Save Water – Solution by Reuse

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Abstract

It is stated that the water crisis in the world is so severe, that there will be war for water rather than a land in future. Communities across the world face water supply challenges due to increasing demand, draught, depletion, contamination of groundwater and dependence on single sources of supply. India is going to face per capita decline from 1730 to 1240 cubic meter.(Report, June 2010). By 2030, India will face depletion of almost 275 billion cubic meters (BCM) of annual renewable water. The appropriate 'BALANCING ACT' would be 'RECYCLE and REUSE' of wastewater. This will bring water back for use rather than disposing it considering as a 'waste'. Here one case study of Atladra Sewage Treatment Plant is presented which shows how waste water can be reused for industrial purpose. We can save fresh water source by reusing the domestic waste water.

Keywords: **waste water, reuse, domestic**

INTRODUCTION

The major pathways of water reuse include irrigation, industrial use, surface water replenishment and ground water recharge. The quantity of water transferred through each pathway depends on the watershed characteristics, climatic and geohydrology factors, the degree of water utilization for various purposes, the degree of direct and indirect water reuse. Water reuse loop should be depending on public health criteria, Engineering, economics, aesthetics and more importantly public acceptance. Considering the complexity of waste water reuse projects following aspects are to be taken care for successful implementation of project for reuse of waste water.

WATER CONFLICT

On the international front, India has clearly demarcated water rights with Pakistan through the Indus Waters Treaty [1].It is stated that next generation may see water in bottles only. Little work was done before the mid-1990s for the economics of reuse of wastewater in irrigation. [2]Analysis of the optimal treatment of municipal wastewater before its reuse for irrigation purpose was provided. [3] A nationwide cost and benefit analysis is done. They determined monthly optimal treatment levels and of the mix of crops calculated to maximize agricultural incomes, according to farmers' point of view. Among the literature on IWRM the conceptual approaches to wastewater management with focus on the reuse of wastewater are represented by Harremoes (1997), Huibers and van Lier (2005), Nhapi, Siebel and Gijzen (2005), van Lier and Huibers (2007), Neubert (2009) and Guest et al. (2009).

Wastewater Treatment And Reuse

To ensure sustainable and successful wastewater reuse applications, the following requirements must be fulfilled:

- The potential public health risk associated with reuse of wastewater are evaluated and minimized
- The specific water reuse applications meet the water quality objectives
- In order to meet the requirements, it is necessary to treat the wastewater prior to reuse applications
- Ensure an appropriate level of disinfection to control pathogens

Domestic waste water

The domestic sewage treatment plant is selected based on grab sampling. The characteristics of last 9 years are studied and the stepwise experimental work and treat ability studies are stated in experimental work. The Domestic effluent treatment plant is located nearby Atladra. Water reuse applications result in exposing the public reclaimed wastewater, thus assurance of microbiological and particularly, virological safety is of up most importance. The principal treatment processes and operations for reuse in these situations are similar to surface water treatment for potable water supply; both normally include chemical coagulation, sedimentation, filtration and disinfection. The high degree of pathogen removal achieved by a properly operated treatment system ensures the safety of the reclaimed wastewater.

Table 1: Comparison Of The Values Of Various Parameters (min, max and average values) With Standards

Parameter	**Avg. Value**	Drinking Water Standards	Cooling Water Standards	Irrigation Standards	Remark
PH	8.58	6.5-8.5	9.8-7.0	5.5-9	within limit
DO	4.48	NS	NS	NS	Out of limit
BOD	55	NS	NS	NS	within limit
COD	97	NS	NS	NS	within limit
TDS	1230	500	NS	NS	Out of limit
TURBIDITY	18 NTU	5 NTU	5 NTU	5 NTU	Out of limit
MPN	>1600	<2	<2	<2	Out of limit
TBC	24705	1/100 ML	1/100 ML	1/100 ML	Out of limit

Looking to quality of waste water of secondary outlet, it is confirmed that with some treatment it can be reused for industrial purpose for industries in downstream area. The sequence of treatment tried is as under.

1. **Coagulation, Flocculation and Sedimentation**
2. In addition to fine suspended matter, wastewater also contains electrically charged colloidal matters, which are continuously in motion and never settle down under the force of gravity because of stability forces like electrical double layer, charge intensity and water of hydration. To find out the optimum dose of coagulant, jar test was done.
3. **Filtration**
4. Filtration of wastewater is most commonly used for the removal of residual floc and colloidal matter in settled effluent. Filtration is also used to remove residual precipitates from the metal salt or lime precipitation of phosphate and is used as a pretreatment operation before wastewater is discharged to activated carbon induced applications. The filter column used for treatment is of following specifications:
5. **Depth of sand bed** - The depth of sand bed should be between 600-900 mm. for organic matters and bacteria to pass through the filter. Here 1.18-1.7 mm fine sand and 1.7-2.36 mm course sand is used.
6. **Gravel for filter** - Sand bed is supported on the gravel bed. Gravel bed has several functions. It supports the sand and allows the filtered water to move freely to under –drain. It allows wash water to move upward uniformly on sand. The gravel is placed in 4-5 layers having finest at top. Here 2.36 –3.25 mm gravel size is used.
7. **The procedure adopted for the treatment of wastewater filtration is as follows**

- Determination of the optimum coagulant dose at optimum P^H
- Application of the optimum coagulant dose to about 5 lit of sample and collection of the supernatant
- Washing the filter column with distilled water and then with the sample.

