

WASTE WATER TREATMENT: CURRENT SCENARIO IN INDIA

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ABSTRACT

At present, the need for water, food and energy conservation has become an important topic of discussion not only in the world but also in India. Which has attracted the attention of not only the public but also the government. Increasing industrialization and urbanization has made the matter even more serious. Wastewater is generated after the use of fresh water, drinking water or brackish water in a variety of applications, which needs proper management. If we talk about waste water management, most of the waste water coming out of the houses is used in sewerage water. Reuse of wastewater is limited to agricultural and industrial purposes. Waste water is generated due to industrial, commercial and agricultural activities, sewer inflow etc. The water released from wastewater treatment plants is also mostly confined to agricultural and industrial purposes. In developed countries, waste water is not such a big problem because there are means of its management and the government and public are also more aware of it. But in developing countries like India, wastewater has adverse effects on human health and environment. Waste water is used directly in agriculture without treatment, which has serious consequences. Today, increasing population, urbanization and modernity have encouraged the use of water, day by day the amount of unusable water coming out from homes, factories etc is increasing. In view of the paucity of potable useful water, it has become necessary to convert the waste water into useful water. This will not only reduce the scarcity of water, but also the damage caused to the environment by dirty, smells and chemical-laden water can be avoided. In this research paper, we will throw light on the types of waste water, their treatment methods, treatment plants in India, treatment projects, benefits of treatments etc.

Keywords: Wastewater, Domestic Water, Industrial Water, Agricultural Water, Urbanization, Sewerage Water. Wastewater Treatment.

Introduction

Due to the rapid expansion of cities, human population growth and correspondingly increasing domestic water supply, the amount of waste water is continuously increasing. The global water crises, all over the world is the shortage of fresh water, combination of water and increasing volumes of waste water¹. To prevent the ill effects of waste water, it is necessary to make it reusable. After recycling the waste water it can be reused for various water demanding activities like agriculture, fire fighting, flushing of toilets, industrial cooling, park watering, formation of wetlands for wildlife habitats, etc².

Most of the wastewater research is available on the technical aspects involved in improving water quality and improving human health and environment over time. Some researchers have also emphasized on the design of water treatment and recycling system³. Some researchers have done framework for efficient wastewater treatment and recycling systems⁴. Global, regional, a country level need for data use have been studied by many authors⁵. To know about global hydrological cycle and world water resources which was studied by T.oki and S.Kanal⁶. It is worthy to collect information about global stressors on water quality and quantity⁷. What techniques and methodology⁸ can be adopted for

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wastewater handling, its reuse⁹. Public perception and participation in water reuse is compulsory activity that was studied by Hartley TW¹⁰⁻¹². Literature related to the role of attitude and willingness of farmer's to use recycled water for irrigation is also available¹³. Some researchers have studied factors influenced public perceptions of water reuse. The main focus of most waste water researchers have been on the techniques related to waste water treatment and improvements of water quality and on minimizing the adverse effects on environment and human health.

In this paper, we will discuss the waste water management, processes and techniques of waste water management, the projects being run by the government of India, the companies running these projects, the impact of waste water on the environment and health of creatures and the role of the public perceptions in reusing the unusable water etc. has been highlighted.

Waste Water Crises

Due to changing lifestyles with increasing urbanisation, more quantity of waste water is being generated and where these are not treated adequately, fresh water bodies are being continuously contaminated by it. Contaminated water coming from industrial units and domestic use is discharged into fresh water bodies.¹⁴

These contaminated waters pollute any water source when it gets into it. Due to which the water of the water source becomes unfit for drinking or other human use. Many times the level of pollution in the water source increases so much that it is not possible to use it even for cattle or agricultural work. Therefore, before getting this contaminated water into any water source, it is necessary to treat it properly so that its side effects on the water sources are minimized. According to the Water (Prevention and Control of Pollution) Act 1974 as amended, it is necessary to treat the contaminated water according to the prescribed norms.

