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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | |  |  |  |  | | --- | --- | --- | --- | | **Safe Water Technologies**    **Abstract**  *Water everywhere is increasingly being contaminated from numerous sources and this, especially in drinking waters is a major concern, due to the associated health hazards. The most common contaminants being suspended matter, mud, silt, algae, bacteria and other pathogens. Besides large bulk processing systems for industry, Safe Water in India also has special focus on small and medium water supply needs. Solutions are offered for treatment of Municipal Waters, Surface Waters, Open and Tube Well Waters including source waters from streams, rivers, ponds and lakes for drinking water for Residences, Housing Colonies, Resorts, Villages, and Small Towns. Today, more than 1.1 billion people lack access to safe drinking water and 2.6 billion people have no access to basic sanitation. In most industrialized countries, access to safe drinking water is nearly universal, and is often taken for granted. This access has come as the result of massive public expenditures, though now more and more water supply agencies are being privatized. In contrast, access is typically lower in developing countries, where economies are weaker, and infrastructure is not as developed. The situation is the worst for the poorest people in developing countries, who often have no access to piped water supply. These families typically spend one fifth of their income on pure water. In this paper I want to emphasize some Safe Water Treatment Technologies which is used in various house hold and Industries viz. Ultraviolet Water Treatment Systems, Specialty Potable and Non-Potable Water Treatment Systems , Commercial Water Treatment Equipment and Components etc are some of the Technologies to be covered in this paper .*   |  |  | | --- | --- | |  |  | |  |   . | |

*Keywords: Water, Safe, Technology*

**Introduction**

Three main sources of water can be considered as substitutes for contaminated water: **groundwater, rainwater, and surface water**. Much has been written about these sources, so this chapter offers only a brief review, with key references.· Groundwater is largely free from harmful bacteria and fecal contamination, though a poorly designed or constructed well can become contaminated from surface water. To prevent this,wells should be grouted around the borehole, and finished at the surface with a concrete platform, with good drainage away from the well. Most commonly, groundwater is reached through boreholes, drilled either by hand or machine. When drilling in arsenic-affected areas, precautions should be taken to make sure that safe aquifers do not become contaminated. If a borehole must penetrate a contaminated aquifer to reach safe water below, the borehole should be grouted after drilling is completed. In some areas, groundwater can have naturally occurring water quality problems aside from arsenic, such as high levels of iron, manganese, nitrate, chloride, or fluoride. Before promoting new sources of groundwater, the chemical quality should be tested in laboratories. · Rainwater is free from arsenic, and if properly collected, can provide a safe drinking water source. Bacterial contamination is a concern, but this can be minimized by collecting rain from a roof (galvanized metal makes a good collection surface). Tree branches should not overhang the roof, and the roof should periodically be cleaned. Water can be collected through gutters, and piped into a storage tank. Tanks can be built of many materials, but ferrocement (cement with wire reinforcement) is strong and inexpensive, and also can keep the water pH near neutral. When rain first begins to fall, especially at the end of a dry season, roof water should be allowed to run off for 10-15 minutes before collection, to clean the roof. Close to urban areas, and when metal roofs are used, collected rainwater can contain unsafe levels of lead and zinc, and possibly other metals. Typically, collected rainwater contains low levels of bacteria (fecal and total coliform counts average 5-15 and 25-75 per 100 ml, respectively). Water quality testing should be done to ensure that collected water meets relevant standards. In some cases, rainwater may be the safest source of drinking water available, even if low levels of bacteria are present. Often, rainfall is seasonal, and large storage tanks would be required to bridge the dry season. While water can be safely stored for long periods, the large tanks may be too expensive. In such cases, small storage tanks provide an inexpensive and convenient water source during the rainy season, and other sources should be found for the dry season. · Surface water requires more treatment than groundwater or rainwater, since it usually has very high bacterial contamination. In order to ensure that treatment is always effective, important to include multiple barriers to contamination. The most effective treatment appropriate at the rural, community level, is slow sand filtration, followed by a safety dose of chlorine. In slow sand filtration, surface water passes through prefilters, and is then filtered through 80-100 cm of sand. A bio-layer develops near the surface of the sand, which can effectively destroy most pathogens. Operation of the slow sand filter may be improved through pretreatment with bank infiltration, sedimentation or roughing filtration. The use of roughing filters, in particular, permits effective treatment of water containing higher levels of turbidity, color, and pathogens. This ‘multi-stage filtration’ is a robust and reliable treatment method in rural communities, and for small and medium size municipalities. Slow sand filtration will not efficiently remove arsenic or agricultural chemicals such as pesticides. It is important to test the water quality of the unfiltered water to make sure that arsenic and pesticides are not present. Likewise, for bacteria, the cleaner the source water, the cleaner the treated water will be. Ponds and other surface water sources used for slow sand filtration should be protected: latrines should not be located near the water, and people and animals should not bathe nearby. Slow sand filters must be regularly cleaned, and the top few centimeters of sand in the filter should be scraped off. After cleaning, the filter will need several days to ‘ripen’, and treat water effectively. During this ripening period, filtered water should be disinfected before drinking.

