

REVIEW ARTICLE

Resolution to Provide Safe Drinking Water for Sustainability of Future Perspectives

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ABSTRACT

Water is vital for the existence of life on earth; is a well known and well understood reality of life. One needs no explanation for this that without water one cannot imagine sustenance of life, had long been realized, since the beginning of civilizations. One can live without any one type of food e. g. carbohydrates, fats, proteins, minerals, nutrients, etc. but cannot live without water for long⁷. Moreover, the production of all types of basic foods by virtue of agriculture, aquaculture, animal husbandry, etc. is not viable without water. For not only for growth, but, also for sustainability, availability of water of quality is a must. All measures that ensure the sustainable supply of quality water need to be adopted. Since the use of polluted water leads the production of contaminated food, it is essential that only water of good quality be used for production of food. Steps to preserve and protect water resources are yet to be taken at the desired levels. It has therefore, become necessary to re-emphasize again and again to adopt appropriate technologies that can help recycle water. In recent times, to control the menace of water pollution, various legislations have been introduced by different countries. The legislations undertaken by the United States include Federal Water Pollution Control Act (1972), the Marine Protection, Research, and Sanctuaries Act (1972) and the Safe Drinking Water Act (1974). Besides, Federal Insecticide, Fungicide, and Rodenticide Act was also amended in 1988. For the success of these legislations, cooperation of the citizens and industrial units is an important prerequisite. In addition to the enforcement and proper use of these rules and regulations, availability of efficient and cheaper pollution control techniques is also required to tackle the threat posed by water pollution. This article aimed at bringing out certain aspects on which each and every one of us has to ponder and act seriously.

Keywords: Technological interventions; Contaminants; Reverse osmosis; Structural attributes; Thermal behaviour; Pesticides; Organic solvents; R&D efforts; Phytoremediation

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INTRODUCTION

It would be worthwhile, looking at certain hard facts about water. All these facts make water the ultimate and most basic need of life on this earth. Water can neither created nor can it be destroyed. Just like that fact about energy which can only be transformed from one form to another. That is why, there exists no manufacturing unit producing water as a product. Even in the case of the technologically most advanced countries in the world, the requirement of water is always met from natural resources. Since it cannot be destroyed, the amount water consumed is always retrieved back. Thanks to the natural cycle of water that ensures the availability of water that ensures the availability of water through rains precipitation, etc. for the sustenance of life on earth. This cycle gets adversely affected, because of the anthropogenic activities specially those which are detrimental to the factors responsible for keeping the water cycle intact. This fact has been realized[1-4]by all nations by quite some time and that is why the efforts are being made at the global level to curb the developments that can lead to bring climate change which is expected to threaten the water cycle. Besides this, the need for assessing the water footprint of every project being initiated in the name of growth and development has become imminent. Even the production of food by agriculture or other means, the necessity for evaluating the water footprint is being taken as the essential criteria for deciding the crop pattern as well as the land use planning. Unless, the sustainable availability of water is given the top priority, misuse of water will continue, resulting into serious consequences. Technological interventions would therefore, be required so that the consumption of water be minimized without hampering the development plans for sustainable growth. Here, it must be noted that even though it is impossible to destroy water, it is very easy to spoil it. If adequate measures

are not taken, water gets spoiled and that is what must be avoided. The challenge has always been to recover good quality water from its spoiled form[5].

A change in the chemical, physical, biological, and radiological quality of water that is injurious to its uses. The term "water pollution" generally refers to human-induced changes to water quality. Thus, the discharge of toxic chemicals from industries or the release of human or livestock waste into a nearby water body is considered pollution. The contamination of groundwater of water bodies like rivers, lakes, wetlands, estuaries, and oceans can threaten the health of humans and aquatic life. Sources of water pollution may be divided into two categories. (i) Point-source pollution, in which contaminants are discharged from a discrete location. Sewage outfalls and oil spills are examples of point-source pollution. (ii) Non-point-source or diffuse pollution, referring to all of the other discharges that deliver contaminants to water bodies. Acid rain and unconfined runoff from agricultural or urban areas falls under this category. The principal contaminants of water include toxic chemicals, nutrients, biodegradable organics, and bacterial & viral pathogens. Water pollution can affect human health when pollutants enter the body either via skin exposure or through the direct consumption of contaminated drinking water and contaminated food. Prime pollutants, including DDT and polychlorinated biphenyls (PCBs), persist in the natural environment and bioaccumulation occurs in the tissues of aquatic organisms. These prolonged and persistent organic pollutants are transferred up the food chain and they can reach levels of concern in fish species that are eaten by humans. Moreover, bacteria and viral pathogens can pose a public health risk for those who drink contaminated water or eat raw shellfish from polluted water bodies.

