

A MANUAL
ON
WATER QUALITY TREATMENT METHODS
AT
COMMUNITY AND HOUSEHOLD LEVEL



A publication of TMST, Odisha

A MANUAL ON DRINKING WATER TREATMENT METHODS AT COMMUNITY
AND HOUSEHOLD LEVEL

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We deem it a unique opportunity to express our sincere thanks to the TMST Odisha, Bhubaneswar for giving us an opportunity to prepare this manual.

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Thanks are to the CEMC team members for their inspiration and constant support during the preparation of this manual.

Last but not the least we appreciate the job of translator and grateful to the artist for his drawings and suggestions.

About this book

This book is a compilation work of various techniques adopted at different parts of the world for removal of a range of chemical parameters which are present beyond the permissible limit in drinking water. The different technologies those are described in this book are mainly limited to household level and for community level. The stepwise pictorial presentation for treatment of contaminated water to remove different chemical parameters and biological treatment will possibly be appreciated by the readers of this book. The authors of this book have tried their best, put their utmost thought and taken maximum care while compiling the available information so that this piece of work will be accepted by every individual.

This book in general comprises three sections and eight chapters are within these sections. Section-I comprises only one chapter which describes different water quality problems in India with specific interest to Odisha and for whom this book is designed. Similarly, the section-II encompasses four chapters. Water quality standards, water quality occurrence in different parts of the state and its presentation in shape of a map are reflected in these chapters. Section -III, which is the most important section of this book, illustrates identification of problems and their mitigation measures at household level as well as at community level. Material quantification and maintenance procedures are also depicted in this section.

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SECTION-I

CHAPTER 1

INTRODUCTION

The rural population of Odisha spared over various hydrological / hydro geological regions. Provision of safe drinking water sources to a large population having different physical, socio-cultural and economic background is a difficult task. Rural India largely depends upon ground water to meet its water demand. Now a day's water quality is emerging a major concern in India. Because of rapid industrialization, urbanization and excessive irrigation the quality of water gets affected.....

There is an urgent need to provide access to safe sources of drinking water who are at a significant health risk. Use of sustainable technologies for communities and household water treatment and storage with proper awareness and capacity building including hygiene education is likely to have various direct beneficial health effects.....

For whom this book is intended for:

This manual is specifically designed for the following stake holders.

- Rural household
- Gram Panchayat functionaries
- Health care personnel
- NGOs working in this sector
- Low cost solution provider
- Technocrats

SECTION-II

CHAPTER 2

Water Quality Standard

Ground water is generally considered to be free from any contamination depending upon its depth of occurrence. This is why it is believed to have better quality than surface water, which is exposed to all sorts of natural and manmade activities. The chemical composition of water may change due to such activities and also related to the soluble constituents of earth surface. The change in level of concentration of different parameters of water may otherwise be said that the water is contaminated.

Drinking water quality is a major environmental determinant of health. Continuous improvement and subsequent assurance of drinking water safety is prerequisite for the prevention and control of waterborne diseases.

Certain chemical quality standards have been established for evaluating the suitability of water for drinking purpose by World Health Organization (WHO) and different countries. The WHO standard and Indian standard of drinking water qualities are given below.

WHO International Standard for drinking water

Sl	Parameters	symbols	Units	Highest desirable	Maximum permissible
Physical					
1	Colour		Hazen	5	50
2	Taste			Unobjectionable	
3	Odour			Unobjectionable	
4	Turbidity		JTU	5	25
Chemical					
5	pH			7.0-8.5	6.5-9.2
6	Total dissolved solids		mg/l	500	1500
7	Total hardness as CaCO ₃		mg/l	100	500
8	Calcium	Ca	mg/l	75	200
9	Magnesium	Mg	mg/l	<30	150
10	Iron	Fe	mg/l	0.05	1.5
11	Manganese	Mn	mg/l	0.1	1.0
12	Copper	Cu	mg/l	0.05	1.5
13	Zinc	Zn	mg/l	5.0	15.0
14	Chloride	Cl	mg/l	200	600
15	Sulphate	SO ₄	mg/l	200	400
16	Phenolic substances as phenol		mg/l	0.001	0.002

