Domestic water treatment

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KEYWORDS

Water, Filter, Reverse Osmosis, Chlorine, Storage tank

ABSTRACT

After water is used domestically it is called wastewater due to contaminants such as shampoo, cleaning supplies, detergent, soap, and excrement. Wastewater treatment is the process of cleaning domestic wastewater so it can be either reused for irrigation, or safely put back into lakes, rivers, groundwater etc. Untreated wastewater is a threat to the health of humans and the environment. Treatment before domestic use is simply called water treatment which refers to the process that water from wells and other natural sources undergo in order to be potable for human.The domestic Water Treatments involves treatment for potable or drinking purpose, Taste, Odour, Hardness, and Contamination. Treatment of the water that is used in domestic situations is vitally important for ensuring the health and safety of all who are drinking it. The water needs to be free from anything that can cause it to adversely affect the activities it is needed for. There are so many different things in the water that can cause it to affect ones health and safety. Microorganisms can cause problems like diarrhea, dysentery, and cholera. The way to get rid of these harmful substances from the water is by providing the home with a quality water treatment.

1. INTRODUCTION

Water from surface sources is often contaminated by microbes; whereas groundwater is normally safer, but even groundwater can be contaminated by harmful chemicals from human activities or from the natural environment. Rainwater captured by rooftop harvesting system or with small catchment dams is relatively safe, provided that the first water is allowed to flow to waste when the rainy season starts. The amount of water to be treated should also be assessed. This can be estimated by assuming that each person will need a minimum of 20–50 liters of water a day for drinking, cooking, laundry and personal hygiene. A community should be consulted when choosing a water-treatment system and should be made aware of the costs associated with the technology.

2. HISTORY

In the 1700s the first water filters for domestic application were applied. These were made of wool, sponge and charcoal. In 1804 the first actual municipal water treatment plant designed by Robert Thom, was built in Scotland. The water treatment was based on slow sand filtration, and horse and cart distributed the water. Some three years later, the first water pipes were installed. The suggestion was made that every person should have access to safe drinking water, but it would take somewhat longer before this was actually brought to practice in most countries.

In 1854 it was discovered that a cholera epidemic spread through water. The outbreak seemed less severe in areas where sand filters were installed. British scientist John Snow found that the direct cause of the outbreak was water pump contamination by sewage water. He applied chlorine to purify the water, and this paved the way for water disinfection. Since the water in the pump had tasted and smelled normal, the conclusion was finally drawn that good taste and smell alone do not guarantee safe drinking water. This discovery led to governments starting to install municipal water filters (sand filters and chlorination), and hence the first government regulation of public water.

In the 1890s America started building large sand filters to protect public health. These turned out to be a success. Instead of slow sand filtration, rapid sand filtration was now applied. Filter capacity was improved by cleaning it with powerful jet steam. Subsequently, Dr. Fuller found that rapid sand filtration worked much better when it was preceded by coagulation and sedimentation techniques. Meanwhile, such waterborne illnesses as cholera and typhoid became less and less common as water chlorination won terrain throughout the world.

In 1903 water softening was invented as a technique for water desalination. Cations were removed from water by exchanging them by sodium or other cations, in ion exchangers.

Eventually, starting 1914 drinking water standards were implemented for drinking water supplies in public traffic, based on coliform growth. It would take until the 1940s before drinking water standards applied to municipal drinking water. In 1972, the Clean Water Act was

passed in the United States. In 1974 the Safe Drinking Water Act (SDWA) was formulated. The general principle in the developed world now was that every person had the right to safe drinking water.
Starting in 1970, public health concerns shifted from waterborne illnesses caused by disease-causing micro organisms, to anthropogenic water pollution such as pesticide residues and industrial sludge and organic chemicals. Regulation now focused on industrial waste and industrial water contamination, and water treatment plants were adapted. Techniques such as aeration, flocculation, and active carbon adsorption were applied. In the 1980s, membrane development for reverse osmosis was added to the list. Risk assessments were enabled after 1990.
Water treatment experimentation today mainly focuses disinfection by-products. An example is trihalomethane (THM) formation from chlorine disinfection. These organics were linked to cancer. Lead also became a concern after it was discovered to corrode from water pipes. The high pH level of disinfected water enabled corrosion. Today, other materials have replaced many lead water pipes.

