Action against arsenic

A project to introduce filters for families with an arsenic contaminated water supply in the Municipality of Telica, Department of León

Progress Report No: 2	*Period covered:* 21st February – 15th May 2012

Objectives and expected outcomes:

This project aims to achieve the following:

- Provide an immediate solution for 23 families (≈ 115 people) who currently consume arsenic >30 ppb.
- Assess the effectiveness of the Kanchan filter and the Aqua Clara filter at removing arsenic at the levels found within the study area.
- Field test 25 filters, monitoring their use with a view to expanding the programme in the future (considering all aspects of water quality, not just arsenic, and taking account of user feedback on issues such as taste and ease of operation).
- Assess the need for separate treatment for pathogens.

Progress this period:

- Work to prepare the materials for 24 Kanchan filters was completed including sieving and washing of sand.
- One filter was set up in the office and when tested reduced arsenic levels from 225 ppb to 0 ppb.
- Two Kanchan filters were installed in each of the communities of El Ocotón and Aguas Calientes and a further eight installed in Bella Vista. Six of these filters were coupled with Filtron ceramic filters and six with a covered bucket for chlorination. A further twelve Kanchan filters were installed in the communities of Unión España and Nuevo Amanecer.
- A presentation was given to the project participants explaining the risks of drinking arsenic contaminated water and the way the filter should be operated.
- Further explanations are being given to reinforce the initial training and demonstrations provided on how to maintain the filters when the water flow decreases.
- One beneficiary in Nuevo Amanecer withdrew from the project and has been replaced. One filter was repaired due to a blockage in the tube obstructing the flow of water.

Preliminary results:

Arsenic

- Average arsenic reduction from Kanchan filters was 89%
- Minimum arsenic reduction in any single filter was 53%
- Maximum arsenic after filtration was 96 ppb (before filtration: 250 ppb)
- In 13 of the 24 filters, arsenic was reduced to below detection limit ('100%' reduction)
- In 18 of the 24 filters, arsenic was reduced to below WHO standard of 10 ppb
- Average arsenic reduction where source water had >200 ppb As was 80%
- Average arsenic reduction where source water had 25-50 ppb As was 91%
- In 2 of the 6 Filtron ceramic filters, arsenic reduced further (from 24 and 17 ppb to 16 and 0 ppb respectively)
- In 2 of the 6 Filtron ceramic filters, arsenic increased slightly (from zero to 6 and 3 ppb respectively)

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Bacteria

- Faecal coliform reduction from Kanchan filters where source water had >200 *E.coli*/100ml was 81%
- Average faecal coliforms after Kanchan filter where source water had >200 *E.coli*/100ml was 320 *E.coli*/100ml (before filtration average was 920 *E.coli*/100ml)
- Average faecal coliforms after Kanchan filter where source water had <10 *E.coli*/100ml was 290 *E.coli*/100ml
- No samples after Kanchan filter achieved WHO standard of 0 *E.coli*/100ml
- In 6 of the 24 Kanchan filters, bacteria were <10 *E.coli*/100ml
- Average faecal coliforms after Filtron ceramic filter were 6 *E.coli*/100ml
- In 4 of the 6 Filtron ceramic filters, no bacteria were present
- None of the six chlorination buckets contained sufficient chlorine residual for disinfection

Other parameters

- On average, the Kanchan filter increased turbidity from 0.8 NTU to 3.6 NTU, apparent colour from 4.0 mg/l Pt to 38.3 mg/l Pt and true colour from 3.6 mg/l Pt to 13.3 mg/l Pt
- On average, the Filtron filter reduced turbidity from 2.7 NTU to 0.6 NTU, apparent colour from 28.3 mg/l Pt to 7.5 mg/l Pt and true colour from 8.3 mg/l Pt to 7.5 mg/l Pt
- Neither pH nor electrical conductivity showed any particular pattern due to filtration