Which type of treatment process takes place in a wastewater treatment plant depends on the type of waste water. There are several kinds of wastewater for e.g. domestic waste water, industrial waste water sewerage water etc. which are treated at the appropriate type of waste water treatment plant.

The main purpose of waste water treatment is for the treated wastewater to be able to be disposed or reused safely.

Sedimentation, biological and chemical processes are commonly used in waste water treatment processes.

Wastewater Treatment in India^{18,25}

According to a recent report published by Central Pollution Control Board (March 2021), India's current water treatment capacity is 27.3% and the sewage treatment capacity is 18.6% (with another 5.2% capacity being added).

Although India's wastewater and sewage treatment capacity is about 20% more than the world average, given the magnitude of the problem, this is not enough, and without swift measures the problem could get worse. Wastewater treatment is the process by which domestic or sewage water is treated in such a way that it removes major pollutants from the water. It involves physical, biological and chemical processes that make water useful. Major contaminants from the water which is collected from household sewage and other forms of runoff, physical, biological and chemical processes are involved to remove contaminants from water.

Today wastewater treatment in India is being looked at from different angles¹⁵.

Industrial Water Treatment¹⁶

Usually the treatment of the waste water generated from industries are of the following categories – boiler water treatment, waste water treatment and cooling water treatment.

According to the nature of contaminated water, polluted water treatment plants are made by different industrial units.

There are various industrial processes which requires water in different forms from heating - cooling processing, cleaning, rinsing and operating, the needs of industries with respect to water are diverse.

Water treatment is also required for improving the quality of water which is required in manufacturing of various products from beverages, pharmaceuticals and even semi conductors. The industrial water effluents when discharged untreated can cause high levels of toxicity and pollution in the environment which ultimately effects in the life of animals and human beings.

Waste Water Treatment Techniques

In General, the waste water treatment plant consists of Equilibrium Tank, Neutralization Tank, Settling Tank, Physical/Chemical Treatment Tank, Filtration Tank, Solar Evaporation Tank/Lagoon etc. Multi-level sewage treatment plants are constructed to treat specific types of industrial waste water such as contaminated water containing excessive organic matter, for example, from distilleries, paper mills, etc. This includes primary treatment, secondary treatment and tertiary treatment.

First Aid

During first AID treatment, the impurities present in the waste water are removed through some simple physical processes. These procedures are as follows:

Filtering

In primary treatment, during the mechanical process, contaminated water is passed through a strainer, from which some large suspended matter such as large size fibers, stones and other suspended particles are separated.

In this way, about 60 percent of suspended particles are separated by the process of filtration.

Sedimentation

After filtering, the contaminated water is kept in a big tank for sedimentation. In which the contaminated water is left stagnant in a large tank about five meters deep. The heavy particles present in the contaminated water settle down due to gravity and the relatively clean water above is taken for further treatment.

Flotation

In this process, the contaminated water is left for some time by aerating or shaking it well. Due to which the solid particles come to the upper surface of the water, from where they are separated.

Second Treatment

Secondary treatment of water is done to treat industrial waste water containing organic matter. In this, biologically degradable organic matter is treated by micro-organisms. The sediments found at the bottom contain a large amount of micro-organisms. As a result, some part of this sediment is again used for secondary treatment. Oxy and anoxic biological treatment is mainly in vogue for biological treatment.

Oxy Treatment

- **Oxidation Pond**

In this process, the contaminated water is treated with the help of aerobic bacteria and algae in large oxidation ponds. Organic matter is decomposed by aerobic bacteria and algae consume this decomposed material as food and eliminate it. This process is adopted for the treatment of domestic (sewage) contaminated water.

- **Aerated Lagoon**

In this process, during the first treatment, the contaminated water is collected in large lagoons and aerated through electrically operated aerators. In which atmospheric oxygen is mixed with contaminated water dumped in the lagoon.