Contaminants have a significant impact on aquatic ecosystems. Enrichment of water bodies with nutrients (principally nitrogen and phosphorus) can result in the growth of algae and other aquatic plants that shade or clog streams. If wastewater containing biodegradable organic matter is discharged into a stream with inadequate dissolved oxygen, the water downstream of the point of discharge will become anaerobic and will be turbid and dark. Settleable solids will be deposited on the streambed, and anaerobic decomposition will occur. Over the reach of stream where the dissolved-oxygen concentration is zero, a zone of putrefaction will occur with the production of hydrogen sulfide (H₂S), ammonia (NH₃), and other odorous gases. Because many fish species require a minimum of 4–5 mg of dissolved oxygen per liter of water, they will be unable to survive in this portion of the stream.

Direct exposures to toxic chemicals are also a health concern for individual aquatic plants and animals. Chemicals such as pesticides are frequently transported to lakes and rivers via runoff, and they can have harmful effects on aquatic life. Toxic chemicals have been shown to reduce the growth, survival, reproductive output, and disease resistance of exposed organisms. These effects can have important consequences for the viability of aquatic populations and communities. Wastewater discharges are most commonly controlled through effluent standards and discharge permits. Under this system, discharge permits are issued with limits on the quantity and quality of effluents. Water-quality standards are sets of qualitative and quantitative criteria designed to maintain or enhance the quality of receiving waters. Criteria can be developed and implemented to protect aquatic life against acute and chronic effects and to safeguard humans against deleterious health effects, including cancer.

Spoilage of water happens, when there is misuse of water as well as when the water gets in contact with pollutants. In agriculture for example, excess of water gets easily contaminated with various agrochemicals used. Similarly, water used in industrial purposes, example given, dyeing process in textiles. Leather, paper, etc., the effluent will always be mainly contaminated water. Here again, the use of optimum process conditions demanding minimum quantity of water for the process would be the wise thing to do. There are numerous such cases, where one can minimize the spoilage of water. Water is a carrier of all nutrients to metabolic process of each and every living system on earth plus it is because of water that the metabolic processes resulting into growth of living beings occur. All types of contaminants or pollutants remaining in water would cause destruction of living cells and hence the danger to life!

WATER POLLUTION AND THE TEXTILE INDUSTRY

The apparel industry has a big pollution problem. The World Bank estimates that 17 – 20 per cent of industrial water pollution comes from textile coloration and treatment (<http://airdye.com/about/how>). They've also identified 72 toxic chemicals in our water solely from textile dyeing, 30 of which are permanent. This represents an appalling environmental issue for the industry. With consumers striving to purchase eco-friendlier products, water pollution from dye houses and coloration treatments could be a major hurdle for apparel manufacturers. How can a company claim to sell a "green" shirt if the dye used to color it is polluting water and may be linked to cancer in humans? Some companies have taken action (maybe link to NADA post?) and removed dyes from certain garments, but there is no denying that consumers want color and variety in their clothing. Fortunately, for companies producing goods with

synthetic fabric there is a solution; AirDye®. AirDye is a dyeing technology that uses air not water to dye garments, allowing companies to create garments with vivid designs and colors, without polluting our water and environment. Here are the AirDye facts:

- Uses 95 per cent less water
- Emits 84 per cent less Green House Gases (GHGs)
- Requires 87 per cent less energy
- Reduces damaging of goods (Up to one per cent of goods are damaged using AirDye compared to 10 per cent of traditionally dyed garments)
- No Rules Wash®. Wash at any temperature, with whites or colors, with or without bleach
- Allows for new designs. Dye different sides of a single piece of fabric different colors or designs-

When creating eco-friendlier apparel, it is important not to forget the role dye plays as an environmental ill. Consumers are becoming quite conscious of how bad traditional dyeing is for the environment but have put up with it until now because there has not been a viable alternative. AirDye is that alternative. The technology is already used to dye and decorate swimsuits for MissPeaches([miss peaches link](#)), t-shirts for A Lot To Say, Window Coverings for Hunter Douglas, handbags for JulieApple, and mostly recently the runway fashions of Costello Tagliapietra. In the race to “go green” companies need an advantage. The companies above have found theirs. What will yours be?