17	Fluorides	F	mg/l	0.6-0.9	0.8-1.78
18	Nitrates	NO ₃	mg/l		45
Toxic elements					
19	Arsenic	As	mg/l	0.05	0.05
20	Mercury	Hg	mg/l	0.001	0.001
21	Cadmium	Cd	mg/l	0.01	0.01
22	Chromium (Hexavalent)	Cr	mg/l		0.05
23	Cyanide	Cn	mg/l	0.05	0.05
24	Lead	Pb	mg/l	0.1	0.1
25	Selenium	Se	mg/l	0.01	0.01

INDIAN Standard for drinking water (IS:10500)

Sl	Parameters	symbols	Units	Highest desirable	Maximum permissible
Physical					
1	Colour		Hazen	5	50
2	Taste			Unobjectionable	
3	Odour			Unobjectionable	
4	Turbidity		JTU	10	25
Chemical					
5	pH			6.5-8.5	8.5-9.2
6	Total dissolved solids		mg/l	500	1500
7	Total hardness as CaCO ₃		mg/l	300	600
8	Calcium	Ca	mg/l	75	200
9	Magnesium	Mg	mg/l	30	100
10	Iron	Fe	mg/l	0.3	1.0
11	Manganese	Mn	mg/l	0.1	0.5
12	Copper	Cu	mg/l	0.05	1.5
13	Zinc	Zn	mg/l	5.0	15.0
14	Chloride	Cl	mg/l	250	1000
15	Sulphate	SO ₄	mg/l	150	400
16	Phenolic substances as phenol		mg/l	0.001	0.002
17	Fluorides	F	mg/l	0.6-1.2	1.5
18	Nitrates	NO ₃	mg/l	45	
Toxic elements					
19	Arsenic	As	mg/l	0.05	
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23	Cyanide	Cn	mg/l	0.05	
24	Lead	Pb	mg/l	0.1	
25	Selenium	Se	mg/l	0.01	

CHAPTER 3

Water Quality in different parts of Odisha

CHAPTER 4

Map showing the broad areas of drinking water contamination in the state

CHAPTER 5

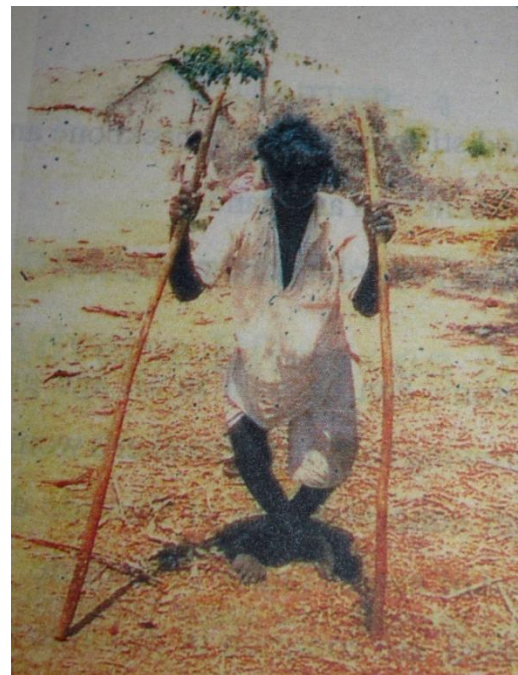
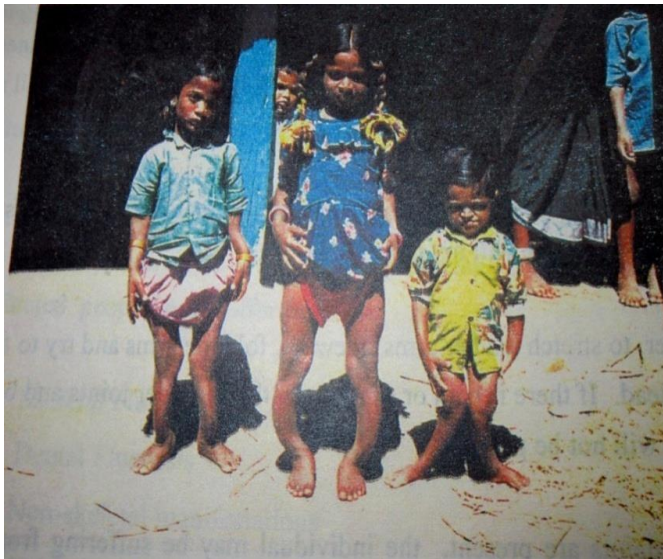
Effects of contaminated Drinking Water:

This section briefs about problems encountered due to specific parameters, e.g. Iron, Nitrate, Fluoride etc.