3. STUDY AREA

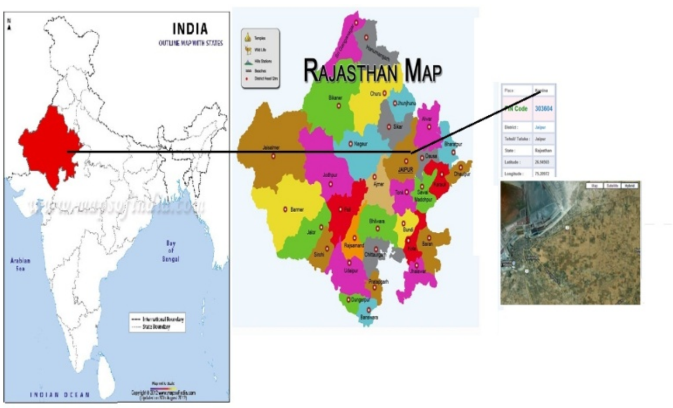


Figure1. Study area of kosina village

The study is on the korsina village, of jaipur district and jaipur taluka, near Sambhar Lake. It has latitude and longitudes are shown in fig1. The domestic water treatment procedures are applied on the various locality of the village, with 20 localities under survey with pre and post of 2 years data. The survey was made by NGO, people science institute dehradun. We found out the TDS, PH value, fluoride, chloride and hardness. This survey provides the quality data of the drinking water.

4. METHODOLOGY

The following is a typical method used for treating surface water. Intake: Water is first diverted from the river or lake into the treatment plant. When the water first comes into the plant it is typically screened to remove sticks, trash or other large pieces of contaminants.

