TRADITIONAL AND HOUSEHOLD WATER PURIFICATION METHODS OF RURAL COMMUNITIES IN DEVELOPING COUNTRIES

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Keywords: Defluoridation, Filtration, Traditional treatment, Water quality, Water treatment

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Summary

A safe and convenient water supply plays a vital role in public health and well-being of the society. While there are numerous conventional water treatment technologies available, for a huge population in rural areas of developing countries, these systems would be inappropriate or too expensive. All over the world, these rural communities have adopted some simple and rudimentary water treatment techniques that can serve either a community or individual households. Basically, all such techniques aim to remove visible impurities such as leaves, twigs, or large suspended particles from water

collected from unprotected local sources. These traditional water treatment techniques range from simple filtration using a sieve or cloth to clarification and filtration using naturally available stone filters and plant materials. Attempts have also been made to develop simple treatment techniques that can serve households of isolated communities either at household level or at community level. Coarse media filters, gravel filters, coconut fiber filters, etc., are examples of such developments. There are also household techniques available to remove even some specific water pollutants such as fluorides that can greatly enhance the safety of usage of water for drinking purposes in water-scarce regions where there is no other appropriate water source.

1. Introduction

A safe and convenient water supply is of paramount importance to human health and the well-being of any society. There exist numerous high technology systems to purify water. But for a huge proportion of population in the developing world that lives in the rural areas, such systems would be inappropriate or too expensive. These rural populations of developing countries adopt some techniques with a low level of mechanization to suit their own situation. The special features involved in such traditional treatment methods are worth considering for dissemination, before general technological solutions based on wider experience are proposed for these communities. The traditional water treatment techniques can be found either serving a small rural community as a whole or individual households. This article collates some of these traditional and household techniques that are widely used in rural areas of developing countries and also some of the water treatment techniques that have been developed, especially to cater for households of these communities.

2. Traditional Water Treatment Methods

All over the world, rural communities have adopted simple and rudimentary treatment techniques that mainly aim at filtering out the visible impurities from the water collected from local sources. Though these traditional methods are expedient and can remove certain types of particles in water, they do not provide water necessarily of what would be considered, under the present day situation, as drinking quality. However, it can be considered that these methods provide water of quality that is acceptable to these rural communities, and in most of the cases, with a further simple step of disinfection, they could yield water free from pathogens. Some of the traditional treatment methods are:

1. Filtration through winnowing sieve (used widely in Mali).
2. Filtration through cloth (commonly used in villages in India, Mali and the southern part of Niger).
3. Filtration through clay vessels (used in Egypt).
4. Clarification and filtration through plant material (commonly used in Tamil Nadu and Kerala, India).
5. Jempeng stone filter method (used in Bali, Indonesia).

2.6. Filtration through Winnowing Sieve

This type of filtration is used when the water source is polluted by wind-borne impurities such as dry leaves, stalks, and coarse particles. The raw water is passed through a winnowing sieve, and the impurities are filtered. This type of filter is widely used in villages of the Bamaka area, Mali. This method cannot be used when the raw water is highly turbid or muddy, since the sieve cannot filter fine suspended particles in raw water.

2.7. Filtration through Cloth

Thin white cotton cloth or a discarded garment is used as the filter medium. This filter can filter raw water containing such impurities as plant debris, insects, dust particles or coarse mud particles. Filtration of suspended particles present in water can be achieved only to a very small extent. Therefore, this type of filtration is not suitable for highly turbid water. It is most suitable for filtration of well water. This practice of cloth filtration is quite common in villages in India, Mali, the southern part of Niger and probably in many other parts of the developing world. In some of the Indian villages, if the raw water is muddy and highly odorous, then wood ash of Sal tree (*Shora robuta*) is mixed with water and then filtered through cloth.

2.8. Filtration through Clay Vessels

Clay vessels with a suitable pore size are sometimes used to filter highly turbid water. Turbid water is collected in a big clay jar and allowed to settle down. Then the water in the jar will trickle through the porous clay wall of the jar. This trickled water is collected in a vessel (usually a clay pot) by placing it at the bottom of the porous clay jar. This method of water treatment is common in Egypt.

2.9. Clarification and Filtration using Plant Parts

Highly turbid water with fine suspended and colloidal particles are first coalesced and settled out using the nuts of a locally available plant, in some of the southern districts of Tamil Nadu, India, which is then filtered using cloth filters. Studies have found that the nuts excrete coagulant chemicals upon soaking which does the trick. Similarly, wiry roots of the rhizomes from the 'ramachham' (*Vetiveria zizanoides*) are placed in a clay jar, which has tiny holes in its bottom. Raw water is poured into this jar, and then the water is allowed to filter thorough this layer of roots. The water then trickles through the tiny holes at the bottom of the jar. The filtered water is collected at the bottom of the jar. Usually this filtered water is very clear and has a pleasant smell. This type of water filtration is common in southern districts of Kerala and Tamil Nadu, India.

2.10. Jempeng Stone Filter Method

This type of water filtration method is developed in Saringan batu Jempeng, Bali, Indonesia. Here, a small artificial pond or a by-pass channel is cut by the side to an irrigation canal, which carries muddy water (Figure 1).

