus groups with CWP users and village leaders re filter distribution, training, follow-up, benefits and problems, and perceptions about disease.	72.9% of households reported that CWPs always provide sufficient water for the whole family. 85% used filtered water for drinking only and 87% drank only filtered or boiled water. 61.7% took filtered water with them to the field. CWPs were well-accepted because water is clear, tastes good, saves money on boiling, and is healthy for children. Biggest problem was broken taps and CWP elements.	Provided sufficient water. Availability of replacements parts is needed for program sustainability. All broken taps were from Vietnamese filter. Vietnamese filters had more problems than IDE filters. Filters for Vietnam should be purchased from IDE Cambodia.
Harris 2005 Survey	NA	Semi-structured interviews with eleven point-of-use (POU) industry experts (four related to CWP) related to challenges to commercial viability of POU treatments systems in low-income settings.	Subsidies can threaten sustainability and undermine markets. Any user payment increases the chance that product will be valued. Upkeep and maintenance required. Building awareness and distribution systems are expensive. Relationships with local organizations are important. CWPs have high set-up costs, are fragile, have slow filtration rates but are low-cost for user. Adoption related to awareness, source water quality, and cultural acceptance.	Commercial approach is necessary to guarantee sustainability. NGOs need to promote health messages. Target men and women's organizations. Conduct community driven promotion campaigns. Refine and improve product positioning and differentiation. Research needed in the areas of demand creation, education, advertising, promotion, cost and use, product improvement. Ensure quality control.
Westphal 2008 Field Study/Survey See Table 2	167 households using CWPs for 1 to 4 years in the Northern Atlantic Autonomous Region of Nicaragua	Cross-sectional survey to determine reasons for use or disuse, cleaning practices, cost, and CWP function.	50% of CWPs were no longer in use due to broken spigots (58%), receptacles or filter elements. 100% of households liked the taste of water, 87% reported that CWPs supplied adequate water, 99%	Method needed for installment loans or subsidies for CWP purchase. Modify spigot and receptacle to improve durability, provide replacement parts. Establish

			purchased their CWP, and 26.3% knew where to get spare parts.	quality assurance protocols in CWP factories, and a certification process.
Brown & Sobsey 2007 Field Study/Survey See Tables 1,2,4,5	506 households using a CWP from either IDE or Resource Development International (RDI) in three provinces in Cambodia.	Cross sectional study determined uptake, use rates, and factors associated with continued use. Compared characteristics of those households with a CWP still in use at the time of follow-up visit to households that had discontinued use.	Breakage rate of 2% a month observed. 43% reported a willingness to purchase an additional CWP but only 26% knew where to purchase one. At follow-up, 350 CWPs were no longer in use, with 65% of users citing breakage as the reason. Continued use was associated with time since implementation, cost recovery, sanitation and hygiene education, willingness to purchase, and use of surface water.	Supply chains for CWP parts and replacements must be available and accessible. CWP programs should be combined with other water and sanitation interventions.
Heierli 2008	CWP production and distribution programs in Nicaragua and Cambodia	Compilation of best methods of marketing safe water systems including filtration, chlorination, SODIS with a focus on Product, Price, Place, Promotion and People.	Problems identified in marketing CWPs include: promoting CWPs as a product for the poor; giving away or greatly subsidizing CWPs produces unfair competition/undermines market sustainability; poor product design results in breakage; lack of a viable supply chain for replacements and parts leads to disuse; lack of reliable indicator that water is safe.	Use IDE/RDI model--cover production costs through sales revenue and social marketing/education costs through subsidies; promote hygiene, prestige, and desirability; market first to early adapters; provide financing for retailers, installment payments to buyers; sell at clinics and pharmacies; assure access to replacement parts; distribute regionally; assure quality control; use popular media.
Al-Moyed 2008 Field Study/Survey See Tables 2,4,5	180 households in 4 villages in Amran governorate of Yemen using rain water from cisterns. CWP produced in Yemen	180 CWPs were distributed along with basic hygiene training and CWP maintenance instructions. Households were surveyed re satisfaction over a 7-month period.	Willingness to buy a new CWP increased over time. Acceptance of CWP was over 96% after 1 month and remained high. Expenses for treatment for diarrhea decreased. Up to 97% of participants liked the improved taste of water. 73% of households would recommend CWP.	CWP was well accepted. Continue health education campaigns. Appropriate price should be defined. Sell points established in capital cities, mass production.
Dundon 2009 Field Study/Survey See Tables 2,4,5	58 CWP households and 58 control households with a child under 5 from a community in Peru. Source water was from tanker trucks.	CWP and control households surveyed for volume of water available, access to sanitation, amount of water boiled, and understanding of care and maintenance of CWP.	CWP households boiled less water and had an average 4.8 liters of water/day as compared to 2.7 in controls. Elements were difficult to lift. Broken elements, spigots and stagnant water on bottom of receptacle were noted.	Design easier method to remove CWP element. Better instructions for cleaning of CWPs. More durable spigot. Spigots should be placed lower in the receptacle. Better hygiene education.

AFA Guatemala (1995). Contra la morbilidad infantil; filtros artesanales y educacion. Instituto de Investigaciones Economicas y socials (IDIES): Guatemala. Universidad Rafael Landivar

Al-Moyed KA., Zabara BA., (2008). Evaluating the health and socioeconomic impacts of colloidal silver impregnated ceramic filters in four villages in 'Amran governorate. Sana'a Univesity Water and Environment Center. Yemen.

Beilefeldt, A., Summers, S., Fahlin, C., Givler, S., Kowalski, K., Medina, K., Hollenkamp, L., Malhotra A., & Wright, H., (2003?). Evaluating the water treatment effectiveness of the Filtron. University of Colorado Boulder.