- **Trickling Filter**

In trickling filter, a dense layer of stones, sand, PVC etc. is laid on which contaminated water is poured. In this method the bacteria destroy the organic matter and the waste is filtered naturally through the filtration bed.

- **Activated Sludge Method**

In the activated sludge method, the micro-organisms in the contaminated water are thoroughly mixed and aerated, due to which the micro-organisms grow rapidly in the contaminated water containing organic matter.

- **Anoxic Treatment**

In this process, anaerobic bacteria are used for treatment. In this, 95 percent of the organic matter is converted into bio gas and 5 percent into biomass. This treatment is done in two ways.

- **Sludge Digester**

In this, complex organic matter is decomposed into relatively simple compounds through biochemical action. These reactions are carried out in the presence of oxygen in the presence of anaerobic bacteria. The biogas produced as a result of decomposition can be used as fuel. A large amount of methane gas is produced as a result of decomposition of contaminated water. The remaining sludge is used as manure.

- **Septic Tank**

In which contaminated water is treated by decomposing organic matter by anoxic bacteria. This process results in a significant reduction in the number of BOD and particulate matter in domestic contaminated water.

- **Tertiary Treatment**

Above treatment is a modern wastewater treatment technology for the treatment of industrial and domestic waste water. In which after secondary treatment, the contaminated water is again treated with different methods so that the quality of the contaminated water can be improved.

Through tertiary treatment, the remaining fine suspended particles, micro-organisms, dissolved inorganic substances and organic matter residues are separated.

For this the following procedures are followed:

Coagulation

On mixing alum, ferric chloride, etc., fine suspended particles present in the contaminated water precipitate forming complex compounds with them. Then, It can be separated by filtration.

- **Disinfection**

After secondary treatment, the contaminated water is sterilized through various oxidizers like chlorine, ozone etc. Chlorine dissolves in water to form hypochlorous acid which is a bactericidal. Similarly, ozone is also an effective oxidizer, which oxidizes many complex organic compounds and sterilizes water.

- **Ion Exchange Resin**

The presence of contaminated water in water is used to separate many heavy metals by means of ion exchange resins. Along with this, the hardness of water is also removed through this medium. This method is also used for the separation of colors in contaminated water.

After proper treatment of contaminated water, they can be recycled under the process. It is also possible to be used in plantation etc. as per the requirement

Sewage Water Treatment

The main aim of Sewage water treatment is to remove various forms of contaminants which are to be found from both household and industrial sewage and. The objective of water treatment is to have water which is environment ally safe and pollutant free . The treated water can then be reused for various purposes such as aqua culture, farming, home garden and so forth.

There are three stages of treatment of sewage water:

- **The Primary Stage**

The primary stage involves holding the water in a basin to allow the heavy solids to settle at the bottom.

- **The Secondary Stage**

The secondary stage involves removing dissolved and suspended biological matter. In this stage basically indigenous water borne microorganisms are used in a controlled way to treat the water.

- **The Third Stage**

The third stage consists of physical and chemical disinfectants being used before the water is discharged into rivers, bays, lagoone wetlands and for various irrigation purposes.

The Importance of Waste Water Treatment¹⁷⁻¹⁹

Without waste water treatment, the amount of waste water would cause devastation, as it still does today in developing countries. Globally, over 80% of all wastewater is discharged without treatment, In some developed countries that do have water treatment facilities, they use different types of methods to treat waste water with one common goal, purify water as much as possible and send it back into the environment to keep humans and the Earth safe.

There are several merits that go with industrial waste water treatment. Here are the five major benefits of waste water treatment.

- Provides clean, safe water processed
- Saving money

- Beneficial to the environment
- Saving water
- A way to minimize waste

These are the major five benefits of industrial waste water treatment. One factor to keep in mind is that it's important to make sure you have a high quality system in place.