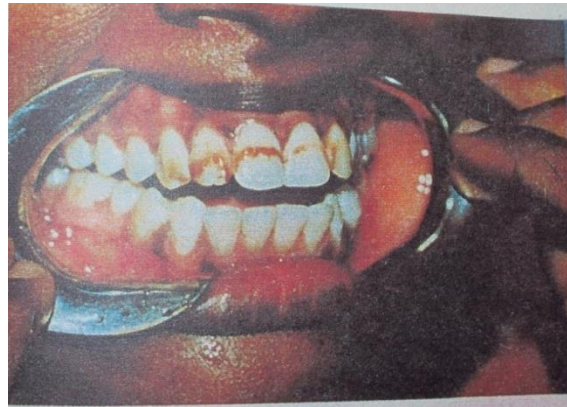
Iron: The presence of iron above permissible limit is objectionable as they leave stains of iron oxides on laundry, utensils and plumbing fixtures. Also iron concentration above one PPM imparts unpleasant taste.

Nitrate: High nitrate concentrations in water are causes of concern. The presence of nitrate may indicate organic contamination. Nitrate concentration more than 45 mg/l is undesirable in domestic water supply because of potential toxic effect on young infants. Due to intake of such water the skin of infants turn blue. That is why this is called blue baby disease. Cattles are also more affected due to nitrate intake which reduces milk production.

Fluoride: It is primarily important to know the concentration of fluoride in water before human consumption. Fluoride, when consumed through drinking water having more than the prescribed standard, can cause health problems. It affects both young and old people. Affected people may suffer from skeletal and dental fluorosis. A few photographs illustrated here showing dental and skeletal fluorosis.



The children and the adult in these two photographs suffered from skeletal fluorosis.



The horizontal lines observed in upper teeth are due to dental fluorosis.

People suffering from skeletal fluorosis have following symptoms:

- Severe pain and stiffness in joints, backbone and hip joint.
- Deformed and bent legs and hands.

People suffering from dental fluorosis have following symptoms:

- White teeth become dull and develop yellow spots or lines.
- Gradually this yellow colour turns brown and appears in shape of a horizontal streak on surface of the teeth.
- In late stages the teeth may become brown or black. The surface of the teeth may will be pitted or perforated. The tooth may get chipped off or the grip of the tooth may get loosened and loss the tooth.

Fluoride can also damage a foetus if the mother consumes water or food with high concentration of fluoride during pregnancy. Children born deformed are common in endemic areas.

Salinity

Bacteriological

Infectious diseases caused by pathogenic bacteria, viruses and protozoan parasites are among the most common and widespread health risk of drinking water. People are introduced to these microorganisms through contaminated drinking water, water drops, washing or bathing. Some waterborne pathogenic microorganisms spread by water can cause severe, life-threatening diseases. Examples are typhoid fever, cholera and Hepatitis A or E. Other microorganisms induce less dangerous

diseases. Often, diarrhoea is the main symptom. People with low resistance, mainly elderly people and young children, are vulnerable to these diseases as well.

SECTION-III

CHAPTER 6

Identification of Problems

This section chalked out how to know the presence of different parameters in water.

Iron (Fe): The presence of iron in drinking water can be easily detected in naked eye by observing any one or all of the following characteristics.

- If the water source is fitted with a hand pump, then colour of the hand pump platform must be turned to brown or brownish red. The intensity of this colour depends upon the concentration of iron content in water.
- It stains the white clothes and utensils if washed in iron rich water for many times.
- A creamy layer floats over the water when such water is kept in a container for a longer time.
- The hairs become sticky if one takes bath in this water.
- More iron rich water sometimes produces a typical smell.
- It changes the taste of cooked food.

