REDUCTION IN WATER FOOTPRINT IN OFFICES/INDUSTRIES AND OTHER PREMISES

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SYNOPSIS

The water resources are very important part of natural resources in India. Their optimal development, conservation and management are crucial parameters for providing a reasonable quality of life to all the citizens. In ancient times, many water supplies for cities came from within or close-by sources of water and clear water-ways were developed to capture and to use available water optimally. As an example, Iltutmish built the tank at Hauz Khas in Delhi in the 14th Century, which provided the domestic water to the local residents.

Due to rapid urbanization and industrialization, city population of the country has increased unabatedly, posing a challenge to the planners, engineers and administrators to cope up with the problems of providing basic amenities such as safe drinking water, sanitation, drainage, solid waste management etc. In order to achieve the said objectives, suitable strategy has to be evolved for sustainable water use in public places and institutes such as Office Premises as well as Industry Premises, Colonies, Co-operative Group Housing Societies, Malls, Theatres & Multiplexes and Hospitals etc, which consume nearly 85 to 90 % of potable water for toilet flushing, cleaning of floors, gardening etc. As we all know, raw water is to be treated properly to ensure its potability as per prevalent standards and guidelines. The treatment of raw water to make it fit for drinking purposes, involves a huge cost for development of the required infrastructure; its maintenance and operation. Considering day to day shortage of water and its non- availability due to its improper use, public premises can adopt simple techniques such as rain water harvesting system, use of waterless urinals and treatment of grey & black water by natural processes to generate new water for non-drinking purposes like gardening, plantation and toilet flushing by using dual water pipe system. The surplus new water can also be diverted to ground water recharge purposes. These techniques can either be used as such or in combination to achieve the maximum efficiency and reduce the water footprint.

Combination of above techniques has been taken up by WAPCOS to optimize the use of available water at its corporate office premises, Gurgaon. By adopting Rain Water Harvesting Scheme, about 740 m^3 of water is being recharged beneath the ground and by installing Waterless Urinals about 480m^3 of fresh water is being saved per annum. Besides these measures, sewage treatment by natural process called Phytorid Technology is being implemented in the Campus. On implementation of this technology, about 3780 m^3 of additional new water will be available both for plantation, gardening etc. (non-domestic utilization) and remaining water will be diverted for recharge purposes.

The paper gives an overview of various techniques adopted by WAPCOS for reduction of water footprint in its office. It is hoped, the experience gained can be tangibly used by other offices/industries and other such public premises to achieve the aim of Reduction in Water Footprint.

1.0 WATER FOOTPRINT

Though water, a resource freely available from nature and it is to be used judiciously for all developmental activities. The water footprint is an indicator of water use that looks at both direct and indirect water use of a consumer or manufacturer. The water footprint of an individual, community or manufacturer is defined as the total volume of freshwater that is used to produce goods and services consumed by the individual or community or produced by the manufacturer.

The interest in the water footprint is rooted in the recognition that human impacts on freshwater systems can ultimately be linked to human consumption and issues like water shortages and pollution can be better addressed by adopting appropriate techniques. Out of many techniques used globally to reduce water foot print, WAPCOS, at its Corporate Office has adopted rainwater harvesting scheme, use of waterless urinals and treatment of grey water and black water by natural processes. These schemes are briefly described below;

2.0 RAINWATER HARVESTING

Ground water has become the major source of water to meet the requirements of domestic, industrial and irrigation sectors in India on account of its occurrence, easy availability and reliability. A balance should be maintained between ground water withdrawal and artificial recharge .Artificial recharge of ground water through scientifically designed structures has proven as a viable option for augmentation of ground water resources utilizing the surplus monsoon rainfall.

The ground water level is getting depleted continuously due to its extensive use. There is, therefore, an urgent need to explore ways and means to recharge ground water. The underlying principle is that the rainwater should be given adequate opportunity to percolate freely into the soil and reach the ground water table. Its main objectivities are to meet the ever increasing demand of water;to reduce the runoff which otherwise choke the storm water drains; to avoid flooding of roads and agricultural land; to augment the ground water storage and control decline of water levels; to reduce ground water pollution, to improve the quality of water and increase assured ground water availability.

