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Recycling water - A case study of Sustainable Society in Bhopal

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Abstract: Water is an essential requirement for all living organism. Though 75% of our planet -Earth is composed of water but still today we are having the shortage of water. The research paper aims to conduct a survey of Eco-societies in Bhopal to ascertain what sustainable measures are taken up by them to make the society eco-friendly. A case study of Aakriti Eco City - one of the biggest project of AG8 Ventures Ltd. would be done. It is an integrated township built on the principles of 'Ecological Preservation' having amenities like Club house, Temple, Underground Sewage system, Waste recycling plant and Water recycling plant. Emphasis would be laid in the study of water recycling processes adopted to recycle water from all the households. The method and technology involved in recycling water and the reuse of treated water would be dealt.

Key words: *Township, Sustainable, Recycle water, water waste.*

1. Introduction

Water plays an important role in our daily lives. The water content in human beings vary from 60 -65 % in males to 50-60 %in females. Though 2/3 of earth surface has water but it is not drinkable nor can be used for agriculture purposes due to high salt content (Brar, 2013). The major sources of water are rivers, seas, wells, tube wells and ponds. . In rural areas, people have to travel several kilometers for fetching water for basic day to day needs. This water is utilized primarily for Agriculture, Industry and domestic purposes. In Industry, water is used for dyeing and bleaching. In household, water is used for drinking, cooking, washing-clothes and utensils and bathing. Water is the main component for agriculture. At every stage, from the sowing of the seed till it grows into full crop water has to be fed to the fields at regular intervals.

From both industry and households, lot of water is flushed through drains and sewage into the open which percolates to the various levels affecting the underground water layer, causing water and soil pollution. The water waste released by dyeing houses consists of harmful chemicals and releases obnoxious gases on being released to the atmosphere. This, also if not treated released in open through drains /channels would cause harmful skin diseases and affect underground water. As per Government regulation, Industries are now developing water treatment plants to treat this industrial water waste to levels which is hygienic and does not have harmful effect on human before releasing it. Brar(2013) states that to meet the scarcity of water, recycling household water waste after treatment and using for specific purposes like flushing toilets and gardening is one of the solution . If the process of regeneration of environment is superceded by the generation of waste then there is environmental degradation.(Scortar , Lazar and Suci, 2007)

Bhopal, the capital of Madhya Pradesh, a land locked state situated in Central India. Bhopal is also called the "City of Lakes" .It is a beautiful city with lot of greenery and plantation all around. There are two lakes which makes the city landscape and climate pleasant. The city got its name 'Bhopal ' after the name of its founder, Raja Bhoj in 11th century. The city also adorned by old palaces and the largest mosque of Asia.

Big Real estate companies investing like Fortune Group, Paras Midas ,Fortune Tulip Heights, Fortune Landmark ,Opel Regency, Opel Orris, IBD The Glory Citi, Soumya Estates, C I Heights, Chinarr Sapphire are some of the big real estate companies which are hitting the city.

AG8 Ventures Ltd. , earlier known as Aakriti Dwellings Pvt. Ltd deals in Real Estate, Sugar Mills, Schools, Spas, etc. The group was created 18 years ago with a modest beginning of small projects. Now a major player in real estate and among one of the largest real estate companies in Madhya Pradesh.AG8 group has undertaken numerous projects in the city- *Aakriti Eco- City*, *Aster* ,*Aakriti The Nest* ,*Aakriti Greens* , *Aakriti Neev* , *Aakriti Retreat* ,*Aakriti Exotica* ,*Aakriti Aqua City* and *Aakriti Highlands* to name a few. . 'Aakriti Foundation for Environment' works for the protection of environment in tandem with the Government Institutions, NGOs and activist to promote Eco Friendly Green movement.

2. Review of Literature

In order to understand the work done by earlier researchers, both National and International work in this area have been studied.

Viradya (2014) in his research states that by 2030 ,60% of the world population will live in urban areas creating concern for fresh water supplies ,sewage disposal and living conditions. Finding dumping ground for disposing the solid waste has created problem for health and air pollution upto the distance of one kilometer away.

Thanooja (2010) in her research aims to educate women to manage waste through vermicomposting technology. Agarwal (1999) as cited , states that population explosion has led to increased concern for pollution created by sewage, solid waste generation, usage of fertilizers, insecticides and fuel burning. Viswanathan (2005) study (cited in Thanooja (2010) states that developed countries have developed waste management techniques which aim at reducing waste and recycling.

Gajalakshmi.S. (2002) in her research states that municipal solid waste in developing countries have higher percentage of organic matter , ash and moisture content.

Brar (2013) states that by 2030 the population living in cities will outnumber those living in rural areas. It has been found that there is a water deficit of 1.25m ham of water annually which is being sourced by exploiting underground water as a result of which the water table is depleting at the rate of 66cm per annum in Punjab.

