BANGLADESH CHEMICAL AND BIOLOGICAL SOCIETY OF NORTH AMERICA (BCBSNA)

A SIMPLE ARSENIC REMOVAL METHOD FOR GROUNDWATER OF BANGLADESH: A METHOD RECOMMENDED BY BCBSNA

The chemistry of removal of arsenic from Groundwater in Bangladesh is well understood. After examining both the technical and the practical economic aspects prevalent in Bangladesh, Three primary criteria were recognized for any method to the effective. Those are:

1) The method should use readily available local material for arsenic removal.
2) The process should be simple for people of adopt.
3) The procedure must be proven scientifically to show that the arsenic level is brought down below at least 50 ppb (parts per billion) level.
4) The process should not produce other harmful chemicals in excess.

A published paper [entitled "Appraisal of a Simple Arsenic Removal Method for Groundwater of Bangladesh"; Khan, Rasul, Munir, Habibuddowla, Alauddin, Newaz and Hussam; Journal of environmental Science and Health, A35 (7), 2000] effectively meet all these requirements. A simple three-pitcher (local known as "3 Kalshi") filtration assembly made entirely from readily available local materials is tested for its etticacy in removing arsenic from the ground water of Bangladesh. In a 3-Kalshi assembly, the first Kalshi has iron chips and coarse sand, the second Kalshi has wood charcoal and fine send and the third Kalshi is the collector for filtered water. Sophisticated scientific analytical measurements were performed to validate measurements of arsenic and measure 24 other metals before and after filtration. **It has been shown that more toxic As(III) can be removed from 800 ppb to below the detection limit of 2 ppb. The As(total)can be removed to a concentration below 10 ppb for most samples even at the highest input concentration of 1100 ppb As(total). Further experiments show that 7000 liters of Arsenic contaminated groundwater can be filtered without overloading and dismantling the system.**

On the basis of the above paper (for detail scientific data, please refer to the paper), BCBSNA proposes the outline of an arsenic removal method, that can be immediately implemented by individual family households in rural Bangladesh. The accompanying sketch shows the typical setup. The procedure described below is suitable for daily drinking and cooking water requirements of a typical household in Bangladesh.

MATERIALS REQUIRED:

a) 3Kalshis (pictures made of fired unglazed clay): each with approximate volume of 18 liters. Make same holes in the bottom of two of the top pitchers (see the sketch).
b) Iron fillings: 3 kg, it could be small iron nails or rods cut into pieces. Or, low carbon iron chips from foundries. **Avoid using any galvanized (contains zinc) iron or alloy material.**
c) Coarse Sand: 2 kg, sand from river beds is suitable.
d) Find Sand: 2 kg, sand from river beds is suitable.
e) Wood charcoal (from burned wood used in cooking): 1 kg, avoid using any fine ash.
f) 2 pieces (4 inch X 4 inch) of 100% polyester cloth or any other synthetic material.

SETUP:

i. Iron fillings, sand and charcoal need to be boiled (or baked) before use. This is to prevent bacterial contamination.
ii. Make small holes in bottom of two kalshis.
iii. Fold the cloth pieces once. Put the folder cloth pieces to cover the holes of the two top kalshis. Make sure the clothes are secured in place by pushing the clothes slightly into holes.
iv. Put the 2nd Kalshi on top of the bottom (pure water reservoir) kalshi. Put half of the fine sand then the charcoal, then the other half of fine sand on the top of charcoal.
v. Put the 1st kalshi on the top of the 2nd kalshi. Put the iron filing (about one-sixth of the kalshi volume) on the cloth cover. Then, put the coarse sand on the top of the iron.

PROCEDURE:

Use deep tube well water. Water must be bacteria free. **This method does not remove bacteria. It only removes arsenic contamination.**

a) Pour the water in the top kalshi and let it percolate through. The optimum flow rate is 4-6 liters per hour.
b) Arsenic free water is collected in the bottom kalshi.
c) Do not use the first 3 or 4 batches of water. Throw those away.
d) Water in the bottom kalshi should be crystal clear. Usually ground water turns cloudy and brownish after 2-4 hours.
e) Use the water from the bottom Kalshi.