The textile industry has a big pollution problem. The World Bank estimates that 17 to 20 per cent of industrial water pollution comes from textile dyeing and treatment. They’ve also identified 72 toxic chemicals in our water solely from textile dyeing, 30 of which are cannot be removed. This represents an appalling environmental problem for the clothing designers and other textile manufacturers. With consumers eager to purchase eco-friendly products, water pollution from dye houses and coloration treatments could be a major hurdle for apparel manufacturers. How can a company claim to sell a “green” shirt if the dyeing process used to color the garment wastes and pollutes water? Some companies have taken action and removed dyes from certain garments, but it seems unlikely that everyone would be happy with off-white or beige as the only choices at the store. Consumers want color and variety in their clothing.

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When creating eco-friendly clothing, drapes, or even carpet, it is important not to forget the role dye plays as an environmental ill. Consumers are becoming quite conscious of how bad traditional textile dyeing is for the environment but have put up with it until now because there has not been a viable alternative. AirDye is that alternative.

TECHNOLOGICAL INTERVENTIONS

Technological interventions are necessary for:

- (i) Development of techniques to assess the presence of different types of contaminants in water and its sources in a rapid manner but with highest accuracy
- (ii) Development of methodologies to be able to determine the exact amount of pollutants present in water even at very low levels with maximum possible reliability
- (iii) Development of devices to separate out the contaminants from the spoiled water so that the recycling of water can be done with almost safely measures in place
- (iv) Development of disposed off the contaminants separated out from the spoiled water in an environment friendly manner

The above technological interventions have been under continuous upgradation during the last two decades. For example, the possibility of being able to detect and quantify the toxic contaminants in water at extremely low levels of parts per billion (ppm) to parts per trillion (ppt) has become a reality now. But much more needs to be done yet in this area. Likewise, the devices such as reverse osmosis membrane technology (ROMT), etc. have been in use for the purpose of decontamination of water. But enough has not been so far. The remediation methodologies using natural processes such as phytoremediation or bio-

remediation of contaminants in water will have to be developed for different types of contaminants has also for various of polluted water from domestic as well as industrial sources. The fact that water can easily be contaminated can be viewed as the disadvantageous feature of water but this attribute of water can also be used for certain high value advantages. For example, water has been exploited by introducing water based products for health care purposes. Don't we realize as to how the mineral water has suddenly become an important product for our food basket. Taking this interesting experience to its next level, products are being developed to meet the health care requirements of population across the world by way of fortifying water with ingredients having medicinal value as well as immunity-enhancing properties. This R & D efforts towards the value addition of water would remain the focus area for several advantages of human life [6-7].

WATER HAS THE UNIQUE STRUCTURAL ATTRIBUTES THAT MAKE THIS NATURAL MATERIAL EXHIBIT EXTRAORDINARY PROPERTIES

The most prominent one pertains to its polarity based on which the materials are categorized as polar and non polar. It is due to the reason, that water is an ideal solvent for any material. Even non-polar substances get mixed with water, through in trace amounts. Water therefore, can easily be a cleaning agent, removing all sorts of dirt from all kinds of surfaces. Since water can hold all kinds of compounds, it gets polluted easily, if not protected well. Several surveys conducted in different parts of the world suggest that the groundwater is having continuously contaminated with different types of pollutants, organic as well as inorganic, known for their toxic effects. Similarly, the river water has also been getting worse even for the aquatic life. All sorts of pollutants from industries as well as from domestic sources are being poured into the rivers [8].