**Rainwater**

Rainwater collection can provide a safe, arsenic-free source of drinking water if weather conditions are appropriate. When properly collected and stored, rainwater can keep a fairly constant water quality for months. In areas with low population density and hard rocks surfaces (rock outcrops or cement), rainwater can be collected from the ground surface by constructing micro dams to channel surface runoff into underground storage tanks. In more densely populated areas, rooftop collection is more common. Corrugated iron roofs are ideally suited for this purpose, though terra cotta or wood tiles, or concrete roofs are also acceptable. Thatched roofs are not appropriate for rainwater collection, as the collected water is high in organic matter. These roofs, however, can be made suitable with the simple use of inexpensive plastic sheeting. Roofs should be cleaned thoroughly at the beginning of every rainy season, regular maintenance is also crucial. Water is collected from the roof surface in gutters, which are connected to a storage tank with a downpipe. In order to minimize the amount of contamination and organic matter in collected water, a fine mesh netting or coarse sand filter should be placed between the downpipe and the storage tank. This will also help to keep insects and small animals out of the tank, and has been shown to improve water quality, and reduce the risk of mosquito breeding. When rain falls after a dry period, water should not be collected for the first ten to fifteen minutes, in order to clean the collection surface. This ‘first flush’ can be achieved through use of a bypass valve, or through a variety of simple designs.

A rainwater storage tank should be completely covered, and have a tap or pump for withdrawing water, to prevent contamination from users. If water is stored in open containers, or users dip cups or pitchers in a tank to retrieve water, the stored water can easily become contaminated with fecal pathogens. The amount of storage required will depend on local rainfall patterns, especially on the extent of dry seasons. If rainfall is scarce or absent for several months, large tanks will be required, or alternate sources of drinking water used during the dry season. In rainy periods, small, inexpensive tanks are able to provide adequate storage for most household needs.

**Groundwater quality**

Where available and of good quality, groundwater is usually the most acceptable source for drinking water supply. Due to the natural filtering of aquifer materials, and long underground retention times, groundwater typically has very little pathogenic contamination, and requires little or no disinfection. In contrast, surface water is often heavily polluted with fecal material as a result of poor sanitation and hygiene practices. Surface water is also more susceptible to chemical contamination from industrial or agricultural runoff, such as heavy metals, pesticides, or nitrate. However, groundwater quality should not be taken for granted. In very shallow aquifers, bacterial contamination is possible, and even likely if the wellhead is poorly protected. In addition to arsenic, other inorganic constituents in groundwater can cause health or aesthetic problem s, notably iron, manganese, nitrate, chloride, and fluoride. Other contaminants listed in the WHO Guideline Values should be tested for if their presence is suspected, either from human activity or from naturally occurring sources (WHO, 1993). If some existing groundwater supplies are found to be arsenic-free, these will usually be the most preferred water source, at least in the short term. The simple act of testing all of a community’s wells for arsenic is valuable in that it will identify safe, as well as unsafe, wells. People can be encouraged to share safe water resources, though if safe wells are scarce or absent, this may not be feasible. If safe wells are privately owned, the owners may be reluctant to allow others access to the wells, out of concern for privacy or a fear that increased use will result in increased maintenance and replacement costs. In some cultures, women are the main water collectors, but also have limited social mobility, and privacy concerns can make sharing of a household well uncomfortable or unacceptable. Arsenic-free wells might become contaminated over time through a third mechanism: arsenic could initially be present in a stable, solid form in aquifer sediments. If the geochemistry of the pore water, especially the pH and redox potential, should change, arsenic could become mobilized, and make its way into the abstracted groundwater.