The presence of **Fluoride, Nitrate, and Salinity** beyond permissible limit and **Bacteriological contamination** in water cannot be detected in naked eye like iron. Even if the water has a crystal clear appearance it cannot be assured that the above parameters are not present in the same water. The occurrence of salinity sometimes can be detected due to taste of water but not always. However, fluoride, nitrate and bacteriological contamination even cannot be detected by taste also. It is therefore wise to perform chemical and bacteriological analysis of water before using it for drinking and cooking purpose.

Sample Collection

Chemical Analysis

Block level

District Level

State Level

CHAPTER 7

MITIGATION MEASURES

The water quality in the state of Odisha are mainly chemically affected by iron (Fe), Fluoride (F), Salinity and Nitrate (NO₃) as it is evidenced from the map furnished in **chapter 4**. However, it cannot also be ruled out that the water is not microbiologically contaminated where villagers are access to the natural water sources such as river, stream, *chua* or water for drinking purpose due to their traditional use and because of the taste of water of the provided source.

To mitigate or minimize or to bring down the concentration of the above mentioned parameters within the range of the permissible limits (referred to chapter 2), a variety of techniques and different methods for drinking water treatment, various practices and technological solutions available for each of the above parameters are illustrated in this chapter with pictures and/or drawings with stepwise instructions for operation.

These techniques and methods can be used at two different levels i.e. at community level techniques and at household level.

IRON (Fe)

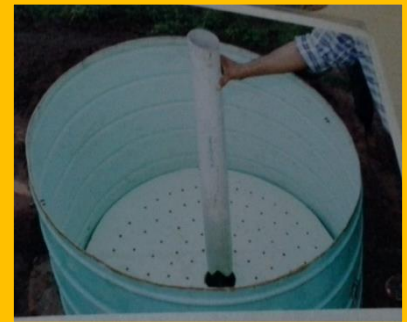
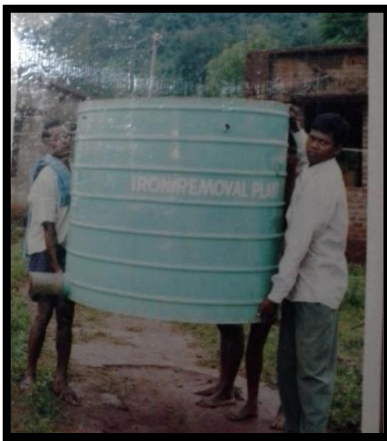
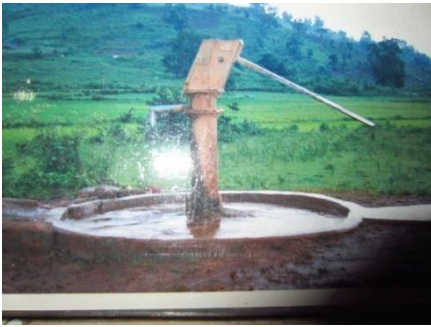
A. Community level techniques:

The responsibility of providing safe drinking water to rural communities lies with government. Accordingly, water sources are provided in each village. Since the sources are existing and some of them are discarded due to poor quality of water, it is advisable to use the recommended techniques in the concerned source for improving the quality.

1. FRP (Fibre-glass reinforced plastic) make cylindrical IRP(Developed at KWDP- WITH DFID support)

This device was designed with the aim to solve water quality problem of remote rural community where water source is mostly fitted with a hand pump and discarded due to rich in iron concentration in water.

The stepwise commissioning of this plant is pictorially presented below.



4. Lower the down pipe



2. Placing supporter for filter plate



3. Placing filter plate



5. Put filter media



6. Cover the tank





Advantages:

- Because of the light weight nature of the plant, it can be transported to any place with minimum labour. This was mainly designed for remote areas where material transport and availability of skilled for many days is a constraint.
- It reduces the involvement of technical man power, maximum one day labour is needed.

Maintenance:

- Needs to be backwashed
- Backwash duration depends upon iron concentration (May be once in a month).

Maintenance procedure:

- Disconnect the inlet pipe.
- Remove the aeration chamber.
- Takeout the tank cover.
- Stir the filter media.
- Open the backwash valve (Observe the colour of the waste water)
- Pour few buckets of water on the filter media in the tank from top.
- Shut the valve when all the waste water drained out from the tank.
- Please observe that there is no leakage in the backwash valve.
- Reinstall the aeration chamber and connect the inlet pipe to the pump.