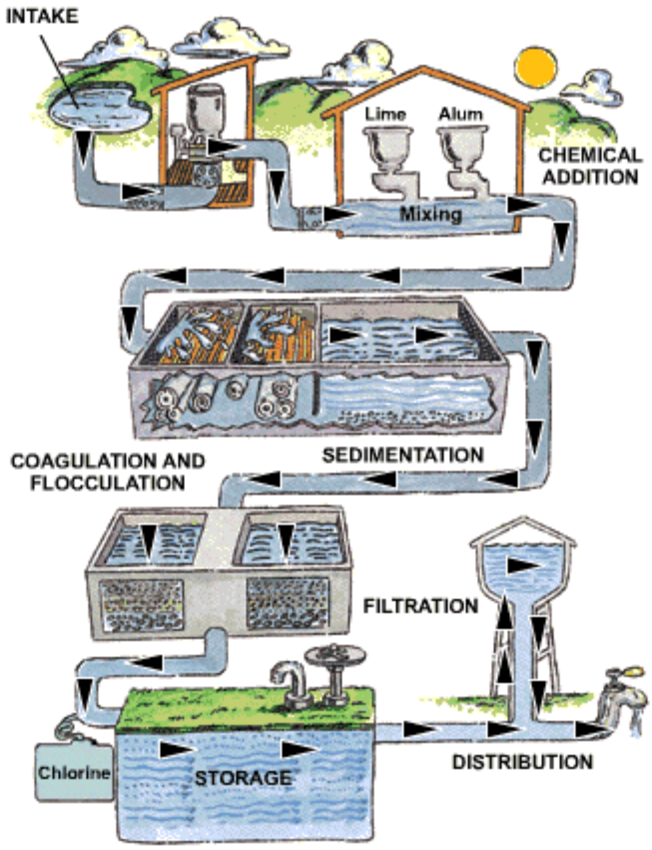


Figure2. Basic Water Treatment Process

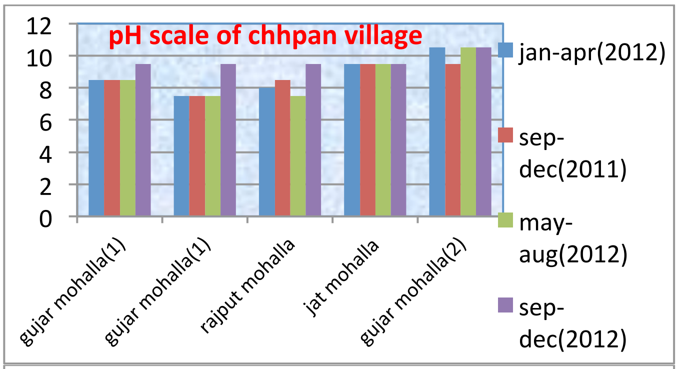
Coagulation: Alum and other chemicals are added to the water to form tiny sticky particles, called floc, that attract dirt particles.
Flocculation: The water is stirred slowly with paddles to mix the alum with the dirty water.
Sedimentation: The water is no longer stirred and is allowed to settle. The heavy particles (floc) settle to the bottom and clear water moves off the top to the filtration chamber.
Filtration: The water passes through filters that help remove even smaller particles. Our filters consist of gravel, sand, garnet and charcoal. Each layer filters out a smaller and smaller particle. The charcoal not only acts as a filter but neutralizes taste and odor.
Disinfection: After filtration, the water moves into a disinfection chamber where it is mixed with chlorine. A small amount of chlorine is added to kill any bacteria or microorganisms that may be in the water. It is at this step that we also add a small amount of fluoride for dental health.
Storage and Distribution: Water is placed in a closed tank or reservoir where it flows through pipes to homes and businesses in the community.

4.1 Hardness in Drinking Water

Hard water is high in dissolved minerals, both calcium and magnesium. As water moves through soil and rock, it dissolves small amounts of these naturally-occurring minerals and carries them into the ground water supply. Water is a great solvent for calcium and magnesium.
The following classifications are used to measure hardness in water: soft 0 - 17.1 parts per million (ppm); slightly hard 17.1 – 60 ppm; moderately hard 60 - 120 ppm; hard 120 -180 ppm; and very hard 180 or more ppm.
Treat hard water by adding a water softener to laundry and the dishwasher or by installing an ion-exchange system to treat all of your household water. Ion exchange can increase the sodium content of the water, which may pose health concerns for your household.

4.2 P^H Adjustment in Drinking Water

The P^H adjustment in drining water should have normal value 7-14.the graph plotted between ph value and two villages and their locality**.**



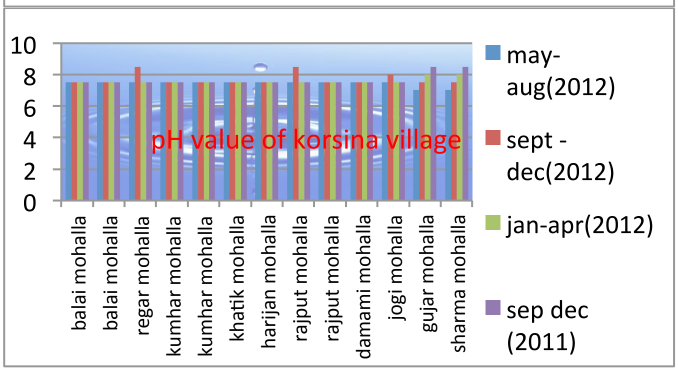
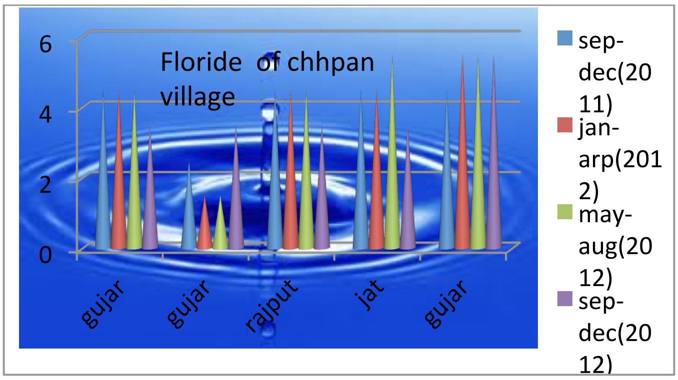