Salmi and Tuomala (2007) states that green business is dependent on European Union and national legislation. In 2004 , the Finland government passed a legislation 'onsite wastewater system decree', to reduce the environmental pollution caused by domestic wastewater by 2017 .Green business play a significant role in implementing the legislation and their growth reflect the adoption of the legislation and technology.

Scortar, Lazar and Suciu (2007)states that each country faces the problem of generation of large volume of waste which requires to be managed by appropriate technology to reduce its impact on environment.

Colon and Fawcett (2006) in his research concludes that community based efforts towards sustainable waste management can play a significant role with the support of local resources and administration. A triangular system involving the local residents, NGO's and municipality is a more successful concept.

Oppili, P. (2013) in his article states that his fully automated sewage treatment plant comprises of only two tanks for the family size of six and which requires an area less than that of the septic tank. The cost is around 1 lakh and electricity consumed is 40w bulb.

3. Objectives of Study

- To do the case study of the Aakriti Eco city society in Bhopal.
- To understand the process of water recycling in the society.
- To do the survey on the satisfaction level of residents on the quality and availability of recycled water.

4. Research Methodology

4.1 Primary Data: The society would be visited to collect the details about the society and also the water treatment plant would be visited to understand the process utilized for recycling of water in the plant set up and visual would be taken.

Unstructured interview would be conducted with the residents of the society to know about the satisfaction level of water availability and quality of recycled water.

4.2 Secondary Data: To know the traditional method of water recycling books, journals would be referred.

5. Case study of Aakriti Eco-City

Aakriti Eco- City is one of the largest projects built on the concept of 'Ecological Preservation'. It is an integrated township and has numerous housing concepts within its premises .They are a mix of Duplexes -Flamingo, Seagull, Villa -GOLD Villa, Meridian - the bigger pent house flats and " *The Blue Sky*" are the High Rise Apartments of 6 storeys each. There is also the Aakriti Business Centre for commercial office and supermarket. In 'The Blue Sky Apartments' there are 11 such buildings built at convenient distance to each other. There are numerous facilities like Club House with Swimming pool and gymnasium, Temple, Recreation Park, Water recycling Plant, Organic waste recycle unit and lots of Plantation done all around the campus. It is declared a 'No Smoking Zone'. Each flat is provided with two water tanks on the terrace. In one fresh water supply comes from Bhopal Municipal Corporation which is used for Kitchen purposes and bathing and in the other the recycled water is stored for being used in the Toilets tap and Flush tanks.

5.1 Chemical Composition of Domestic Water Waste

The increased volume of household waste generation is a result of rapid urbanization and growing level of standard of living. The policies of household waste management across the globe aim at reducing waste generation, waste recycle and safe storage (Scortar, Lazar and Suciu, 2007).

Domestic water discharges can be categorized as:

- i) Bathrooms & Clothes washing water
- ii) Utensil washing water

The waste water generated from bathroom and clothes washing, contains chemicals as the soaps and detergents which gets dissolved in water. The water waste generated from washing utensils primarily comprises of organic waste and some soap content.

Detergents and soaps have chemical composition. The soaps are hydrocarbon chains with ionic bond of sodium (Na) or potassium (K) attached with carboxylic acid -COOH group. This ionic bond-salt of carboxylic group dissociates in water and makes it soluble. The hydrocarbon end is non-polar which is soluble in non-polar substances like fats and oils. Detergents are also hydrocarbon chains like soaps but they differ in their water soluble part. There are three different types of water soluble groups which are attached to the detergents. They are Sodium Alkyl Benzene Sulphate, Sodium Alkyl Sulphate or a glycerol. When soap or detergent is added to water, these polar groups form clusters known as 'Micelles', with the polar groups forming the outside of the cluster and center with non-polar ends. When a detergent or soap is added to water that contains oil or other insoluble material, then the detergent or soap molecule surrounds the oil droplets. This oil or grease is dissolved in the alkyl group of soap or detergent and the ionic end causes the micelle to dissolve in water.

6. Recycling Process of Household Wastewater

In Aakriti Ecocity all the drains from each household are interconnected to the main drain into which all the household waste water collects and is channeled to the water treatment plant (Figure 1). The water treatment plant has various sections from which the water flows from one chamber to the other clearing different types of impurities

simultaneously. The various stages of treatment are as follows:



Figure.1 STP Plant-Outer View

i. Pretreatment

The water flowing from the Bathrooms, kitchen sinks and washes basin flow down the drain from all the houses/flats and collects in a bigger underground drain and then flow into the screening chamber through the bar screen where the waste water is cleared of polythenes, cotton bud, wipes, broken bottles and rags (Figure 2) that might block or damage the equipment in further processing.