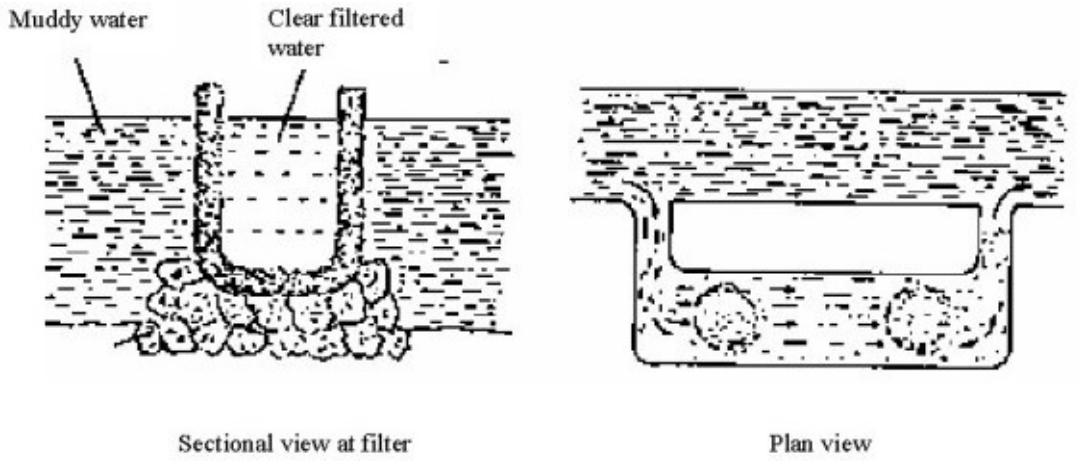

Figure 1. Jempeng stone filter

Jempeng stone filter units are placed in the artificial ponds. The filter unit is carved out of a porous material called 'cadas'. This unit has an average height of 60 cm, a diameter of 50 cm, and a wall with a thickness of 10–12 cm. This unit is placed on the top of a stone-supporting gravel bed. Muddy water filters through the porous wall of the filter unit and gets collected inside. This type of unit can be used as a village water treatment unit. It can treat even highly turbid water. The main feature of this unit is that the only cost involved is the investment cost. Practically there is no operational or maintenance cost such as for cleaning.

3. Appropriate Water Treatment Methods

As a continuation and improvement to traditional treatment methods, some simple treatment methods that are appropriate for small rural communities have been developed by local water experts in many developing countries. Some of such methods include:

- horizontal flow coarse media filter;
- upflow gravel filter;
- two-stage filter;
- upflow/downflow filter.

3.5. Horizontal Flow Coarse Media Filter

This technique uses coarse gravel or crushed stones as filter media and is highly suited for turbid waters with turbidities greater than 50 NTU. A combination of filtration and sedimentation of suspended solids take place during the horizontal passage of water through the filter bed (Figure 2). At the same time, biological mechanisms similar to those in slow sand filtration help to remove pathogens, although in a limited manner. Research at Asian Institute of Technology, Bangkok, Thailand, indicated that the unit can account for 60–70% removal of turbidity and about 80% removal of coliforms.

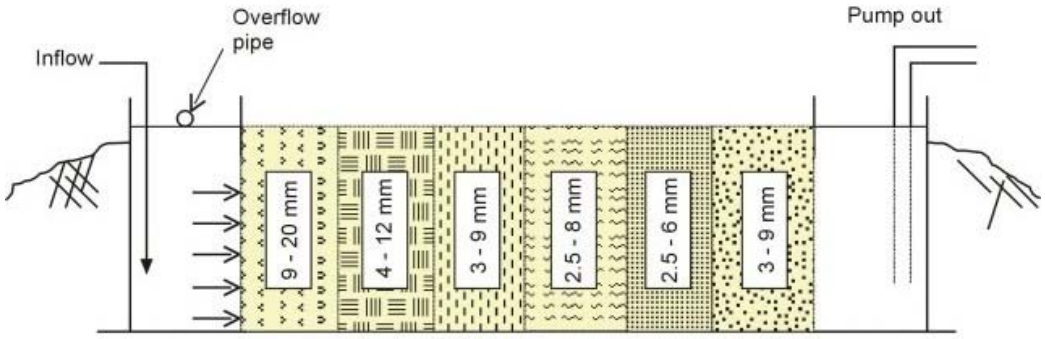

Figure 2. Horizontal flow coarse media filter

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Biographical Sketches

S. Vigneswaran is currently a Professor and a Head of Environmental Engineering Group in Faculty of Engineering, University of Technology, Sydney, Australia. He has been working on water and wastewater research since 1976. He has published over 175 technical papers and authored two books (both through CRC press, USA). He has established research links with the leading laboratories in France, Korea, Thailand and the USA. Also, he has been involved in number of consulting activities in this field in Australia, Indonesia, France, Korea and Thailand through various national and international agencies. Presently, Dr. Vigneswaran is coordinating the university key research strengths on "water and waste management in small communities", one of the six key research centers funded by the university on competitive basis. His research in solid liquid separation processes in water and wastewater treatment namely filtration, adsorption is recognized internationally and widely referred.

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