Figure3.the graph of ph adjustment of chhpan and kosina village

Distilled water has a pH of 7 (neither alkaline nor acidic) and sea water has an average pH of 8.3 (slightly alkaline). If the water is acidic (lower than 7), lime, soda ash, or sodium hydroxide is added to raise the pH. For somewhat acidic waters (lower than 6.5), forced draft degasifies are the cheapest way to raise the pH, as the process raises the pH by stripping dissolved carbon dioxide (carbonic acid) from the water. Lime is commonly used for pH adjustment for municipal water, or at the start of a treatment plant for process water, as it is cheap, but it also increases the ionic load by raising the water hardness. Making the water slightly alkaline ensures that coagulation and flocculation processes work effectively and also helps to minimize the risk of lead being dissolved from lead pipes and lead solder in pipe fittings. Acid (HCl or H_2SO_4) may be added to alkaline waters in some circumstances to lower the pH. Having alkaline water does not necessarily mean that lead or copper from the plumbing system will not be dissolved into the water but as a generality, water with a pH above 7 is much less likely to dissolve heavy metals than water with a pH below 7.

4.3 Fluoride in Drinking water

The fluoride content in drinking water should have a normal value of 1.5.the graph plotted show the fluoride content in drinking water of 2 villages. Graph contains the study samples taken from various; localities of these two villages. The two villages korsina and chappar has the fluoride content in their water exceeding the required level for which the water is unfit for drinking purpose.the fluoride content in the water can be reduced by the techniques in our study which will make water safe for drinking in this areas**.**
Fluoride can enter public water systems from natural sources, including runoff from weathering of fluoride containing rocks and soils and leaching from soil into groundwater.



Fluoride pollution from various industrial discharges and emissions can also contaminate water supplies. In a few areas of the korsina village and chhapan village, fluoride concentrations in water are much higher than normal such as gujarmohalla.

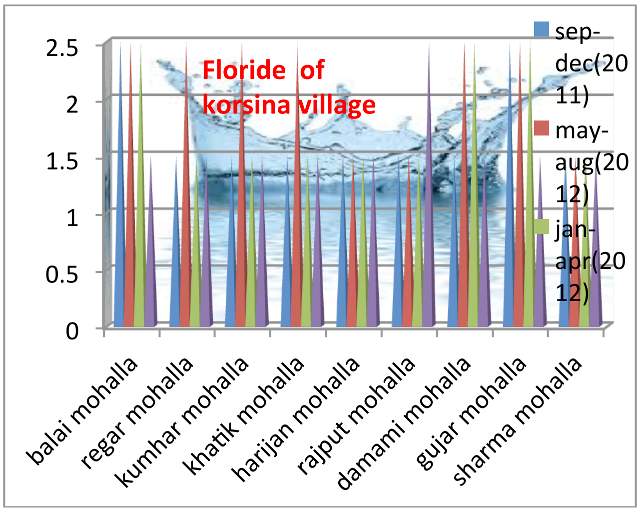


Figure4.the graph of fluoride Of chhpan and kosina village

4.4 Coagulation in Drinking Water

Particulate pollutants are present in domestic and industrial wastewaters. Natural waters also contain a wide variety of particulate impurities. To remove these particles sedimentation, flotation, and/or filtration are commonly used. The efficiency of these technologies depends on the size of the particles, and for colloids it is normally very low. In this case, the separation efficiency can be greatly enhanced if the small particles are aggregated into larger flocs (coagulation/flocculation). Because of their surface charge, many impurities in natural waters and many pollutants in wastewaters are often colloid ally stable and resistant to aggregation. The aggregation of colloids can be accomplished either by destabilization or by the enmeshment of the colloidal particles in a growing hydroxide precipitate formed in the waste (sweep coagulation). Two are considered to be the main processes involved in the destabilization of colloidal. Decrease in the thickness of the diffuse part of the electrical double layer, caused by an increase in ionic strength.

4.5 Filter in Drinking water-

Other popular methods for purifying water, especially for local private supplies are listed below. In some countries some of these methods are also used for large scale municipal supplies. Particularly important are distillation (de-salination of seawater) and reverse osmosis.

4.5.1 Boiling

Water is heated hot enough and long enough to inactivate or kill micro-organisms that normally live in water at room temperature. In areas where the water is "hard" (that is, containing significant dissolved calcium salts), boiling decomposes the bicarbonate ions.