Cost: The cost will approximately be Rs.30000.00

2. TERRAFIL FILTRATION (IMMT, Bhubaneswar)

The red clay water filtration media, called as 'Terrafil', is a burnt red clay porous media used for filtration and treatment of raw water into clean drinking water. The 'Terrafil' is produced from the mixture of red clay (silt clay), river sand and wood saw dust, which is sintered to make porous.

The Terrafil is usually fixed at the bottom of a container and raw water is allowed to pass through the Terrafil. Since diameter of the capillary openings of the clay membrane in the Terrafil is in sub-micron size, almost all suspended particles and microbes etc. present in the raw water are restricted to travel along water inside the Terrafil, and these impurities are removed from the raw water on the top surface of Terrafil without clogging the core of the Terrafil, for which long operational life of the Terrafil is obtained. In this way the moderate raw water is filtered and treated to clean drinking water. 99% of turbidity, 95-100% of micro-organisms, 75-90% of soluble iron, colour etc. are effectively removed from the raw water during filtration process through the Terrafil. The rate of filtration depends on pressure of water on the Terrafil; however, the water head is limited to 1.5 kg/cm² to maintain proper strength of the Terrafil. The filtrates clog the top surface of the Terrafil over time during use and hence reduce the flow rate. Therefore scrubbing of top surface of the Terrafil with a nylon brush or similar materials is necessary to remove the sediments, open the pores and rejuvenate the flow rate. The TERRAFIL can be made in any shape; however circular disc shape is more preferable in view of strength, high flow rate, easy operation and maintenance.

PRODUCT OF "TERRAFIL" RED CLAY WATER FILTRATION MEDIA

'TERRAFIL' is generally prepared in form of a solid disc, having 50 mm thickness and different diameters as per necessity. The Terrafil disc can be fitted at bottom of any container directly through epoxy resin or cement or any adhesive which is not harmful to human being, or the Terrafil disc can also be fitted with a mount (holder) through cement or adhesive. The domestic or community size water filtration system contains two chambers; the upper chamber is placed on the top of bottom chamber. A set of Terrafil, depending on the rate of filtration, are fitted at the bottom of the upper chamber. The upper chamber holds raw water and bottom chamber store the filtered water. The Terrafil are fitted on the bottom of the upper chamber in such a manner that water can pass through the Terrafil only, and the joint between Terrafil and the bottom chamber is fully water tight.

The chambers can be made with any material, such as stainless steel, Terracotta, food grade plastic etc. Since the rate of filtration depends on the water pressure over the Terrafil and surface area of the Terrafil, number of the Terrafil can be decided as per the need. The average rate of filtration in domestic size filter is in the rang eof 1-4 ltr./hr., which depends on turbidity of raw water and number of Terrafil disc used in the filter. Community size gravity flow water filter can be constructed with masonry chamber or ferro-cement pre-fabricated chamber. The rate of filtration depends on number of

the Terrafilts fitted in the upper chamber, however, average rate of filtration is in the range of 60-120 ltr/hr.

The water tight chamber has a flanged opening for cleaning of the Terrafilts. The upper chamber is also connected with a sludge outlet pipe for removal of sediments from time to time. However, the pressurized Terrafil water filter can operate successfully up to the water pressure of 1.5 kg/cm². The chambers can be made out of stainless steel and food grade plastic. The rate of filtration is dependent on number of Terrafilts used and pressure of raw water in the upper chamber, the rate of filtration can be raised to 2000 ltrs./hr easily.

TYPICAL DESIGN, DRAWING AND ESTIMATE OF COMMUNITY BASED TERRAFIL FILTRATION SYSTEM INSTALLED.

COMMUNITY BASED TERRAFIL FILTERS:

The Community Terrafil Filters being adopted in Karnataka consists of the following components:

- i) Upper Chamber to hold raw water, with raw water connection from OHT / Pumping main.
- ii) Lower Chamber to collect filtered pure water, with taps (2/4 nos.)
- iii) The middle partition to hold Terrafil Filter discs developed by I.M.M.T., Bhuvaneshwar
- iv) Masonry platform to erect the Community Filters

MATERIALS FOR UPPER CHAMBER / LOWER CHAMBER:

After the technology transfer for manufacture of Terrafil disc to entrepreneur, the next step was to search for a suitable container to hold the raw unfiltered water and pure filtered water. The following options were thought off as suitable material.