Waste Water Treatment Protects Human and Ecosystem²⁰

Waste water contains elements toxic to humans and the ecosystem. Wastewater treatment facilities not only help to purify the water but also eliminate situations like what is currently seen in developing countries. Several water-related diseases, including cholera, jaundice, diahrea and schistosomiasis, etc. remain widespread across many developing countries where only a very small fraction of domestic and urban waste water is treated prior to its release into the environment. There is no doubt that waste water treatment also protects the ecosystem.

Aquatic life requires fresh water. When their water environment is fully saturated with waste water, they cannot survive. If chemicals, such as nitrogen and phosphates enter streams, rivers or large bodies of water in excessive amounts, it causes plant growth which release toxins into the water. Due to these toxins fish and other aquatic creatures can no longer exist

Wastewater as a Resource

Depending on the treatment of waste water, it can be rich in resources such as nutrients, inorganic and organic compounds as well as energy, making it worthwhile for recovery and reuse.

Waste water management can therefore be a positive addition to the environment quality with significant returns in terms of enhancing food quality, food security, creating livelihood opportunities climate change adaptation and sustainable ecosystem.

Waste water can also be treated to provide energy. Various forms of energy can be generate from waste water and it's biosolids with biogas being the most prominent. Waste water treatment plants are increasingly generating their own energy, which an important achievement in that countries I because energy consumption is a major cost in treatment countries. It is the transformation of fecal sludge and other organic waste into dry fuel like briquettes.

The well known use of fecal sludge is as fertilizer, especially from septic treatment plants, compared to biosolids recovered from waste water treatment plants. The most common materials, however that are recovered from wastewater are the water itself, which can be used for irrigation and it's crop nutrients and biosolids as fertilizer.

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Present Status of Water Treatment Companies in India

There are various waste-water treatment companies in India, giving the growing demand for the treatment of waste water for several purposes. These companies use the reverse osmosis concept based system to conduct water filtration.

Top 10 Wastewater Treatment companies in India

- Netsol Water:
- WABAG
- Thermax
- Siemen
- Voltas Limited
- UEM
- Wog
- H Dorr
- SFC Environmental Technologies
- Ion Exchange India

Some other important companies are as follows:

- **Aqua Innovative Solution:** One such company which specializes in water treatment in various parts of the country.
- **Jai Sai Marketing or Kajal Technologies:** this was founded in 1999 in Gujarat and since then they specialize in the manufacture of water treatment chemicals and solutions .
- **Hipure India:** They specialize in different forms of water purification systems since 2002 .
- **Crystal Water:** They produce equipment parts and components which are related to water purification technologies.
- **Doctor Water:** They are manufacturer s as well as supplier and exporters of minerals water plants, reverse osmosis system, water softening plants, demineralization plants and so forth .

These are some of the various water treatment companies in India which specializes in different aspects of water treatment technologies.

How to Improve Waste Water Management in India

CEEW (council on energy, environment & water) in association with the 2030 water resources group completed a study on finding viable pathways for improved wastewater management in India . This study highlights a framework of essential factors for decision -making.

Eight factors were identified for making an informed decision:

- Drivers for initiating wastewater management
- Policies and regulations
- Access to technology and finance
- Scale of intervention
- Management strategies and institutional framework
- Public perception
- Phases of deployment
- A framework for participatory approach

These factors need to be seen together focusing on just one factor, which has often been the case in interventions, could lead to failure or underperformance.

Social Perception in Waste Water Treatment²¹⁻²²

Social perception plays an important role in the driver of the success or failure of waste water reuse schemes. Depending on public perceptions impressions and attitudes wastewater scheme can be supported or constrained, Positive public perception leads to greater acceptance of water treatment techniques. While negative public perception can prevent well implementation of waste-water treatment plants and projects.

The degree of water reuse is influenced by many factors depending on the reuse purposes. Such factors are the degree of contact awareness programmes, the degree of water scarcity, expression of disgust, public opinion, risk or availability of alternative water sources , calculated costs and benefits, trust and knowledge, issues of choice, attitudes towards the environment, economic consideration, involvement in decision making, the source of water to be rejected and experience with treated wastewater.