WAPCOS has adopted roof top and open space rainwater harvesting methodology in its office complex. Total roof top area of the building is 1180 m^2 and there is about 600 m^2 open space. The scheme is operational since 2002 and contains following components:

- The network of drains from the roof top has been connected with the main collector (30 cm dia) which also receives rainwater from open space through surface bar screen manholes located on the main collector drain below the ground surface.
- The main collector has been connected to a recharge pit (2.3 m x 2.1 m x 2.7 m).
- An injection well has been dug in the pit up to the designed depth for effective recharging of ground water.
- The filter material consists of three layers , bottom layer of cobbles, middle layer of gravels and top layer of coarse sand.

Photograph showing Injection Well and Laying of Filter Material

2.1 Review & Renovation of the Scheme

The scheme was inspected before the onset of 2012 monsoon season. Following observations were made and accordingly renovation of the scheme was taken up:

- With the passage of time, the collecting pipes had lessened their capacities to drain the water effectively due to siltation / clogging etc. The pipes have been cleaned to ensure the uninterrupted flow of water.
- The layer of filter in the pit was clogged by fine materials and debris. Therefore, the existing filter material of 1.2 m depth was excavated, washed and re-layed.
- The depth of injection well was measured to be available 1.35 m only. Gravels of filter material had fallen into the injection well were removed by spiral hook device arrangement, thereafter augering was undertaken by screw type auger. The injection well was made functional upto a depth of 4.75 m as further operation of auger was difficult.
- The filter was designed on the availability of existing materials. The bottom layer consisting of gravel & cobbles of size 50 mm to 100 mm overlain by 20 mm to 50 mm size gravels and thereafter sand filter layer of size 0.5 mm to 2.0 mm was laid properly.
- Perforated pipe of injection well of 15 cm dia with top cap was extended above the pit to a level of 0.7 m so that clean water could pass through it in the recharge well.
- To avoid the disturbance and to protect the filter from incoming water, *Shahabad* stone slates of 0.5 m x 0.5 m have been placed on the filter material.

- The recharge pit has been covered by grill to protect from shed leaves and to ensure safety.

2.3 Management and Maintenance

In order to ensure that the scheme runs efficiently, following measures have been initiated:

- Regular inspection is being made to ensure the smooth flow of rainwater from roof to collection drains, main drain and of recharge pit and checking that there is no clogging in the pipes thereby ensuring collection of water in the recharge pit without any interruption.
- On collecting rain water in the recharge pit, it was observed that water stood in the recharge pit and after 2 to 3 days all the collected water was absorbed by the soil, indicating recharge of ground water depending on quantum of rainfall.

2.4 Annual Recharge through Rainwater Harvesting

The south west monsoon sets in the last week of June and withdraws towards the end of September and contributes about 85% of the annual rainfall. The average annual rainfall at Gurgaon is of the order of 612 mm. The annual recharge has been computed as follows:

- Considering the rainfall intensity of 25 mm/hr and a loss rate of 5 mm/hr, the effective rainfall for recharging works out to be 20 mm.

- The maximum volume of water available for recharging is equal to 35.6 m^3

The annual recharge corresponding to the annual rainfall works out to be **740 m^3.**

3.0 WATERLESS URINALS

Many of us believe that urine has its own odour, but infact, urine itself does not bear odour in normal circumstances but when a chemical reaction takes place in presence of catalyst over the period of time, odour and heat is produced. Functional principle of flap technology is used to prevent urine vapour flow bank through Urinals in wash rooms.

Besides this, these have other advantages over the conventional urinals, as summarized below:

It makes toilets odourless:. Urine is mainly composed of urea and the by product is ammonia, which is responsible for the foul smell of urine. Urea is broken down by bacteria using an enzyme called urease. For each molecule of urea, two molecules of ammonia are produced. These urea eating bacteria are ubiquitous in the nature. So, as long as they find moist or wet place, they will be dwelling. This is the case with Flush Type Urinals. But, in Waterless Urinal, there is no moisture at all. The surface of urinate is made smooth by advance anti bacterial and anti stains, nano-silver anti-bacterial glazing which makes it hydrophobic. Being Hydrophobic, the urine itself pass down the pipeline. Once the urine goes under the pipeline, the Innovative Flap technology closes the trap due to the vapour pressure, which seals it. So, there is no chance of odour in waterless Urinals. Waterless Urinals are helpful in conserving water as no water is required to flush out the urine.