4.5.2 Granular Activated Carbon filtering

Granular activated carbon filtering is a form of activated carbon with a high surface area, adsorbs many compounds including many toxic compounds. Water passing through activated carbon is commonly used in municipal regions with organic contamination, taste or odors. Many household water filters and fish tanks use activated carbon filters to further purify the water. Household filters for drinking water sometimes contain silver as metallic silver nanoparticle. if water is held in the carbon block for longer period, microorganisms can grow inside which results in fouling and contamination. Silver nanoparticles are excellent anti-bacterial material and they can decompose toxic halo-organic compounds such as pesticides into non-toxic organic products.

4.5.3 Distillation

Involves boiling the water to produce water vapour.The vapour contacts a cool surface where it condenses as a liquid. Because the solutes are not normally vaporised, they remain in the boiling solution. Even distillation does not completely purify water, because of contaminants with similar boiling points and droplets of unvapourised liquid carried with the steam. However, 99.9% pure water can be obtained by distillation.distillation process are done by solar panel in kosina village.

4.5.4 Reverse osmosis

Mechanical pressure is applied to an impure solution to force pure water through a semi-permeable membrane. Reverse osmosis is theoretically the most thorough method of large scale water purification available, although perfect semi-permeable membranes are difficult to create

In Situ Chemical Oxidation, a form of advanced oxidation processes and advanced oxidation technology is an environmental remediation technique used for soil and/or groundwater remediation to reduce the concentrations of targeted environmental contaminants to acceptable levels. It can be used to remediate a variety of organic compounds, including some that are resistant to natural degradation.

4.6 Treatment at Houses in Drinking water

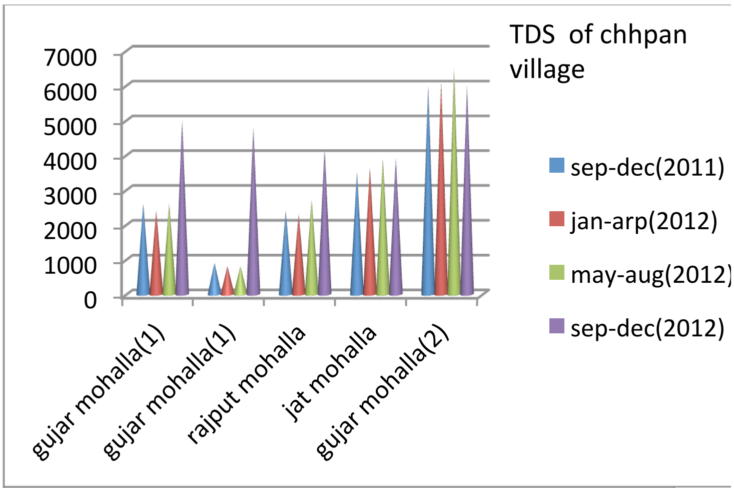
The Fact Sheets in this section deal with both community and household methods for treating water.

- Household water-treatment systems
- boiling;
- Household slow sand filter;
- Domestic chlorination.

4.6.1 Household slow sand filter
The technology with a household slow sand filter, water is passed slowly onwards through a bed of sand, where it is treated by a combination of biological, physical and chemical processes. Fine particles in the water are filtered out by the sand, while microorganisms grow on top of the sand filter and feed on bacteria, viruses and organic matter in the water. The filter can be made of clean 200-litre steel barrels connected by hoses. The system consists of a raw-water supply tank, a filter tank and a clean water tank. A floating weir (that can be made of a bowl, two small tubes and a hose)in the supply tank maintains a constant flow of water to the top of the filter tank, where it is purified by passing downwards through a 45–60-cm bed of washed sand and a 5-cm layer of fine gravel. The water flows through the sand at about 0.1 m/hour (1 m3 m-2 h-1). Water drains from the bottom layer of the filter tank via a perforated tube and is led to a clean water-storage tank. To prevent oxidation of the steel barrels, they must be treated with cement mortar, or any safe protective paint. Instead of steel barrels, tanks of fibrocement and other materials can also be used. All tanks should be protected with lids, with good operation and maintenance, a household slow sand filter produces water virtually free from disease-causing organisms.