Water pollution is caused by emission of domestic or urban sewage, agricultural waste, pollutants and industrial effluents into water bodies. Nowadays, its main source is the waste material discharged by industrial units. Waste materials like acids, alkalies, toxic metals, oil, grease, dyes, pesticides and even radioactive materials are poured into the water bodies by many industrial units. Some other important pollutants include polychlorinated biphenyl (PCB) compounds, lubricants and hot water discharged by power plants. The pollutants unloaded into the water bodies usually dissolve or remain suspended in water. Sometimes, they also accumulate on the bottom of the water bodies. Another important pollutant, that can endanger marine life, is the oil spilled by oil tanks. As per the estimates of the United Nations, 1.3 million barrels of oils are spilled annually into the Persian Gulf, and about 285 million gallons are spilled into the oceans every year.

In the United States, the industries contribute to more than half of the total water pollution. The industrial effluents contain pollutants like asbestos, phosphates, mercury, lead, nitrates, sulphur, sulphuric acid, oil and many other poisonous materials. In many countries, industrial water is not treated adequately before discharging it into rivers or lakes. This is particularly true in the case of small-scale industries that do not have sufficient capital to invest in pollution control equipment.

In many instances, the researches and studies carried out to determine the toxicity of these pollutants are focused on the individual effect of the toxic elements. Therefore, sometimes these researches lead to an underestimation of the total toxicity of these harmful materials. Besides, their toxicity is assessed with the help of tests carried out on bacteria, which also fails to take into account the accurate toxic effects on other organisms.

These harmful pollutants are a major contributor to many grave diseases such as diarrhoea, cholera, hepatitis, dysentery and salmonellosis. Besides, many of the pollutants are also carcinogenic i.e. they can cause cancer. Some pollutants like sodium can cause cardiovascular diseases, while mercury and lead cause nervous disorders. DDT is another toxic material which can cause chromosomal changes. Excess fluoride in water may damage the spinal cord, while arsenic can cause significant damage to the liver and the nervous system. In addition to all these, organic compounds present in the polluted water facilitate the growth of algae and other weeds, which in turn use more oxygen dissolved in the water. This reduces the amount of oxygen dissolved in the water and the consequent shortage of oxygen for other aquatic life.

All this has become a global phenomenon, not restricted to any particular country; extent of contamination may be varying from country to country. In India, this situation has come to a serious level and immediate actions are being initiated on different fronts to avert dangerous consequences. Here, technological interventions are needed to development of process know-how that can help treat the waste water for its recycling and to dispose off the sludge removed from waste water in an environment friendly manner. As on today as on today, to recover water of good quality from polluted water is a big challenge [9].

THE OTHER FEATURE OF WATER IS ITS THERMAL BEHAVIOUR BECAUSE OF WHICH THIS IS USED AS A THERMIC FLUID

It is due to this reason that water has been an important raw material or a utility resource for any industry. Here, again, the aim should be to recycle water and avoid its spoilage. In the past, several synthetic materials have been developed either as industrial solvents or as thermal fluids but due to concerns for environment safety, they are now being replaced by water. Aqueous systems are being preferred compared with those based on organic compounds. For example, all types of paints and coatings based on organic solvents are being reformulated using water as the base. Similarly, pesticide formulations based on organic solvents were popular till the other day but would be no more so in the future. Technological interventions are being sought to develop safe yet effective formulations using water as the base [10-14].

CONCLUSION

Water can exist in three different phases i. e. solid, liquid and gas. This can easily be the advantageous feature specially while designing processes for recycling of water. With all the above facts known, one must remember that there exists enough water for all living beings on the earth. It is also true that availability of enough water can be ensured forever. Even with the current rate of water resources are conserved and protected. Today, technological interventions that help recover water from the dirty water are needed at various stages of water supply, especially for drinking purposes. In all the ancient civilizations prospered, it was mainly because they were growing around the river basins. The present day humans should not take water for granted and treat it as the most valuable gift of god to the mankind. Therefore, misuse of water would mean as disrespect to the god. It is not the question of being able to afford but it's a question of survival for all of us on the earth that the spoilage of the water be avoided world over, irrespective of the economic situation of the country. Otherwise, the damage to water cycle plus unhindered contamination of water resources would bring calamities for all. Better be aware and focus the R&D efforts to avert such a situation, which the wisdom suggests is always avoidable.

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