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Clean water for developing countries

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Abstract

Availability of safe drinking clean water, a pivotal natural resource, is still a remote dream to many around the world, and a lot of cities especially in developing countries. Efforts to develop efficient, economical, and techno- logically sound methods to manufacture clean water for developing countries have increased worldwide. We focus on solar disinfection, filtration, percolation, hybrid and mongrel filtration methods, treatment of harvested and collected rainwater, herbal water disinfection, and arsenic removal technologies. Simple, yet innovative water treatment devices ranging from use of plant xylem as filters, tera filters, and hand pumps to tippy taps and nozzle designed and prepared indigenously and locally are methods mentioned here. By characterizing the technical ways of major water disinfection methods relevant for developing countries on medium to small scales and balances and emphasizing their merits, demerits, economics, and scalability, we highlight the current scenario and smooth the way for further research and explore and development and scaling up of these processes. This survey concentrates on clean drinking water, especially for rustic populations in developing countries.

Introduction

Water for drinking, or drinkable water, is of paramount importance. The availability of water globally varies to a large degree in different countries, and even if it is available, whether it is clean for human consuming is doubtful. This is especially true for developing countries, where incoming to neat and drinkable water is bounded. The present review scouts about clean water, especially with respect to drinking water [1]. The technologies available at present, their development, and emerging novel technologies are described with a focus on developing countries; we address the medium to small scale, as on the large scale, enough information is available. Clean water essentially means water that is appropriately pure and free from physical, chemical, and biological pollutants and may be used for purposes such as drinking, bathing, and cooking.

It is major that every human being has access to safe drinking water, as it is the right of every person. The microorganisms that are in unclean waters are of uncountable kinds of which bacteria, viruses, and protozoa are the wide kinds. Thus, drinking water should be clean from any of these harmful microorganisms. However, waterborne diseases are a major challenge globally. (WHO) estimates that nearly 1.6 million people die every year from diarrhea, and 90% of these are children younger than five years of age, mostly in developing countries. Therefore, controlling pollution on one hand and developing effective disinfection methods on the other are the two most important and serious approaches available to handle the crisis [1].

Material and Method

Water may be polluted by a set of materials as it is explained in (Figure 1) depending on the source of the water body, the environmental factors, and human activity. Physical contaminants lead to turbidity of water causing to

the being of materials like clay, microorganisms, or soil runoff, and particles in water bodies may harbor microbes (pathogenic or nonpathogenic). Microbes get in into water bodies mainly in the form of, e.g., animal and human wastes or runoff from farms.

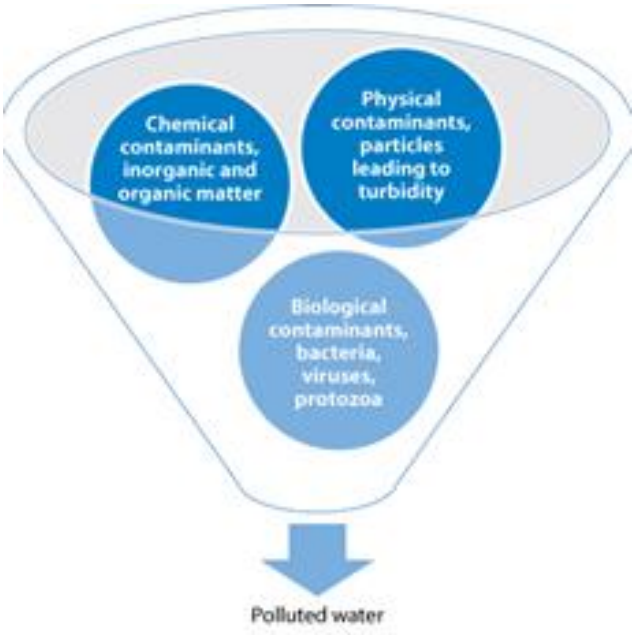

Figure 1. Common physical, chemical, and biological pollutants that pollute water

The inorganic contaminant arsenic is one major pollutant that causes skin, bladder, kidney, and liver disorders, lung cancer, and hyperkeratosis. Lead poisoning can be mortal, and small levels also can lead to intellectual defects in infants and young children [2]. It is believed that lead poisoning was the main reason for the breakdown of the Roman Empire because in ancient Rome, water pipes were made of lead.