Community acceptance

- The 24 filters are being used by approximately 150 people
- Filters are filled between one and four times per day
- 14 of the 24 filters were being used to treat water for cooking as well as for drinking, according to responses to the questionnaire
- One filter was not being used at all after one month, while in nine other cases it appeared that one or more family members were not drinking water from the filters
- There appear to be three reasons for not using the filter – lack of awareness of the problem, objection to the taste and concern that the filters are not actually effective
- 10 of the 24 filters were installed in an ideal situation in the house; others were too low or too vulnerable to being knocked over
- 12 of the 24 filters were kept clean and hygienic
- Comments about the water from the filters included “tastes of rust”, “agua pesada” (hard water) and “doesn’t quench thirst”; the majority, however, found the taste acceptable
- 11 of the 24 users showed some level of awareness of the problem and understanding about the use of the filters, though few could name arsenic as the contaminant

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Analysis of preliminary results:

The Kanchan filter is reducing arsenic, but the percentage reductions are less than those reported in the literature (90-95% reduction for arsenic up to 500 ppb). This may be due to the presence of phosphates (which compete with the arsenic for 'spaces' to adsorb onto iron), so additional analyses will need to be undertaken. The efficiency of the arsenic filter decreases with arsenic concentration in the raw water which is not surprising. It appears that some iron is getting through the Kanchan filter as evident from the increase in colour, both apparent (precipitate) and true (solution). It is possible that this iron contains arsenic. Of note are the two results where further arsenic reduction took place due to the Filtron, corresponding in one case with a decrease in colour. To confirm this it may also be advisable to test for iron in future rounds of sampling.

The turbidity of the effluent water is unacceptably high in some cases. Few problems of turbidity are reported in the literature which suggests that there may be some problems with the construction of the filters, despite the significant effort made during the construction process to use only clean, fine sand (<1 mm).

The bacteriological analyses are entirely consistent with previous experience of biosand filters. Where the raw water is highly contaminated, bacteriological contamination is significantly reduced (though not to acceptable levels). Where the raw water is relatively clean (Unión España, Nuevo Amanecer), the filters introduce contamination. It is not clear, however, whether the contamination is introduced in the filter itself or from manipulation of the water prior to filtration. Most households fill uncovered and unhygienic barrels from their taps due to the intermittent mains supply and it is in this storage that significant contamination may occur. Future rounds of testing could include additional sampling from household storage prior to filtration. The Filtron is very effective at removing bacteria and, from the first round of testing, it appears that this may be the preferable method for bacteria removal rather than chlorination which no-one was implementing correctly.

Regarding the social aspects, most filters are being used, though only around half are well kept and used by all the family. Few really understand the problem and of those that do, it is especially noteworthy that some are reluctant to trust that the filter actually works. Whilst the Kanchan filter is proven to reduce arsenic (though not as much as had been expected) and the Filtron is proven to reduce bacteria, it is far from clear at this stage in the project that household treatment would be an effective solution at a community-wide scale.

Report completed by: Jane Longley	Date: 26th May 2012

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Sand was collected from a nearby river bed which was found to be the source of the cleanest sand for the filters.

Rusty nails are prepared for the Kanchan filters. Arsenic adsorbs onto the rust reducing the concentration in the water which passes through the filter.

A machine using a washing machine motor to vibrate the wooden frame was built to speed up the process of sieving the finest sand for the filters.

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Coarse gravel is used at the bottom of the filter nearest the outlet. It was very important to ensure that this material was as clean as possible.

Project assistant Leonarda Zapata trains community members in how the filters work and why they are needed.

The first filter put together in the community of Ocotón successfully reduced the arsenic level from over 250ppb (brown dot on test paper) to below the WHO limit of 10ppb (very pale dot).

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Hydrogeologist, Andrew Longley, trains Maria Luisa Centeno Salazar, from the community of Ocotón, in how to chlorinate the water after it has passed through the Kanchan filter to remove the arsenic.

Kenia Moreno from Bella Vista fills the Kanchan filter which removes the arsenic from the water. The water then passes through the Filtrón to remove bacteriological contamination.

Candida Rosa Moreno from Bella Vista fills a glass of water from her filter. Here the water passes through the Kanchan filter to remove arsenic and is then chlorinated to remove bacteria in the second bucket.