

reusing Wastewater to minimize the pollutants And meet global water needs

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Freshwater Scarcity, Pollution, and the Need for Wastewater Reuse

The global freshwater supply is becoming finite and is at risk due to pollution. The inclining demand for water availability for purposes such as industries, agriculture, and urban areas is resulting in competition over the allocation and accessibility of limited and scarce freshwater resources. Most of the water available is either polluted or used making it wastewater. Wastewater is water that has been used. The components of such water are a variety of pollutants, which vary according to how water is used.

However, there are two significant categories of wastewater according to their sources. These are the domestic wastewater. It is also referred to as sanitary wastewater. The primary sources of this type are residential, such as sinks, bathing, toilets, and laundry. Such sewage could contain body wastes with intestinal infection pathogens. The other category is industrial wastewater. Commercial enterprises and manufacturing processes often discharge this. Such sewage may comprise rinse wastewater, including plating metals, residual acids, and toxic chemicals.

It is not ethical to just allow the disposition of wastewater in a way that can endanger human health and lesser life forms or destruction of the natural ecosystems. Through various ways, the earth has remarkable capabilities of healing itself. However, there is a limit to what can be done, and it is necessary to make it an objective to always live within the safe bounds. Discharging untreated or insufficiently discharged water is often associated with health complications and infections in most parts of the world. Such releases are referred to as [water pollution](#) and lead to fish kills, the spread of diseases, and the destruction of other types of aquatic life. Water pollution severely affects all living organisms and can negatively impact water consumption for household needs, drinking, fishing, recreation, commerce, and transportation (Adeyeye, 2014). This, therefore, calls for water treatment.

Treatment Technology and the Removal of Biological and Chemical Contaminants

Treatment of wastewater is done to get rid of contaminants or pollutants. The water treatment process aims to improve and purify the water by removing some or all contaminants likely to be available, thus making it fit for reuse or dischargeable back to the environment. Discharging of

treated water can be done to the surface water such as dams, rivers, seas, oceans, and groundwater beneath the earth's land surface. Through proper wastewater treatment, the overall acceptable water quality is maintained. The primary water treatment plants minimize the organic and suspended solids thus limiting environmental pollution. However, advancements in technology and needs have facilitated the evolution of treatment plants and processes that eliminate dissolved substances and toxic matter. Nowadays, improvements in scientific knowledge, as well as moral awareness, have resulted in a decline in discharges by preventing pollution and recycling, with the noble objective of zero discharge of contaminants and pollutants (Kennedy, n.d.).

Treatment technologies are categorized into physical, biological, and chemical processes. Safe disposal, reuse, or proper handling is done on the residual substances eliminated or obtained in treatment. Clean treatment water is later released into surface water or groundwater. Residuals called biosolids and sludges can be reused through safely controlled land application or composting. In other instances, the residuals are incinerated. For a long time, human beings have dumped wastes and sewage in water sources, thus depending on natural cleaning methods such as dilution and physical bacterial breakdown. Domestic and industrial wastewater increased in volume as the population grew. Some advancements in cities like Boston involved sewage collection in tanks and discharging it to the sea only on the current tide. Barging of sludge out to the ocean was done to avoid complaints (Eliot, 2016).

In the 1970s, in America, most of the treatment was mostly made of removing suspended and floating residuals, purifying biodegradable organics, and eliminating pathogens through disinfection. There was no uniform application of standards throughout the nation. Between 1970 and 1980, environmental and aesthetic issues were taken into consideration. Treatment was advanced with nutrients such as phosphorous and nitrogen being eliminated in many regions. Since 1980, attention to health issues related to toxins has influenced the advancement of new treatment technology. Nations and the federal government established standards on water quality, which were to be met as treatment aims. Both aquatic life parameters and direct human health were considered in developing standards. Water reuse and conservation produce various environmental advantages, as a result of reduced water diversions and decline in the effects of wastewater released on environmental water quality (Stec and Kordana, 2015).

Agricultural Reuse and the Conservation of Limited Water Resources

Many scientists have agreed that recycling water is critical in managing our water resources. It is through water recycling and conservation that the environmental requirements can still achieve sustainable development and a viable economy. Some have further described water recycling as the brightest star in obtaining the water needs. With the water shortages occurring nowadays, it is increasingly challenging to justify the ancient wasteful "use once throwaway" concept traditionally

applied by urban societies (Muston, 2012).

Conservation, reuse, and recycling of water can significantly increase the advantages obtained from limited freshwater supplies. The throwaway case of a “throwaway” city in the “status duo” tends to divert, uses water, and later gets rid of it. There is also a notable improvement in the downstream river flows which has led to a 20% decline in water demand through water efficiency and water conservation in both urban and agricultural uses. The reduction is coupled up with the beneficial reuse of about 90% of the reclaimed water flows for non-potable consumption (Polprasert, 2015).

There is a decline in water quality in rivers due to the high release of contaminants and pollutants. This can be described well in that the quality of water downstream is a function of both the number of pollutants and contaminants being released and the amounts of freshwater being drawn from the river. It has been observed that reusing water minimizes the pollutants being discharged and improves water quality downstream. The correlated enhancements in the downstream quality of water due to the decline in diversions and minimized releases of treated wastewater. This can be done at an indeterminate length of 120km of the river within two large cities (Polprasert, 2015).