ARSENIC REMOVAL FROM WATER BY 3-KALSHI METHOD

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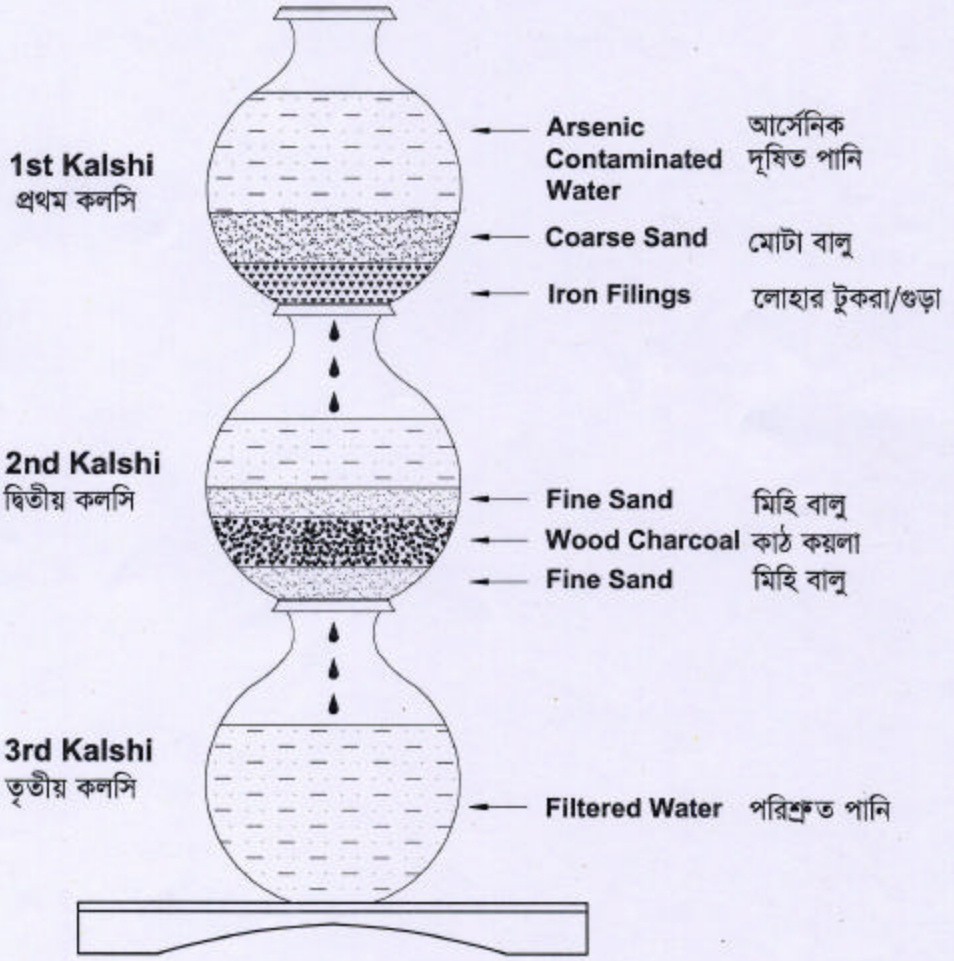

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MAINTENANCE:

a) Use the water from the bottom kalshi as long as the water is not cloudy.
b) No replacement of iron is necessary. If water in the bottom kalshi turns cloudy, then replace the send layers.

The water quality obtained from 3-kalshi setup meets and exceeds the WHO and Bangladesh standard and makes potable water from contaminated water of near waste water quality.

OPTIONAL STEPS:

a) To remove bacteria from iron and charcoal, one can pour 10 liters of boiled water through the step (1) in the procedure section. Alternatively iron, sand and charcoal may be boiled (for baked) before use.
b) By letting the water sit for a while, it is possible that a good part of the arsenic salt precipitates in the bottom. One would have to pour the water from top in order to leave the precipitate at the bottom.

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