- i) LLDPE used by Sintex Water Tank or similar material
- ii) RCC Hume pipe containers
- iii) GRP Containers
- iv) M.S. Container

Two types of Models were developed for Community Terrafil Filters for removal of Iron in drinking water borewell sources.

MODEL-1: The upper & lower Chambers were made of any of the above materials as pre-cast container manufactured with LLDPE / RCC Hume pipe / GRP / M.S.

MODEL-2: The upper chamber to hold raw water and underground pure water chamber are RCC, Caste-in-situ with a self priming positive head hand pump to pump pure water and also can be used to clean the Terrafil discs with water jet.

PROCESS OF MANUFACTURE OF TERRAFIL DISCS



Mixing Process



Casting of Terrafil Discs



Terrafil Discs before cindering



Kiln constructed for cindering discs



Plastic Holder for Household filter

PHOTOS OF COMMUNITY TERRAFIL FILTERS INSTALLED

MODEL – 1



Casting of R.C.C. Terrafil Disc Holder



R.C.C. Terrafil Disc Holder after fixing Terrafil discs



R.C.C. Terrafil Disc Holders



Community Terrafil Filter LLDPE material



Community Terrafil Filter R.C.C. material

MODEL -2

RAW WATER TANK ABOVE GROUND LEVEL, PURE WATER TANK BELOW GROUND LEVEL WITH SELF-PRIMING HAND PUMP



3. IRON REMOVAL UNIT OF DRDO

This unit is developed by Defence Research Development Organisation. It is

- made up of mild steel
- cylindrical in shape.
- comprising of four chambers.
- having a backwash outlet for cleaning.
- designed for 300lph output.



DRDO IRON REMOVAL UNIT

4. LENNTECH IRON REMOVAL PLANT

Iron eliminated from water by oxidation in this plant. The pH treatment is done if the water is acidic in nature. Gravel and sand is used as filter media. Chemical oxidation can also be carried out with stronger oxidants such as chlorine dioxide (ClO_2) or potassium permanganate (KMnO_4). Iron concentration up to 7mg/l in water can be reduced to the permissible limit.

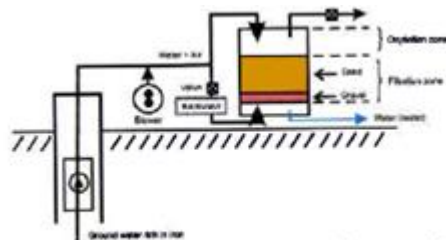


Figure 5.8: Schematic diagram of Lennotech iron removal plant

5. IRON REMOVAL UNIT OF CREPA

This is another similar technology developed to bring down the existence of excess iron concentration in water to the prescribed limit so as to develop the water quality for drinking and cooking purpose. This unit is composed of an aeration chamber on top from which aerated water falls in to settling chamber. The clarified water is removed to an adsorption tank containing two layers of gravel. The first layer is consisting of 1.5 to 2.0cm sized gravel of 45 cm thick and the second layer consisting of 2.5 to 5 cm sized gravel of 25 cm thick. Water flows over a weir at the outlet of the adsorption tank to the sand filtration unit of 40 cm thick.

There is a considerable decrease in the iron level in the treated water by this technology. Local materials can be used for such construction.