Education and the level of physical contact are the most influential factors that have been frequently associated with levels of acceptance of treated wastewater. Other factors including cultural, religious and socioeconomic factors influence wastewater treatment.

Therefore, it is essential to weigh the different objectives of the recycling options in coordination with people's /user's acceptability and preference and select the recycling projects which are most likely to be accepted by the community and therefore make the project implementation successful.

Gender Roles and Waste Management²³⁻²⁴

Waste generation, as well as management, is affected at the household level due to the concept of gender-specific roles, gendered division of labour, and gendered consumption patterns. In terms of stereotypically gendered duties, women are expected to perform household chores such as the disposal of garbage.

The participation of women in the entire process of waste management is not only a first in India, but it is also considerable study in the world. It is now widely accepted that for successful implementation of development programs related to waste management, it is necessary to incorporate gender perspective in development efforts.

When employed as waste collection labourers, women are reliable workers. Since income opportunities are scarce for illiterate women, they are willing to overcome the barriers of distance.

They are mostly also responsible for the purchasing of household necessities, therefore, making them also the generators and handlers of domestic waste.

Gender Roles and Implications

Successful community participation is better achieved by including gender, age, education level, power wealth and so on.

It is very important to acknowledge the difference of interests and roles between stakeholders. There are numbers of gender aspects which influence how both genders are involved in and benefits from improvements to the water.

In general, women are most vulnerable to water related disasters, including water scarcity and bad water quality. Many women in developing countries face many problems such as maternal and child mortality and sexual violence.

Thus, it becomes a necessity to bring women frequently on the scene for consultation and allow their full participation in waste water management.

Implementation of gender sensitive approach produces more effective and affordable outcomes. Gender based participation in waste management can be improved by applying following facilities to men and women engaged in waste management system.

- By providing better health insurance policies
- By arranging camp for regular health checkup
- Safe work environment for women workers
- By arranging training programs for women for enhancing their technical knowledge
- By supporting that agencies and NGOs which are doing work for them
- By converting this work into formal service by paying regular salary to ensure their safe future and do compulsory having uniform and Id card

Acknowledgement gender roles based approach not only contributes to the success of a project, but also offers planning options to optimise the overall social & economical development and reduces competition & confliction over water resources.

Summary

It is concluded that in developing countries like India, the problems associated with wastewater reuse, arise from lack of it's treatment. The use of **constructed wetlands** is now being recognized as an efficient technology for wastewater treatment. Compared to the conventional treatment systems, constructed wetlands need lesser material and energy, are easily operated, have no sludge disposal problems and can be maintained by untrained personnel. Further these systems have lower construction, maintenance and operation costs as these are driven by natural energies of sun, wind, soil, microorganisms, plants and animals.

By considering all aspects it is concluded that these systems have lower construction, maintenance and operation costs as these are driven by natural energies of sun, wind, soil, microorganisms, plants and animals. Hence, for planned, strategic, safe and sustainable use of wastewaters there seems a need of policy decisions and coherent programs encompassing low-cost decentralized waste water treatment technologies, bio-filters, efficient microbial strains, cultivation of remunerative non-edible crops and modern sewage water application methods.

Rising population, urbanization and industrialization has let to an almost unmanageable wastewater problem in India. The main goal of waste water treatment facilities is to protect humans, creatures and the ecosystem from harmful and toxic elements found in wastewater. By considering all aspects it is concluded that with increasing pressures on water resources, wastewater recycling and reuse have rapidly become an imperative for integrated water management strategies. In wastewater treatment, social factors such as public perception, public acceptance and the dimensions of gender

based involvement have great implications on the success of waste water reuse and recycling. Besides of treatment facilities are expensive, labour intensive, and time consuming, we must find solutions to rising challenges.

Although, treatment facilities are expensive, labour intensive and time consuming but by keeping the necessity of waste water management it is significant to face all challenges to dissolve this problem.

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