Odour Synthesis in Conventional Flush Urinal

$(NH_2)_2CO$ {Urea} + H_2O {water} + urease {enzyme} ▶ $2(NH_3)$ {ammonia} + CO_2 {carbon dioxide}

Odour Synthesis in Waterless Urinal

$(NH_2)_2CO$ {Urea} ⟶ $(NH_2)_2CO$ {Urea}

↓

Air Sealed Trap ⟶ Pipe Drainage No return vapours from drain

It does not leave any stain: The body of waterless Urinal is Hydrophobic. i.e. it does not permit water droplets to remain on the surface. Thus, no urine can accumulate on the surface and so no mineral or organic substance, contained in the urine can form scaling structure and this result to no stain. It follows the principles of Lotus Effect. Every time urine will pass through, it will even collect accumulated microscopic dust particles.

It makes toilets bacteria less: Practically urine is 100 % sterile, it contains no bacteria under normal circumstances. Bacteria can live only when they get moist environment. Waterless Urinals use no water and hence, the chances of bacteria formation are negligible.

The other advantages of Waterless Urinals are improved hygiene & washroom air quality; No clogging of drains & overflow; No issues of splash; Saving of energy for lifting the water & storing in water tanks at roof and Easy to maintain

3.1 Installation of Waterless Urinals

36 Nos. of Waterless Urinals have been installed in the WAPCOS, Corporate Office, Gurgaon.

- On an average, 400 male officials work in the Office for about 240 working days in a year.
- Average use of toilet is considered to be 5 times (5 lpcd) in a day by an individual.

3.2 Annual Water Saving

By installing these urinals, it is estimated that, **480 m^3** of domestic water is being saved annually.

4.0 WASTE WATER MANAGEMENT

In the contemporary society, with the water cost rising and disposal of waste water not easy, waste water tends to become a long-term liability. Its management does not imply merely discharging the waste water in nearby water bodies and rivers, thus making the water non-potable. Waste water management has to be eco-friendly and sustainable. Further, waste water management should be able to recycle the waste water so that it is fit to be reused. Additional water availability by properly treating waste water is the key issue.

4.1 Treatment of Waste Water by Natural Process

Phytorid Technology, a natural process is based on principle of natural wetland and is defined as a “Wetland specifically constructed for the purpose of waste water management and pollution control.” Phytorid Technology can be used to improve the quality of point and non-point sources of water pollution including, domestic grey water and black wastewater and agricultural wastewater etc. This technology can also be used to treat petroleum refinery, waste compost and landfill leachates, fishpond discharges and pretreated industrial wastewater such as those from paper and pulp mills, textile mills and seafood processing. Phytorid Technology is complex ecosystem wherein an understanding of the interactions between abiotic and biotic components are fundamental to treatment processes.

Phytorid technology uses planting certain types of plants which recycle the waste water and make it available for non-domestic utilization. The contaminant removal mechanism associated with these plants is depicted in Plates 1, 2 & 3. The various types of plants used for the purification of waste water are shown in Plate-4.