Industrial Recycling and the Reduction of Environmental Discharge

Many term recycled water as a valuable source. Rather than discarding it, recycling can be done using adequately treated water. This would be for a second time to lower the demands on a high-quality freshwater resource and enhance the environmental quality of water. Recycling of water also increases the availability of water supplies and facilitates the achievement of a significant human advantage with less freshwater. Therefore, water recycling can substantially meet the global need for water and reduce humanity’s effects on the world’s water environment (Ahuja, n.d.).

The discussion that identifies the advantages in the past years has been focused on the cost and expenses of the implementation of water reuse schemes, but less attention is paid to the gains on the side of the entire equation. There is no proper accounting in the evolution of the merits of a project for both the environmental and indirect benefits. The use of reclaimed water instead of fresh water for the current consumption is capable of freeing up the already non-existent capacity of the water supply system and catering to other new water uses. Through this, there are savings regarding the expenses in the development of new water transfers, water sources, treatment and distributing systems. It can also lead to essential enhancements in the quality of water downstream (Enger and Smith, 2004). The key benefits associated with water recycling plants and the overall water treatment and recycling process include:

- Agricultural advantages include a reduction in diversion expenses, consumption of a safer “droughtproof” provision of reclaimed water, an increase in farm production, and the significance of the recycled water nutrients, which save on the application of fertilizers.

- Advantages in the supply of water in urban areas. These include savings in the capital expenses of diversion facilities, drought storage, water treatment, and transfer systems. There are also savings made in operational and maintenance costs, including treatment chemicals and pumping energy.
- Advantages of urban wastewater. These include the savings made in the discharge pump stations as well as the pipeline and the savings in the removal of nutrients and treatment costs needed for discharge to sensitive waters.
- Environmental water quality-related significance. Examples of these benefits are the reduced diversions of fresh water which results in the increased flow of the river for downstream consumers which is of better quality. Another advantage is the decline in the discharge of pollutants thus improving downstream water quality as well as an improved downstream quality of water, which results in a decrease in the environmental impacts and enhanced river aesthetics. There is also a reduction in the effects on fisheries and other aquatic lives, improved public health for the downstream consumer, and enhanced waterway values in recreation.

Public Health, Regulation, and the Safe Use of Reclaimed Water

There are also economic and sustainability advantages to water treatment and recycling. In many coastal regions in Australia, the expenses incurred in developing new freshwater sources often exceeded the US 0.5 \$/m³ with higher costs in drier inland areas. A substantial amount of work is being carried out in evaluating water recycling projects regarding their sustainability and economics. A recent instance is the Sydney Water Corporation's Water Recycling Strategy, which makes assessments and assessments on the potential water recycling initiatives regarding the leveled annual capital in \$/m³ as well as the impacts of greenhouse gases described in equivalent kWh/m³ uses of energy. Some scholars have attempted to explain the yearly expenses approach (Eslamian, n.d.). The findings of these assessments have a variety of suggestions.

These suggestions include selecting a massive industrial reuse initiative and cities' landscaping plans, which are situated near treatment plans and have higher economic value than dual reticulation private initiatives. Another suggestion is that indirect recycling and reuse through supplementation of the water supplies is likely to be more cost-efficient than the numerous non-portable recycling and reusing options but is likely to have higher greenhouse effects. The decentralization of the treatment and recycling systems could also warrant further examination. Also, there could be a 10 to 20-year opportunity window after implementing the low-cost water conservation steps and plans. This would facilitate the making of informed decisions on implementing advanced water recycling applications and further enhance the technology (Adeyeye, 2014).

Successful water reusing and recycling projects have been implemented in many nations. This step has exhibited the feasibility of reusing water on large scales and its role in sustainable global water

management. Such initiative cases, as well as comprehensive health research studies, have indicated the potential of using water to supplement drinking water sources. Integrated approaches to sewerage, urban streams, and stormwater planning can point out the opportunities that are not apparent when different strategies are formed for each service. The findings are well-integrated, have more appropriate responses, and have significant expense savings for local societies. Water preservation and reuse initiatives are the main elements in integrated city water strategies. Conservation of water and beneficial reusing of water can reduce diversions of freshwater from streams and enhance the downstream quality of water (Khan, n.d.).

Global Water Security and the Future of Circular Water Management

Conclusively, several direct and indirect advantages are achieved from minimized deviations and improved downstream quality of water. These benefits ought to be considered when evaluating the implementation of recent water recycling initiatives. Reusing water raises the available water supply and facilitates significant human desires and requirements, thus reducing human effects on the global water environment. A step from the ancient “apply once and throw away” concept, to the modern appropriate “preserve, use wisely and reuse” water economy will be significant to the whole world. There is still a lot to be done to improve and enhance water recycling technologies and advance project sustainability and economics assessment. While one may view the global water challenge as a significant threat, we have witnessed massive water conservation and recycling progress over the past years. The leading cause of optimism is that, with focused energy, humans can reverse the deterioration of the earth’s water environment thus meeting the global water needs sustainably.

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