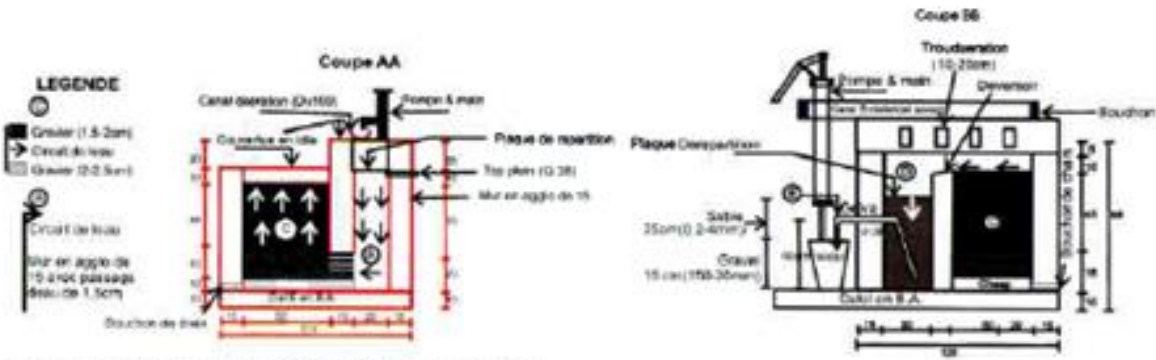


Figure 5.9: Schematic of a typical iron removal unit

6. UF MEMBRANE ASSISTED DEVICE

B. Household level techniques:

1.

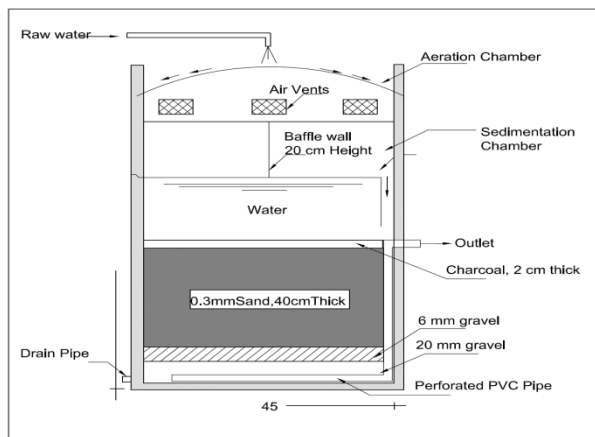


Figure shows a household level filter model to remove iron from drinking water. It can bring down the iron concentration to the desirable limit from raw water with iron concentration up to 10PPM.

The equipment consists of a circular Ferro-Cement container with 45cm diameter and 110cm overall height. Three separate detachable containers meant for aeration, sedimentation and filtering respectively are assembled together to act as Iron Removing Plant. The sedimentation chamber with four compartments is placed in between the aeration chamber and filter chamber. 20mm PVC water pipe pieces are used to draw water from the filter. A 40cm perforated piece is fixed at the bottom of the container to receive water flowing through the filter media. A vertical piece of 50cm length is connected to this and is fixed on the inner wall of the container. Another piece of PVC pipe with tap fitted at one end is inserted into the container through an opening in the wall and is connected to the top end of the vertical piece to act as outlet. The container is filled with river sand, gravel and charcoal as follows after thorough cleaning and drying. The filter media is having fine river sand having an effective size of 0.25 -0.30mm.

Description:

The bottom most layer : 20mm gravel 5cm thick.

Second layer : 6mm gravel 3cm thick.

Third layer : 0.3mm sand 40cm thick.

Top layer : Charcoal, 2cm thick

Each layer is separated with nylon cloth for easy replacement during cleaning of filter media.

Operation and Maintenance

Step 1: Pour 50 liters (approx) of raw water into the aeration chamber through the water supply line.

Step 2: Let the water get accumulated in the space for water to be filtered through charcoal, sand filter after aeration and sedimentation.

Step 3: Wait for 15-20 minutes for the water to be filtered through the sand and gravel. Finally the filtered water will enter in the perforated outlet pipe. Collect the filtered water from the outlet as shown in the figure.

Step 4: Repeat the process for more water.

Fabrication & Maintenance:

When the discharge from the filter becomes lower than the desired limit, then the top layer of the sand has to be taken out thoroughly washed and replaced. The testing data indicates that for an iron content of less than 10PPM this system

performs efficiently for a period of 3 to 4 weeks. After which the filter needs to be cleaning.