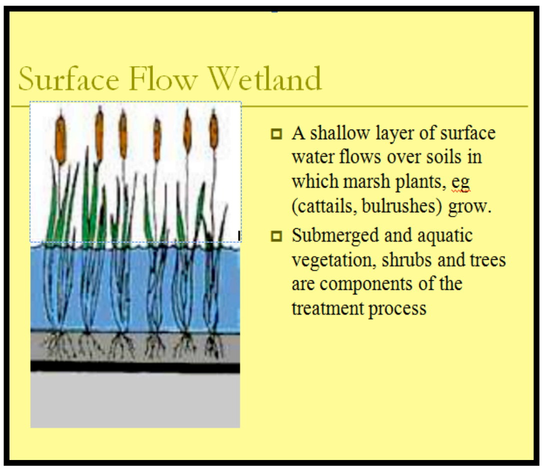

Plate - 1

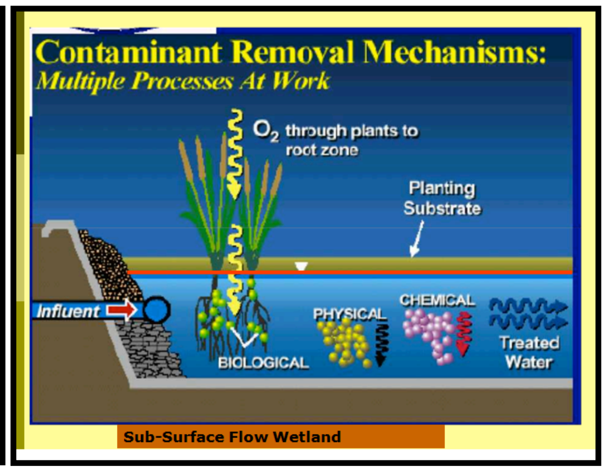

Plate - 2

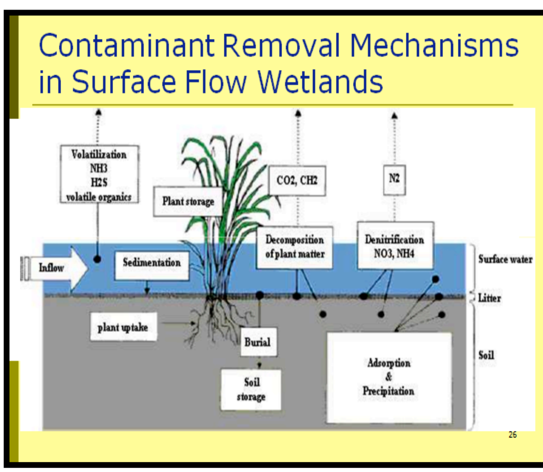

Plate - 3

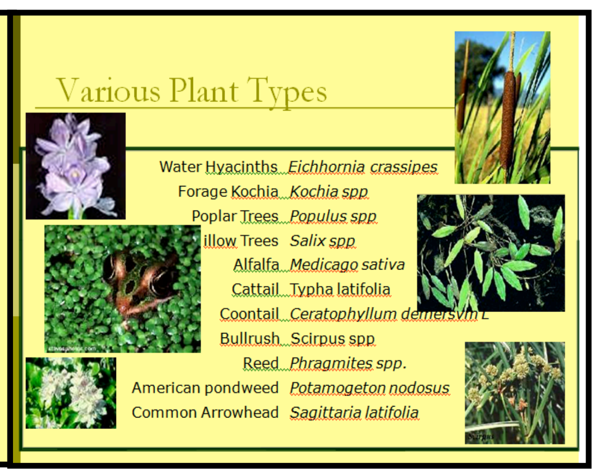

Plate - 4

4.2 Implementation of Phytorid Sewage Treatment Technology

This plant, in association with NEERI, is being put in operation in WAPCOS Corporate Office and is expected to be made operational soon . Grey and black water coming from the office sewers will be treated by this technology. The treated clean new water of the order of 15.75 cum/day is proposed to be utilized both for gardening and plantation purposes and remaining water to be diverted to recharge pit for recharge purpose.

4.3 Annual Generation of Treated New Water

- Collection of wastewater@ 35 lpcd for 500 users is 17.50 m^3/day
- Generation of new water (90%) is 15.75 m^3/day
- Annual generation of new water considering 240 working days is 3780 m^3

5.0 SUMMARY & CONCLUSIONS

In view of dwindling water resources and unabated increase of water demand, conservation of water and its optimal use is one of the most important focal themes, not only for the water managers, but also for the water users. Continual efforts need to be made by all concerned to conserve water and use it judiciously. The results of the efforts in conserving the water have been quite encouraging and installation of waterless urinals has been appreciated by the end users and visitors to this office. Besides this, Phytorid Sewage Treatment Technology to treat the waste water, by which an additional quantity of about about **3780 m^3** new water will be available for both plantation, gardening etc. (non-domestic utilization) and remaining water will be diverted for recharge purposes.

Total reduction in Water Footprint of the order of 480 m^3 by installing Waterless Urinals, re-use of treated water for plantation & gradening by 1500 m^3 has been achieved. Apart from this, ground water recharge of the order of 740 m^3 by rain water harvesting and 2280 m^3 by diverting treated water by natural process has been accomplished.

It is hoped, the experience gained would be tangibly used by other offices/industries and other such public premises to achieve the aim of reducing the Water Footprint.

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