WATER RECYCLING POSSIBILITIES IN URBAN AUTOMOBILE SECTOR

PROF. R.K.KHITOLIYA*, AMAN KUMAR GOYAL**, DHRUV KUMAR** AND DINESH CHANDRA***

Abstract

Water is no more considered as an entity free for all .With rapid urbanization and economic growth the water demand in the cities of the developing world has tremendously increased. Most of the water supplying agencies are striving hard to meet the quantity required. A considerable quantity (approx.2%) is consumed in the automobile washing sector which has remained hidden so far. Rising living standards results in more vehicles and thus more vehicular water consumption. Citing the less stringent quality requirement, water in this sector can be viably and cheaply recycled.

The present paper explores the possibilities of recycling of vehicular washing water in and around Chandigarh city. It has one of the highest vehicle/person density in India making it ideal for such study. The paper examines the advantages of a locally improvised small water recycling plant over large scale alternative. It analyses the commercial viability of such an arrangement considering various effecting parameters e.g. quality, quantity, vehicular specifications and type of washing required. By adopting mentioned technique water demand of nearly 15000 people can be met in Chandigarh on daily basis.

INTRODUCTION

In the present scenario water shortage is being faced by most of the urban inhabitations In India's context situation was not very grave some decades back but rapid economic and population growth has made the task difficult for water supplying agencies . A considerable amount of water supplied by these agencies is consumed in automobile washing and maintenance. The present paper analyses the amount of water being consumed in this sector in Chandigarh and adjoining areas. This water can be treated and recycled economically by utilizing locally available resources. It mentions the steps which have been taken by some parties in this direction in Chandigarh city. Thus it lays emphasis on water recycling and justifies the identification of hidden sectors in the urban areas where water is used in large quantities and then disposed off as sewage.

WATER CONSUMPTION IN AUTOMOBILE SECTOR

Chandigarh has one of the highest vehicle/person ratios in the India. A large number of service and washing stations cater to their maintenance. Following facts have been revealed about them

- In each facility normally one hydraulic lift is used. Some of them also have a second line with a metallic ramp used.
- The ramp is used only when washing load increases (more than two cars in queue)
- Washing is done with a .5" pressurized water jet (pressure of 2Kg/cm^2).
- Irrespective of type of vehicle (car or Jeep), it takes 20-25 minutes to wash an almost clean vehicle (200-250litres/vehicle) , 35-40 minutes for a dirty vehicle (350-400 litres/vehicle) and 55-60 minutes on a very

* *Prof. & Head Post Graduate Environmental Engg.** Students, PEC Chandigarh ***Hari Krishna Plastics, Delhi.*

Table 1: Diseases Related to Poor Water Supply and Sanitation

Type	Spread by	Examples	Prevalence
Water borne	Drinking water contaminated by pathogens, or washing hands, food, or utensils in contaminated water.	Cholera, typhoid, dysentery, diarrhoea, infectious hepatitis, giardiasis, guinea worm disease.	6 million children under the age of five die from diarrhoea annually; 10-12 million children die each year from all types of diarrhoeal diseases. There are 10 to 48 million annual guinea worm cases.
Water contact	Invertebrate living in water which act as carriers.	Schistomiasis (bilharzias), leptospirosis, tularemia.	Over 200 million people infected worldwide with Schistomiasis.
Water hygiene.	Inadequate supplies of water for personal hygiene.	Skin diseases; scabies, leprosy, yaws. Eye diseases; trachoma, conjunctivitis,	500 million affected with trachoma (blindness occurs in severe cases), prevalence of skin diseases approaches 80% of population in some areas.

The importance of water treatment is to produce and maintain water that is hygienically safe, aesthetically attractive and palatable, in an economical manner. Though the treatment of water would achieve the desired quality, the evaluation of its quality should not be confined to the end of treatment facilities but should be extended to the point of consumer use. The treatment of water intended for human consumption is a very old practice. Baker reports references in Sanskrit literature dating back to 2000B.C. to such practices as the boiling and filtering of drinking water (Peavy, chapter 4). The present world has come a long way from those times! A lot of progress has been made in this field especially since the technological boom in the last century. The need for more healthy water, reduced water losses and lesser power consumption are the targets to be achieved.