The use of solar rays for water disinfection dates back many centuries. This simple yet effective method for water disinfection has huge possibility for implementations in developing countries given its low cost and zero energy requirements [4]. The technique's simplicity is depending on the capability of microorganisms present in contaminated water to directly ingest solar rays leading to its inactivation. In addition, sunlight is also known to burn molecules such as pigments and porphyrins present inside the cells, which in turn results in the formulation of reactive oxygen species like hydrogen peroxide that cause harm to the cell membrane, proteins, and DNA [3]. Thermal effects of solar disinfection, called solar pasteurization, are also included in the disinfection operation, during which the assimilation of solar infrared rays raises the temperature of water, leading to the inactivation of microbes.

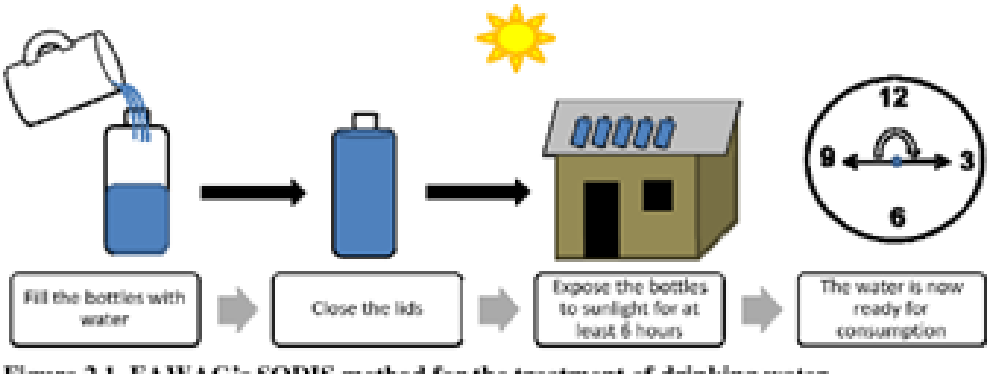

Figure 2. impact of water quality on solar disinfection

Rainwater gathering is used for collecting and storing rainwater from rooftops, land surfaces, runoffs, and catchments. The water becomes a household source for local uses, such as drinking and cooking, as well as for use in agriculture. In lowly polluted areas, catchment surfaces and metallic rooftops could be a source of pollutants such as inorganics and heavy metals, at least in the initial monsoon/rainy period. In addition, bacteria, viruses, and protozoans may earn access to the storage areas by way of fecal pollution resulting from birds and mammals. High levels of bacteria, such as 80.3% coliforms, 40.9% *E. coli*, and 28.8% enterococci, have been reported in harvested

and collected rainwater, thereby highlighting the necessity to disinfect gathered rainwater before to its consumption [5].

Disinfection of collected rainwater has been achieved by many methods, such as chlorination after its removal from the tank to minimize side reactions with inorganic matter settled at the tank bottom. Slow sand filtration is particularly useful to eliminate microbial contamination. For particulate matter, rapid sand filtration is one option, and metal membrane filters with ozonation and aeration on the feed side also serve well to remove most of the pathogens and explain rainwater to an acceptable quality [5].

Conclusion

Clean drinking water, a basic human right, continues to be a challenge worldwide owing to the humongous and myriad physical, chemical, and biological pollutants in water bodies, thereby affecting human lives.

Ongoing, continuous, and commendable efforts by the United Nations, World Health Organization including scientists, have resulted in remarkable improvement of the water scenario globally.

traditional techniques, such as filtration, hybrid filtration, and herbal water disinfection, are economical, easy to use, natural, and simple methods to gain clean drinking water in developing countries, especially in the form of point of use in households for turbidity removal or pathogen inactivation. Water treatment at the community level needs more focus and development [4].

collected rainwater is an excellent source of clean drinking water that not only conserves water but also is frail to simple and traditional disinfection techniques to render it pathogen free [3].

References

1. https://www.who.int/news-room/fact-sheets/detail/drinking-water
2. https://thewaterproject.org/why-water/health
3. https://pubmed.ncbi.nlm.nih.gov/26247291/
4. https://usfblogs.usfca.edu/sustainability/2020/04/17/water-treatment-in-developing-countries/
5. https://www.borgenmagazine.com/10-clean-water-solutions/