

# **Study on Life Span of Ceramic Filter Colloidal Silver Pot Shaped (CSP) Model**



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# **I. Introduction**

Several studies on the ceramic filter promoted by Potters for Peace have been carried out previously. Nevertheless, since the CSP model started to be distributed it has not been defined for how much time the filter can remove bacteria and parasites effectively. An approach on this issue was conducted in 1999 by the Aquatic Resources Research Center (CIRA, in Spanish) of the Nicaragua National University (UNAN) along a research work on the CSP model. For that study a seven years old filtering element was tested for total coliform, fecal coliform and fecal streptococcus removal. The results obtained showed that the CSP was capable of removing all the total coliform and fecal coliform organism, but also increase slightly the concentration of fecal streptococcus (see more details in Lantagne 2001). It should be noted that the seven years old filtering element that was used for the test was one of the first prototypes, and it was a little bit smaller than those that exist and are distributed today which is why the mentioned results couldn't be taken as conclusive for the new type of CSP model.

It has not been defined for how much time the CSP can be used before its capacity for bacteria and protozoa's removal decrease below 100 % and therefore has to be replaced. In all the filters factories around the world two years has been established as the time when the filtering element has to be replaced, nevertheless this time was selected randomly and such statement doesn't rely enough upon a scientific evidence.

The Practica Foundation and the Potters for Peace work together on issues related to water supply for developing countries. One of the Appropriate Technologies that both organizations promote is the CSP model. They helped a Dutch Family Balmen in a CSP model distribution project in the community Chacaraseca, which is a rural village located one and a half hour from Managua City by car. The project distributed about 1000 filters.

To know of the results of the project, the family Balmen funded the research study through PRACTIVA that is presented in this document.

## II. CSP Brief Facts

The CSP model promoted by Potters for Peace and Practica Foundation consist of a porous clay pot sitting down in a receptacle that can be plastic made or clay made. In the bottom of the receptacle there is a faucet that allow the water from the receptacle to be taken. In order to protect the filtrated water in the receptacle from external contamination, a lead is allocated above the filtering unit.

According to Lantagne (2001), there are two mechanism responsible for the bacteria and protozoa organism removal trough the filtering element. One of them is the colloidal silver that is impregnated in the ceramic and the second one is the pore size of the filtering element. The mechanism for colloidal silver application was changed in the year 2002. Before 2002 the colloidal silver solution used to be coated with a brush in the inside and the outside of the filter. After that year the element was soaked in a colloidal silver solution for 30 second. According to the experimental studies of Erick Oude Vrielink, 30 seconds is the time needed for a maximal colloidal silver absorption in the filtering element.

Today, the concentration of colloidal silver that remains in the filtering element after it is soaked is unknown, nevertheless, according to Lantagne (2001), the concentration of colloidal silver in the filtrated water after the second run is lower than the concentration after the first run, therefore it is expected that a permanent amount of colloidal silver remains in the element even if water runs trough permanently.

The actual pore size of the filtering element ranges from 0.6 to 3.0 microns. The goal is 1.0 micron, in order to remove E coli without the need for a disinfectant. The variation in pore size is due to the use of the sawdust in the fabrication process (see more details in Lantagne (2001)).

Once the element is fired its chemical and physical structure doesn't change over time, therefore the element should be capable of remove bacteria a protozoa permanently .

### III. Study Description

This investigation was aimed to get more scientific base on the lifetime of the filtering element. For this purpose, 19 filtering elements of different ages were tested, 14 of those filters were collected from the community Chacaraseca. Nine out of those 14 were distributed in the period 2002-2003 (2-3 years old), and the others five filtering elements were distributed in the period January - July 2005 (1-1.7 years old).

The others five filtering elements were distributed in 1999 at the rural communities Mancotal and Jiguina in the north part of the country.

All the filtering elements that were collected were replaced by a new one.

### IV. Methodology

Once the filtering elements were collected, they were transported to the Potters for Peace's office in Managua City inside cardboard boxes. Once in the city, the elements were placed in plastic buckets and tap water from Managua city was run through all of them. A run water sample from each element was collected in a whirl pacp sterilized plastic bags and then tested for the Sulfur Hydrogen (H<sub>2</sub>S) Producers Bacteria using a HACH Presence/absence test. Because all the run water samples of the previous test were positive for H<sub>2</sub>S producing bacteria (indicating presence of the organism), it was assumed that the filtering units were contaminated during the transportation from the rural village to Managua city. Therefore all of them were sterilized, heating them in a kitchen oven at 400 °C for four hours. With this method the bacterial growth in the filters was expected to be eliminated. In order to confirm this, tap water from Managua was run once again trough two of the filtering element and the HACH test was repeated.

The obtained results are presented in table 1-1.