- Passing the sample and adjusting the flow rate at 10 ml/min.

Passing the supernatant collected after coagulation and flocculation through the filter, determine MPN and the turbidity of the effluent as well as influent.

- Specifications of the Filter column:
- **Rate of Filtration = 10 ml/min**

Rate of Filtration	**= 10 ml/min**
Length of base	= 955.5 mm
Length of bed	= 500 mm
Diameter	= 48 mm
Gravel size	= 2.36 – 3.25 mm
Coarse sand size	= 1.7 – 2.36 mm
Fine sand size	= 1.18 –1.7 mm
Area of filtration	= 1808 mm^2

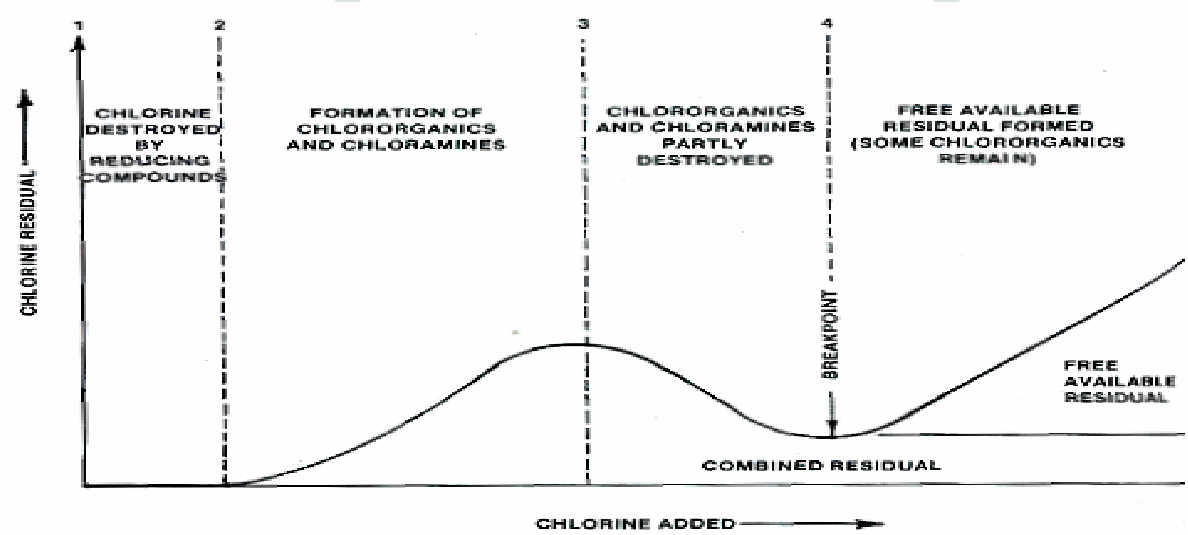

***Fig. 1:** Theory Of Break Point Chlorination*

Ion Exchange: First passing of water through a bed of cation exchange can carry out removal of minerals present in the water resins bed, then through a bed of anion exchange resins. For treatment at lab scale the cation and anion exchange columns have been used.

8. Chlorination: Chlorination is commonly added to wastewater treatment plant effluent; it reacts with ammonia to be predominantly mono chloramines and dichloramine. Chlorination was carried out both directly on the sample and after filtration to find the dose of chlorine to be applied. The sample was treated to find out the breakpoint chlorination and the residual chlorine at different concentrations. MPN as well as total bacterial count before and after chlorination was determined. Here NaOCl of 6 % purity is used for treatment.

9. After experimental study all parameters are within range for reuse standards and there were two options suggested for reuse of domestic waste water.

- Use from plant installed in domestic treatment plant itself.
- Laying of pipeline and carry waste water to industry and treat according to their requirement.

Laying of pipeline

Laying of pipeline will also involve substantial capital investment but the operation is much simpler and costs incurred are much lower. From the Survey Of India Map of the surrounding areas nearby the industry and the treatment plant site the distance and area across which pipeline is to be laid was identified to be about 1.5 Kms. A study was also undertaken for transportation of the waters by means of pumping main / gravity main. Looking to the terrain of the area, it was found that the treatment plant is at an elevated level than the industry. Hence it is possible to transport the effluent under gravity. Some land would have to be acquired for laying of the pipeline and as the pipeline runs from a locality area, necessary permissions are required to be taken for acquiring of land and the laying of the pipeline. Various pipeline materials were also studied for cost benefit analysis and the optimization of the head loss arrangements during transportation. The design features and the cost benefit analysis using various pipe materials is discussed below.