This unit can be fabricated with locally available materials with an approximate cost of Rs3000/-

2. IRON REMOVAL UNIT OF CSIR-NEERI

3. ION SPECIFIC RESIN UNIT CSIR-CGCRI

Fluoride

Community level techniques

Household level techniques

- 1. Activated alumina**
- 2. Bone char**
- 3. Degreased and alkali treated bones**
- 4. Fly ash**
- 5. Tamarind gel and seed**
- 6. Nalgonda technique**
- 7. ICOH domestic defluoridator**
- 8. Electro-coagulation method –NEERI**
- 9. CHEMO- defluoridatION TECHNIQUE – NEERI**
- 10. TERI defluoridatION UNIT**
- 11. DOMESTIC defluoridatION UNIT, SRILANKA**
- 12. DOMESTIC defluoridatION UNIT, using activated alumina**

Nitrate

Community level techniques

- 1. Technology from Ion exchange limited**
- 2. ISEP Nitrate removal method**

Household level techniques

Salinity

Community level techniques

Household level techniques

Bacteriological

COMMUNITY LEVEL TECHNIQUES

Slow sand filters

HOUSEHOLD LEVEL TECHNIQUES

1. Boiling
2. Solar disinfection by the combined action of heat and UV radiation
3. Filtration
4. UV disinfection with lamps
5. Chlorination
6. Combined system of chemical coagulation-filtration and chlorine disinfection.

BOILING: It is one of the most commonly practiced oldest methods of household water treatment. It is also one of the recommended methods for water treatment in developing countries for obtaining safe water. This technique is effectively used during or after flood when water sources are affected by flood.

- Find out the drinking water requirement of the household.
- Boil the required water in a clean container in any heating device, either in one attempt or in more attempts depending upon the available size of the container.
- Continue boiling for a minimum period of 20 minutes.
- Allow the water to cool after boiling and keep it under covered condition.

SOLAR DISINFECTION (SODIS): It is also an ideal method to treat microbial contaminated water for drinking purpose. In this method, the solar radiation, both light and temperature, is being used to destroy pathogenic bacteria and viruses present in water. Its efficiency depends upon the climatic and weather conditions.

- Use Polyethylene Terephthalate (PET) bottles of 1 to 2 liters size for this method. Glass bottles can also be used.
- The bottles must be transparent and colourless.
- Clean the bottles.
- Pour the microbiologically contaminated water in to such bottles.
- Expose these bottles fully to sunlight for a minimum period of 6 hours.
- The exposure to sunlight is depending upon weather conditions.
- The water having turbidity more than 30 NTU cannot be used for such treatment.
- It does not work satisfactorily in cloudy days within this 6 hours duration. Its exposure duration should be increased to two days if the sky is clouded for the whole day.
- Corrugated iron sheets on top of the house are the best places for keeping in sunlight.
- The treated water should be kept in the same bottle for drinking.



Filtration:

A) Cloth filtration:

1. Measure the diameter of mouth of the container where the drinking water will be stored.
2. Take a piece of cotton cloth of more than doubled the diameter of the container.
3. Bi-fold the cloth and tie it at the mouth of the container.
4. Pour the collected drinking water into the container through the cloth tied at the mouth.
5. By this method of filtration, Helminthes and larger Protozoas can be removed along with suspended solids.
6. This can easily be done at household level without much expense.

B) Media filtration: There are various types of filtration media which are, in general, used for filtration purpose. Some of them are:

1. Granular media
2. Slow sand filter
3. Ceramic and porous cast filters.

These medias are effectively used to filter the suspended solids and to some extent the comparatively larger microbes.

DISINFECTION:

Water disinfection means the removal, deactivation or killing of pathogenic microorganisms. Microorganisms are destroyed or deactivated, resulting in termination of growth and reproduction. When microorganisms are not removed from drinking water, drinking water usage will cause people to fall ill.

Necessity of drinking water disinfection

The larger part of pathogenic microorganisms is removed from water during the primary water purification steps. However, water disinfection is still necessary in order to prevent drinking water from being harmful to our health.

Disinfectants: The major disinfectants are:

1. Chlorine
2. Chloramines
3. Chlorine dioxide.
4. Hypo-chlorites(both of sodium & calcium)

However, the effectiveness of chlorine is influenced by:

1. Concentration of chlorine.
2. Contact time.
3. pH of water
4. Temperature

Bibliography

- IEC -04, Guide on water and excreta related disease, Rajiv Gandhi National Drinking water mission.
- Water quality, K.R.Karant
- I.M.M.T., Bhubaneswar
- NEERI