Figure.2 Screening Chamber

ii. Primary Treatment

The sewage then flows into the horizontal tank where by centrifuge, the sedimentation occurs and sludge settles to the bottom and the grease and oil rise to the surface which are skimmed off (Figure 3). There is further screening to eliminate the polythene, pieces of glass if left. The water is then moved for secondary treatment.



Figure.3 Primary sedimentation tank

iii. Secondary Treatment

To degrade the biological content of sewage from food waste, soaps and detergents, the water is put in large aeration lanes through which air is pumped to promote the breakdown of the sludge in tiny bits by bacteria (Fig.4) carried out by Fluidized Aerobic Bioreactor (FAB).

BOD is the amount of oxygen required per liter of wastewater to decompose the organic pollutants by bacteria.



Figure . 4 Bacterial actions on sludge

Then in the Flocculation, water is treated with Poly Aluminum Chloride and with Poly electrolyte (Figure 5) which causes the formation of solute, and partially cleaned water is moved to the tube settler tank.



Figure . 5 Poly Aluminum Chloride and Polyelectrolyte tank

Then this treated water is passed through trickling filter which is a bed coarse stone over which the waste water is sprayed.



Figure. 6 Flocculation and tube settler tank

iv. Tertiary Treatment

Now the almost treated water is passed through the settlement tank where the sludge formed due to bacterial action settles down .The sludge is scrapped, collected and discharged out to near stream. The water is treated with chlorine and hypochlorite to remove smell as in Figure 6.

v. Filtration

Water after flocculation and passing through the tube settler is having small granular particles and color of the water is yellow. Subsequently, water is passed through three filter chambers as seen in Figure 7:

Dual Media filter chamber: Water is then passed through Dual Media filter chamber which removes the small sand like particles.

#Activated carbon filter chamber: The yellowish color of water is changed to clear white in this process.

Softener chamber: Finally the water passes through the softener chamber to remove the hardness of water.



Figure. 7 Dual Media, Activated Carbon and Softener chambers

The water now almost free of harmful substances is stored in large Feeder tanks -Figure 8



Figure.8 Feeder tanks

The water which cannot be purified is again sent back to the collection chamber for recycling again as in Figure 9.



Figure.9 Unpurified water drained back

The treated water is then recycled back to the residents in separate tanks for toilets usage. This recycled water is also used for watering and maintaining greenery in the society.

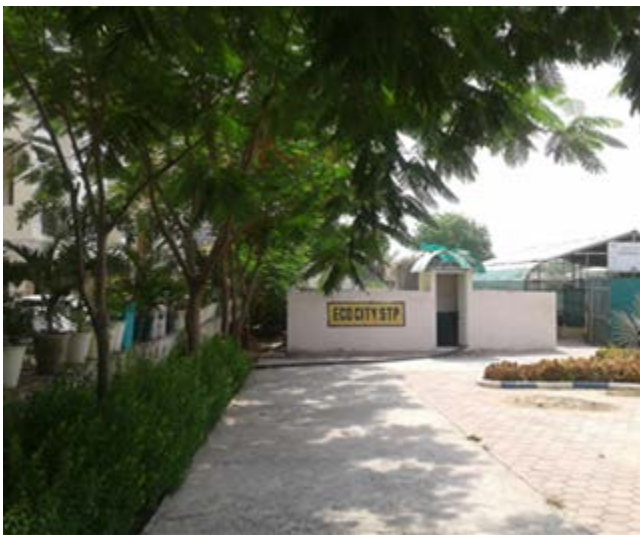


Figure.10 STP plant

7. Conclusions

From the study it is clear that as there is shortage of water and the acute shortage is expected to deepen by 2025. Thereby, if recycling of water is also taken care at domestic level then we would be able to save water and also decrease the volume of polluted water being released to the drains thereby controlling pollution of soil and water levels below earth layers and save from various diseases .

The residents of Aakriti Ecocity were interviewed with respect to quality and quantity of recycled water available for use. Around 50 residents were interviewed it was found that the recycled water does not have 'visible impurities' and the quantity supplied is

sufficient for each household. This recycled water is also used for watering the garden and plants which are maintained in the society. By this process large volume of freshwater is saved and even the disposing of waste water to nearby stream and soil is avoided.

By using recycled water even for toilet flush and for gardening purposes we are able to reduce the volume of water consumed and also control the volume of infected water being released to the soil and land thereby promote sustainable community effort . Today, people are becoming quite aware of environmental problem and if effort like this is made in each society which does not require very large space and investment to set up the unit, the degradation of the environment could be controlled and the scarcity of water would be reduced. Therefore, real estate developers should take up this initiative while undertaking residential projects so that we are able to conserve water for the future and live in a healthy future.

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