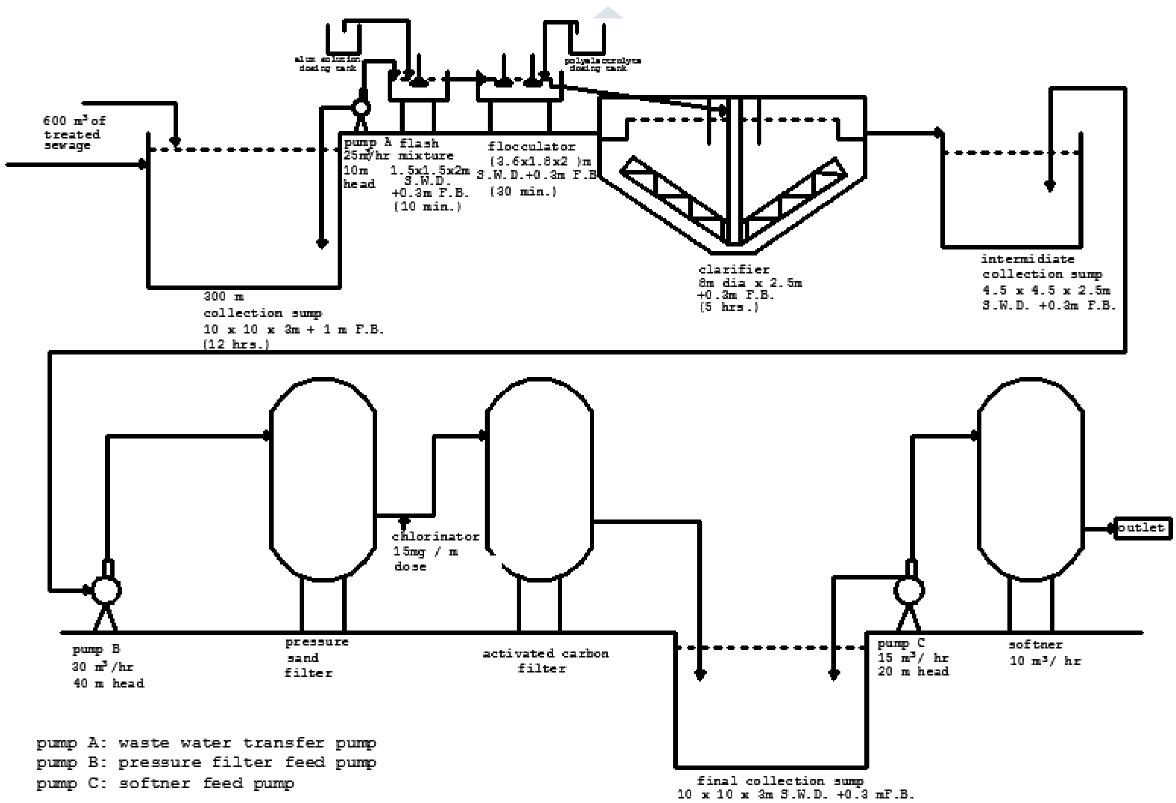

Figure 1.1 *Fig. 2: Proposed flow diagram*

Coagulation Flocculation Sedimentation Sand Filtration Chlorination Activated carbon filters Softening using Ion exchange.

The above mentioned treatment is best suited and recommended as tech-no economical solution. If cost analysis is done, it can be stated that within three years basic cost will be recovered but this plant will be permanent solution for u=industry to get water.

Also for Vadodara municipal corporation this is going to be a major step towards saving fresh water sources.

CONCLUSIONS

The analysis of treated effluent from the Atladra New sewage Treatment Plant was carried out and various treatments were carried out in the laboratory with reference to the reuse possibilities for the industries on the downstream of the plant.

- Three treatment sequences are tried to get the results within desirable limit. Industries can directly take water and treat in their own premises or a treatment plant can be installed at the domestic sewage plant premises and treated water can be transferred to industrial area by piping network.
- After coagulation, sedimentation and filtration the disinfection was carried out, as a first option of tertiary treatment (disinfection), with 15 mg/lit dose of 6 % pure NaOCl which reduces MPN <2 and total bacterial count about nil. Disinfection by chlorination after removal of hardness by ion exchange was also carried out which gives the results as MPN <2 and total bacterial count about nil.
- From three treatment trains, the first option of primary, secondary and tertiary treatment, 'coagulation – flocculation – sedimentation – filtration – chlorination –softening-activated carbon filter' is found as techno economical solution. It is also analyzed that if the treatment plant for reuse of domestic wastewater is constructed for industrial reuse purpose, within a one year time period the cost can be recovered.
- Instead of whole treatment sequence as shown, after filtration, wastewater can be reused for boiler feed purpose. For this purpose, hardness required is < 50 mg/lit and ion exchange treatment gives the hardness below 20 mg/lit. The hardness removal by lime treatment also reduces the hardness by about 50 %.

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