4.6.2 Water chlorination at household level
The technology Chlorination of water at household level can be used as an emergency measure or as part of everyday life. When water quality cannot be trusted, a carefully measured amount of concentrated chlorine solution is added to a container with a known amount of clear water. The mixture is stirred and left for at least 30 minutes, to let the chlorine react and oxidize any organic matter in the water. After this, the water is safe to drink. The amount of chlorine needed depends mainly on the concentration of organic matter in the water and has to be determined for each situation. After 30 minutes, the residual concentration of active chlorine in the water should be between 0.2–0.5 mg/l, which can be determined using a special test kit. The concentrated chlorine solution can be made of clear water and chlorine-producing chemicals, such as bleaching powder, sodium hypochlorite, or organic chlorine tablets. It can be prepared at household level, but also in larger quantities and distributed among the households. A concentrated chlorine solution should be used within a relatively short time (defined according to the compound used) before it loses its strength. In some cases, chlorine-producing chemicals are added directly added to the water, without prior dilution. Some chlorine products come in combination with a flocculants to help settle suspended material in the water.

4.7 Total dissolved solids in Drinking-water
Total dissolved solids (TDS) are the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. The principal constituents are usually calcium, magnesium, sodium, and potassium cations and carbonate, hydrogen carbonate, chloride, sulfate, and nitrate anions. The graph show the tds is exceeding the normal value of 2000.



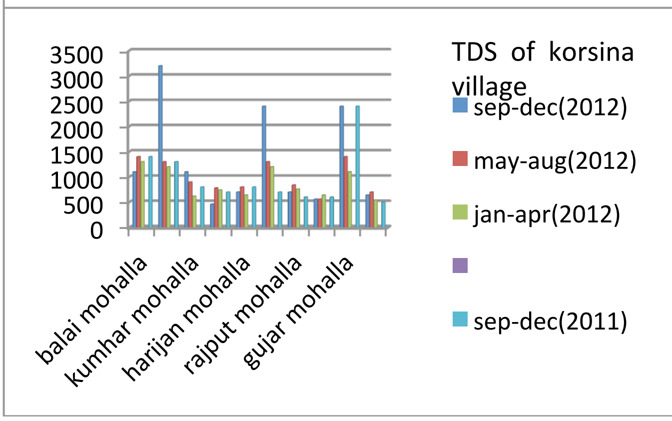


Figure5.the graph of TDS Of chhpan and kosina village

The presence of dissolved solids in water may affect its taste . The palatability of drinking water has been rated by panels of tasters in relation to its TDS level as follows: excellent, less than 300 mg/litre; good, between 300 and 600 mg/litre; fair, between 600 and 900 mg/litre; poor, between 900 and 1200 mg/litre; and unacceptable, greater than 1200 mg/litre. Water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste.

4.8 Chlorine in Drinking-water
Large amounts of chlorine are produced for use as disinfectants and bleach for both domestic and industrial purposes, and it is also widely used to disinfect drinking-water and swimming pool water and to control bacteria

and odours in the food industry. In water, chlorine reacts to form hypochlorous acid and hypochlorites. All three species exist in equilibrium with each other, the relative amounts varying with the pH. In dilute solutions and at pH levels above 4.0, very little molecular chlorine exists in solution. The concentrations of hypochlorous acid and the hypochlorite ion are approximately equal at pH 7.5 and 25 °C. Chlorine can react with ammonia or amines in water to form chloramines.

5. RESULT AND DISCUSSION

The study is on the korsina village, of jaipur district and jaipur taluka, near Sambhar Lake, In which water affected by TDS, pH, chloride and floride in post data (sept-dec 2011 and 2012) due to runoff off rainfall water are mixed with contaminants such as shampoo, cleaning supplies, detergent, soap, and excrement., so the water taste is salty and its is harmful for human being. This problem are seem to 90% less in pre data (april-may 2011and 2012).In which chhapan village, TDS,$P^{H,}$ chloride,floride, hardness have high value to a specified range, this water is not good for human being so water treatment are required to reduce this problem.

6. CONCLUSION

The basic human need is water. So for this, the water should be properly treated and maintained. Water treatment is that process, which is used to make water more acceptable for desired end use. These can include as drinking water treatment process is to remove existing contaminants in the water, or reduce the concentration of such contaminants so that water becomes fit for its desired use. In korsina village and chhapan village, according to water quality reverse osmosis's process are best suitable on commercial level water treatment.

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