**Surface Water**

Surface water presents more of a challenge than groundwater or rainwater in that it is usually heavily contaminated with fecal bacteria. Other contaminants may be contributed from agricultural sources, such as nitrates, phosphates, and pesticides. Finally, surface water is more vulnerable to industrial contamination. In urban and peri-urban areas, surface water often receives untreated wastes from industrial factories, untreated solid wastes, and urban runoff. As a result surface waters can have very high biochemical oxygen demands (BOD), and be seriously contaminated with organic compounds and trace metals. Surface water can also have naturally high levels of inorganic compounds, eroded from source rocks upstream, that can cause human health problems.

**Materials And Methods**

**Residential Specialty Water Treatment Systems**

* Softener/Filters — available with computer metered or clock timer controllers
  + Hard Water Systems
  + Hard Water and Nitrate Systems
  + Hard Water and Tannin Systems
  + Hard Water and Carbon Added Systems
* **Soft n` Pure**— water purification system with a softener and a chemical / bacteria filter
* BetterLife Series — patented filters and softeners with integrated UV
* Nitrate Removal Systems
* Tannin & Organic Removal Systems
* Iron & Hydrogen Sulfide Removal Systems
* Sediment Removal Systems — with automatic or manual backwashing
* Carbon Filter Systems — with automatic or manual backwashing
* Radon Removal Systems
* Arsenic Removal Systems
* VOC Reduction Systems
* MTBE Reduction Systems
* Hydrogen Peroxide Dosing Systems

**Commercial / Industrial Equipment**

* Commercial Sediment Filters — with automatic backwashing
* Commercial Carbon Filters — inline and automatic backwashing
* Specialty Carbon Systems — for arsenic, chloramines, radon, VOC, BOD, & MTBE reduction
* Commercial MetalEase™ Filters — iron, hydrogen sulfide, and heavy metal filters with automatic backwashing
* Industrial Water Softeners and Filters
* Commercial UV Systems — 15 to 50 GPM
* Commercial / Industrial UV Systems — 40 to 1,345 GPM
* Commercial RO Systems — 400 to 18,000 GPD
* Commercial RO Systems — for very high TDS, brackish water, river intake, seawater intrusion, & seawater desalination

**WATER FILTRATION COMPONENTS**

**Residential, Commercial, and Industrial Components**

* Tank Heads and Manual Backwashing Valves
* Custom Machined Plastic Tank Heads and Manifolds
* Residential and Light Commercial Filter and Softener Control Valves
* Commercial Filter and Softener Control Valves
* Commercial Deionizer Control Valves
* Industrial Filter and Softener Stagers and Controllers
* Industrial Diaphragm Valve Kits - pre-designed for all types of systems
* Fiberglass Wrapped Pressure Tanks with ABS Liners — 5 to 24 inch diameter
* Fiberglass Wrapped Pressure Tanks with Polypro Liners — 7 to 13 inch diameter
* Fiberglass Wrapped Pressure Tanks with Vinylester Liners — 24 to 48 inch diameter
* Fiberglass Wound Pressure Tanks with Polyethylene Liners — 6 to 48 inch diameter
* FRP Molded Pressure Tanks - 6 to 16 inch diameter
* Steel Pressure Tanks — lined and primed

**Filtration Media and Ion Exchange Resins**

* FilterEase and FilterEase-HD — sediment filtration, lighter than sand, 20 micron particulate filtration
* MetalEase , MetalEase-AS and MetalEase-61 — removes iron, hydrogen sulfide, arsenic, radium, & other heavy metals without chemicals — simple backwashing cleans the bed
* ProActive Coal-Based Carbon — proprietary brand of non-viscous, coal-based carbon — acid washed available
* ProActive Coconut Shell Carbon — standard 20 x 50 mesh and catalytic 12 x 40 mesh
* Anthracite — sized to any specification
* KDF — for low level chlorine treatment
* pH Neutralizer — to raise the potential hydrogen in water
* Manganese Greensand Equivalent (MTM) — oxidizing agent carrier

**Filter Housings and Cartridges**

* Pentair / Plymouth Products Housings and Filter Cartridges (Pentek)
* Bag Filters and Multi-Cartridge Filter Housings
* Fiberglass RO Housings

**Filter Housings**

* 5 and 10 inch Plastic Filter Housings
* 20 inch and Jumbo Plastic Filter Housings
* Stainless Steel Filter Housings
* Valve-In-Head Filter Housings
* Mounting Brackets and Wrenches

**Filter Cartridges**

* Sediment
* Carbon
* Specialty
* Inline Filter Cartridges
* Absolute Rated Filter Cartridges

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