WATER SUPPLY SCENARIO IN URBAN INDIA

Water forms the lifeline of any society. It plays a critical role in any country's welfare with pervasive linkages to most aspects of its economic development. Water supply and sanitation are basic needs in urban areas to ensure the health of its residents. In India, in spite of substantial emphasis on the water supply sector, as of 1991, only about 82% of the urban households covering 85% of the urban population had access to safe drinking water. Against this overall coverage, estimates also indicate that in 1988-89 about 58% of the urban households had access to drinking water facilities within their premises and about 40% within a distance of 0.5 kms. Even the above statistics do not reflect the true conditions as there are substantial distributional inequalities between the states, between the cities within the states and between the different areas within each settlement. Against the national average consumption of 140 lpcd of water, the per- capita consumption is too low and ranges from 165 lpcd in few larger towns to about 50 lpcd in most small towns. The availability of water in the urban slums is around 27 lpcd (Country presentation, 1998).

POTABLE WATER SCENARIO IN DELHI

There has been a significant rise in the demand for water due to the continuous increase in urbanization and population growth in Delhi.

Delhi's requirement for drinking water is about 1000MGPD, for which 7 functional water treatment plants (WTP) are being run here by Delhi Jal Board (DJB) catering to the needs of about 10 million people. In spite, of this only 650MGPD of potable water is available for consumption, thus causing a short fall of about 350MGPD. Thus scarcity of drinking water is a major concern of Delhi Government. During the summer period, the problem accelerates and hits the peak.

But a ray of hope of finding a solution to this problem has come in the way of availability of a new source and construction of a new WTP. DJB has recently completed the construction of a 140 MGD (635 MLD) WTP at Sonia Vihar in East Delhi. Water for this WTP has to be drawn from the upper Ganga Canal (near Murad Nagar, UP) through a 3250 mm diameter RCC conduit. When the water from upper Ganga Canal shall not be available during the annual maintenance works of canal for an approximate period of a month, water shall be drawn from Yamuna River by providing an intake arrangement on the left bank near the present Raw Water Pumping Station for Gokulpuri.

By way of this WTP, DJB has brought a revolutionizing water treatment practice to North India. For this purpose it had awarded contract for the construction of a 140 MGD WTP on Design, Build Operate basis to Degremont Ltd. for a period of 10 years.

140 MGD SONIA VIHAR WTP

The Sonia Vihar water treatment plant is going to be one of its kinds, in the northern region of the country, due to the following unique features it has:-

- Optimal land usage.
- High quality treatment of water.
- Replacement of conventional clarifier with Pulsator ®.
- Aquazur ®- V filters- a modified version of rapid gravity sand filter.
- Provision of sludge treatment units.

Sonia Vihar WTP has a compact layout due to which there is optimal usage of land. There has been land saving to the extent of about 50-60% of the land required for conventional design. Due to the scarcity of land in urban areas optimization of land usage is highly needed.

The treated water is going to have exceptionally high quality conforming to the standards laid down by Central Public Health and Environmental engineering Organization (CPHEEO). Some of the quality parameters of treated water are expected as follows:

- Turbidity < 0.4 NTU
- Residual Aluminum < 0.1 Mg/l
- pH - 7.0 to 8.0
- Color < 5 Pt/ Co Scale
- Taste and Odour : Unobjectionable

Pulsator® is a pulsed sludge blanket clarifier. It has been designed to make it a space- saving and high rate solids contact clarifier. Pulsator combines flocculation and clarification functions in one basin for optimal use of space. Vacuum-generated flow pulsations create a homogeneous sludge blanket that results in excellent effluent quality at minimal operating costs.

Pulsator has demonstrated superior performance with problem of surface waters and water with low levels of suspended solids. Ideal for removing color, turbidity and organic material. Pulsator is fully capable of handling variations in influent flow and raw water quality.

Pulsator is proven- delivering improved efficiency and lower costs in hundreds of operating installations.

- Combines flocculation and clarification in a single basin for compact footprint, lower construction costs.
- No submerged moving parts; all underwater components are corrosion-resistant for minimal maintenance.
- The unit has no mechanical sludge mixing system that would break up the floc particles already formed. Given the high concentration of the sludge blanket, and its

role as a barrier, variation in the raw water quality and quantity will have no negative effects; a slow variation in the turbidity of the settled water is observed, but this does not produce any massive loss of the sludge in clarifier.