Brown, J., & Sobsey, M. (2007). Use of ceramic water filters in Cambodia. Water and Sanitation Program. UNICEF.

Bullard M. (2002). Low-cost household water purifiers for flood-prone areas. Vietnam. International Development Enterprises Report on filter technology trials to the International Federation of the Red Cross and Red Crescent Societies

Campbell, E. (2004). Evaluacion de las purebas Hach para la deteccion de bacterias productoras de H2S en filtros de barro promovidos por la organizacion de Ceramistas Por la Paz. Universidad Centroamericana.
Contact: Enrique@aguasolutions.com

Campell, E. (2005). Study of life span of colloidal silver impregnated ceramic filter. Prepared for Potters for Peace.
Contact: Enrique@aguasolutions.com

Donachy, B. (2004) Training for rural health promoters and beneficiaries on the use, maintenance, and monitoring of the Colloidal Silver Impregnated Ceramic Water Filter.
Contact: barbaradonachy@gmail.com.

Duke, W., Nordin R., & Mazumder A. Comparative analysis of the Filtron and biosand water filters.
Available at: http://pottersforpeace.org/wp-content/uploads/comparative_analysis_of_the_fltron_and_biosand_water_filterseditms.pdf
Contact: bsduke@telus.net, nordin@uvic.ca, mazumder@uvic.ca.

Dundon, S. (2009). Peru filter project final report. Prepared for Potters for Peace. Contact

Fahlin, C. (2003). Hydraulic properties investigation of the Potters For Peace colloidal silver impregnated ceramic filter. Undergraduate Independent Study Research. Available at: http://s189535770.onlinehome.us/pottersforpeace/wp-content/uploads/univ-of-col-hydraulic-properties-study.pdf.

Harris, J. (2005) Challenges to the commercial viability of point-of-use (POU) water treatment systems in low-income settings. Master of Science thesis in Water Science Policy and Management, Oxford University.

Heierli, U. (2008). Marketing safe water systems: Why it is so hard to get safe water to the poor- and so profitable to sell it to the rich. Swiss Agency for Development and Cooperation, Employment and Income Division. Available at: http://www.poverty.ch/safe-water.html.

Lantagne, D., Klarman, M., Mayer, A., Preston, K., Napotnik, J., Jellison, K. (2010). Effect of production variables on microbiological removal in locally-produced ceramic filters for houshold water treatment. *International Journal of environment Health Research*.

Lantagne, D. (2001a). *Investigation of the Potters for Peace colloidal silver impregnated ceramic filter. Report 1: Intrinsic effectiveness*. Alethia Environmental, Boston, MA. Available at http://pottersforpeace.org/wp-content/uploads/alethia-report-1.pdf. Contact:

Lantagne, D. (2001b). *Investigation of the Potters for Peace colloidal silver impregnated ceramic filter. Report 2: Field investigation.* Alethia Environmental, Boston, MA. Available at http://pottersforpeace.org/wp-content/uploads/alethia-report-2.pdf.
.
Larimer, C., Ostrowski, N., Speakman, J., Nettleship, I., (2010). The segregation of silver nonoparticles in low-cost ceramic water filters. *Materials Characterization 61:*408-412.

Napotnik, J., Mayer A., Lantagne D., Jellison K. (2009). Efficacy of silver-treated ceramic filters for household water treatment. International Ceramic Pot Filter Workshop. Atlanta, GA, USA. Available at: http://www.filterpurefilters.org/pdf/Efficasy%20of%20Silver.pdf
jas9e@virginia.edu <jas9e@virginia.edu>

Nims, B., Walsh, M. (2001)

Oyanedel-Craver, VA., & Smith, JA. (2007). Sustainable Colloidal-Silver-Impregnated Ceramic Filter for Point-of-Use Water Treatment. *Environmental Science Technology 42,* 927–933.
http://s189535770.onlinehome.us/pottersforpeace/wp-content/uploads/oyanedel-craver-and-smith-est-2008.pdf
Corresponding author e-mail: jas9e@virginia.edu.

Roberts, M. (2003). Ceramic water purifiers Cambodia field tests. IDE Working Paper No.1. International Development Enterprises.
Contact: Michael Roberts, M.S., International Development Enterprises, ide@online.com.kh
http://pottersforpeace.org/wp-content/uploads/cwp-cambodia-field-tests-2003-10.pdf

Smith, L. (2004). Evaluation of ceramic water filters as a household water treatment method- Takeo Province, Cambodia. Oxfam-GB/ London School of Hygiene and Tropical Medicine.

Swanson A. (2008). Evaluation of the complementary use of the ceramic (Kosim) filter and Aquatabe in Northern Region Ghana. Master of Science Thesis in Civil and Environmental Engineering.MIT.

Tun, WW. (2009) A study of arsenic laching from colloidal silver ceramic water filters manufactured in Myanmar. UNICEF

Van Halem, D. (2006). Ceramic silver impregnated pot filters for household drinking water treatment in developing countries. Master of Science Thesis in Civil Engineering, Delft University of Technology. Available at: http://s189535770.onlinehome.us/pottersforpeace/wp-content/uploads/finalcsfreport_29-10-2-van-dalem1.pdf

Walsh, M. ((2000) A household survey of the ceramic water filter in Nicaragua.

Westphal, K., Wall, E., Guo Y., & Schwab K. (2007?). The effectiveness and sustainability of a low-cost water filter in removing pathogens during long-term household use. Johns Hopkins Center for a Liveable Future Faculty and Student Innovation Grant (2006-07). Contact: kwestpha@jhsph.edu.