Table 1-1: HACH test Results for Fired Filters

<i>Sample code</i>	<i>HACH test in 24 hours</i>	<i>HACH test in 48 hours</i>
<i>Raw Water</i>	P	P
<i>2002 a</i>	N	N
<i>2004 d</i>	N	N

P: indicates a positive result

N: indicates negative result

The results presented in the table 1-1, indicates that there was no microbial growth in the filters after the sterilization.

*Research on The Colloidal Silver Impregnated Pot*  
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## 4.1 Challenge Study

The challenge study was divided in two parts since it was requested by the laboratory where the tests were carried out. In the first part, only five filters were tested and the rest of them were tested in the second part.

A contaminated solution was prepared diluting polluted water from the sewage system of Managua city in tap water from the same city. Samples of the contaminated solution were sent to the microbiology laboratory of the Central American University (UCA) and then tested for the water microbial indicators Total Coliform a *Escherichia Coli* (*E.Coli*). Of note is that the first indicator was selected because, according to the World Health Organization (WHO, no date), it is the best indicator of removal capacity of water treatment system and *E coli* was selected since is the best indicator for the presence of fecal contamination.

Once the results of the lab test on the contaminated solution were obtained, water of this contaminated solution was run through five filters, and then a run water sample from each filter was collected in a whirl pack sterilized plastic backs and sent to the microbiology laboratory at UCA where they were tested for the water microbial indicators Total Coliform a *Escherichia Coli*. The obtained results are presented in the table 1-2.

Table 1-2: Challenge Study Results (First part)

<i>Filter code</i>	<i>Total Coliform NMP/100 ml</i>	<i>Percentage of Removal</i>	<i>E coli NMP/100 ml</i>	<i>Percentage of Removal</i>
<i>Raw Water</i>	Over 1600 <sup>1</sup>	-	350	-
<i>1999 a1</i>	95	94%	0	100%
<i>2000 1</i>	1600	0%	0	100%
<i>2002 a1</i>	0	100%	0	100%
<i>2003 a1</i>	8	99%	2	99%
<i>2004 d1</i>	0	100%	0	100%

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<sup>1</sup> Although the concentration was over 1600 MPN/100 ml, it was taken as 1600 MPN/100 ml in order to be able to estimate the removal rate.

Table 1-3: Challenge Study Results (Second part)

<i>Filter code</i>	<i>Total Coliform NMP/100 ml</i>	<i>Percentage of Removal (%)</i>	<i>E coli NMP/100 ml</i>	<i>Percentage of Removal (100)</i>
Raw Water	Over 1600 <sup>2</sup>		Over 1600	
1999 A	0	100	0	100
1999 B	0	100	0	100
1999 C	0	100	0	100
Five years (a)	0	100	0	100
Five years (b)	0	100	0	100
2004	0	100	0	100
2004 A	0	100	0	100
2004 B	0	100	0	100
2004 C	0	100	0	100
2004 D	0	100	0	100
2003 A	0	100	0	100
2003 B	0	100	0	100
2003 C	0	100	0	100
2003 D	0	100	0	100
2002 A	0	100	0	100
2002 B	0	100	0	100
2002 C	0	100	0	100
2002 D	0	100	0	100
2002 E	0	100	0	100

<sup>2</sup> Although the concentration was over 1600 MPN/100 ml, it was taken as 1600 MPN/100 ml in order to be able to estimate the removal rate.

## 4.2. Analysis

The obtained results indicates that only two out of 19 filters did not remove 100 % of the indicators total and E coli. It is very interesting that all the five years old filtering elements removed 100 % of both, total coliform and E coli. Indicating that the filters performance doesn't decrease in a five years period.

The filtering element that only remove 99% (see filter with code "2003 a1" in table 1-2) of the indicators *E coli* and total coliform, showed a larger capability to remove the *E coli* organism than total coliform, which is positive since *E coli* is a more significant pathogenic organism for human health than total coliform (the group), and also the obtained results were expected due to the smaller size of some organisms that are within the total coliform group.

It is important to note that the fact that the six years old filter (see filter with code "1999a" in table 1-2) remove less total coliform than the rest of the filters, but still remove 100% of *E coli*, can indicate that the smaller members of the total coliforms group that can pass through the filter's tortuosity are removed (inactivated) by colloidal silver and *E coli* is removed by the smallest porous of the filter.

It is important to take in to account that all the filters that were tested in this study were "re-heated" before the test, therefore it will be important to carry out the same test from samples taken the community. In order to ensure that samples analysis only provide information on the CSP but not on the receptacles, the receptacles should be sterilized before the sampling.

## V. Conclusion and Recommendation

Based on the results that were described above, the filtering element's capability for the removal of total coliform and E coli is equal to 100 % until five years. The consultant recommends to extend the time (two years) that is recommended at this moment for the filter's replacement to five years.

The results that were presented in this study are based on filtering elements that were "re-heated", therefore it will be important to take samples from none "re-heated" filters before the recommendations presented above can be taken as conclusive.