- One major advantage of the unit is that too much sludge is drawn off, the resulting water loss does not affect the sludge blanket; operational integrity remains the same.
- Very low energy consumption compared to other clarification process.
- Fully automated, requiring little operator attention.

General working of the Pulsator

The Pulsator as shown in Fig. 1 comprises of a flat bottom tank, with a series of perforated pipes at the base, through which the raw water is injected to ensure even distribution over the entire floor of the Pulsator. A series of perforated pipes or troughs at the top of the tank allow uniform collection of the settled water, avoiding flow variation from one unit component to another.

Different methods may be used to feed the distribution system intermittently. They all involve storing a certain volume of raw water for certain amount of time, then discharging it instantaneously into the unit.

The most economical means of achieving this is to take the raw water into a chamber from which air is sucked by means of a vacuum device displacing an air flow that is approximately equal to half of the maximum flow rate of the water to be treated. The chamber is connected to the distribution system at the base of the Pulsator.

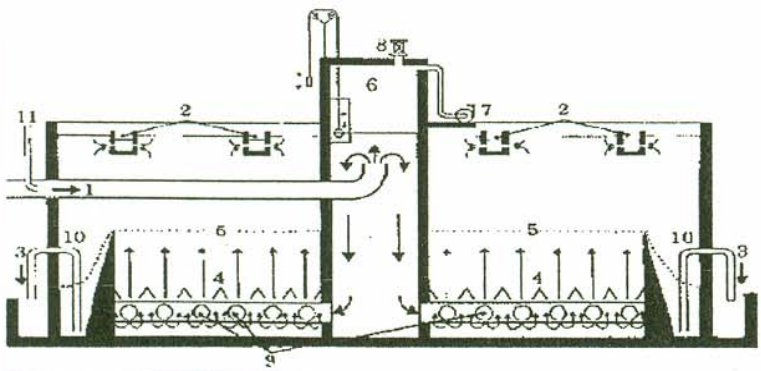
During the filling phase, the raw water level rises gradually in the chamber. When it rises 0.6m to 1m above the clarifier water level, an electric relay actuates a valve that is thrown open to connect the chamber with the atmosphere. Atmospheric pressure is therefore immediately exerted on the water stored in the chamber, which rushes into the clarifier.

These units are usually calibrated so that the chamber drains into the clarifier in 5 to 20 seconds, whereas it takes 20 to 40 seconds to fill.

The suction in the chamber is created using a fan or blower operating as a vacuum pump. The opening and closing of the air release valve are controlled by the chamber water level. The main distribution system, located in the lower portion of the clarifier, has a large cross- section to reduce head loss.

The orifices along the laterals are positioned to permit a homogeneous sludge blanket to form in the lower part of the Pulsator. The blanket pulses up (fig.2) and down (fig.3) and tends to expand due to the added reagents and the impurities borne by the raw water, its level rises regularly. The excess sludge flows into hoppers provided in one section of the Pulsator and becomes concentrated there.

Fig. 1: Pulsator



1. Raw water intel.
2. Clarified water outlet.
3. Sludge removal.
4. Stilling baffles.
5. Upper level of sludge blanket.
6. Vacuum chamber.
7. vacuum pump.
8. Air release value.
9. Raw water distribution system.
10. Studge concentrators.
11. Reagent feed.

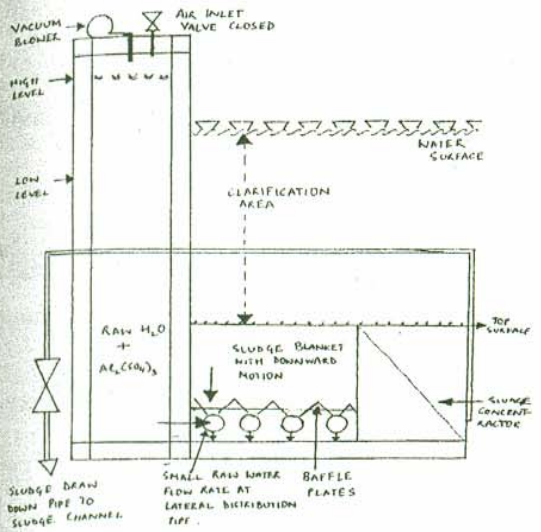


Fig.2: Pulsator during lifting phase

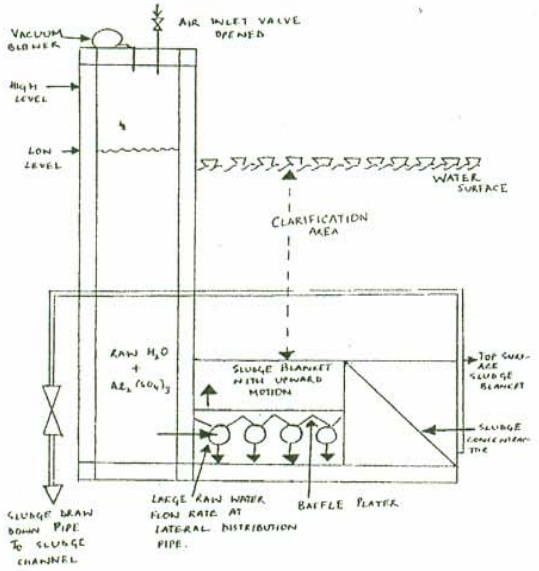


Fig.3: Pulsator during dropping phase

Aquazur®-V Filters are rapid gravity sand filters, which combine excellent treated water quality with operational flexibility and low operating costs and very high filtration rate thus resulting in small surface areas. The combined air scour and water backwash, which operates without expanding the filter media, helps to reduce water losses by almost 40% compared to conventional filters and eliminates the power costs associated with these water losses. Operating the backwash at this constant head also keeps sand losses to a minimum and prevents overloading the remaining operating filters.

The Aquazur- V - filter is made up of a rectangular concrete tank, fitted with a floor into which long- stemmed, fine slotted nozzles are screwed, covered by a bed of uniform size sand.

The basic characteristics of the Aquazur- V filter are as follows:-

- Deep filter bed of uniform grain size.
- A great water depth ensuring a positive pressure throughout the whole filter, thus preventing the escaping of gas from the filter bed.
- Back washing simultaneously by air and water accompanied by surface sweep using filtered water admitted through holes in the base of the supply trough, surface sweep is designed to drain any impurities, ensuring that there is no point with a zero horizontal velocity where impurities that have been detached might resettle.

Another unique feature of the Sonia Vihar plant is the provision of sludge treatment on the site itself. Minimal wastage of water (the total water losses in the plant shall be less than 1.5% of average over the year as compared to conventional plant where it is more than 8%). The sludge treatment facility has been provided solely for the purpose of saving water and for drastically reducing water losses.

Polyelectrolyte dosing is to be carried out in two stages. First stage of dosing is after sludge sump. And the second stage is after thickeners. The sludge which is going to be obtained at the end of the sludge treatment process will be dried and used for landscaping at the plant site itself. Thus the problem of sludge disposal is eliminated for years to come.

CONCLUSIONS

The Sonia Vihar water treatment plant is one of the most ambitious projects undertaken by DJB and shall provide a solution to one of the gravest problem faced by Delhi today. Some of the advantages it has over the other conventional WTP are:

- Minimized use of chemicals in the plant,
- Ease of operation and maintenance and
- Operational flexibility to optimize performance during the seasonal raw water quality variations.
- Provision of a Pulsator®, Aquazur® V-filter and sludge treatment units.

With the commissioning of this WTP DJB shall be able to meet the water demand of all the state citizens and provide the people of Delhi a deliverance from their thirst.

ACKNOWLEDGEMENT

The authors acknowledge the information and support offered by the employees of Delhi Jal Board and Degremont Ltd. without which this work could not have materialized. The authors appreciate the co-operation extended by Mr. Siddhartha Rai for completing this work.

REFERENCES

1. Degremont, Water Treatment Hand Book, Volume 2.
2. Morrison. A, "In third world villages, a simple hand pump saves lives" Civil Engineering ASCE, October, 68- 72 (1983).
3. Manual on water supply and treatment, Third edition (May 1999)
4. Howard S. Peavy, Donald R. Rowe, George Tchobanoglous, "Environmental Engineering", published by McGraw Hill International Edition, 1985.
5. Country presentation/ Case study presented in the ESCAP Sub- regional Workshop on Private Sector in- involvement in the Water Supply & Sanitation held in Delhi in April, 1998.
6. www.delhijalboard.com/about.htm as on 8/4/2005
7. www.delhijalboard.com/sonia-vihar.htm as on8/4/2005.