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Water Audit Of Vvp College Campus

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Abstract: To counter the depleting water resources and ill usage of water by identification of the problems, leak points, losses, wastage and giving suggestions to minimize the same. The evaluation of water sources which pumped water throughout the campus was the foremost step of the water audit of the campus and then water meters were installed at suitable distribution points to measure the usage. Water meter indicates the measured value of water usage at that particular location.

Index Terms **- Inlet, Outlet, Storages, Water Requirement, Suggestion,**

I. INTRODUCTION

Water is a precious natural national resource with almost fixed quantum ofavailability. With continuous growth in country' s population, per capita availability ofutilizable water is going down, whereas with ever-rising standard of living of people andall around rapid industrialization and urbanization, demand of fresh water is going upcontinuously. Unabated discharge of industrial effluents into water bodies is furtheraggravating the situation of scarcity of water of acceptable quality. In spite of the fact thatfresh water is rapidly becoming scarce, it is continued to be used wastefully.

Declaring water conservation a national mission, in June 2003, the Prime Ministerof India, appealed to all countrymen to collectively address the problem of alarminglyprogressing water shortage, by conserving every drop of water and suggested forconducting water audit for all sectors of water use.

- **OBJECTIVES OF WATER AUDIT:**

  Objectives of water audit is to find out physical losses due to pipe leakage and over flow, losses due to metering errors, unauthorized connections and free water supply given by Municipal authority for public stand post and park in the distribution system.

II. METODOLOGY

- **American Water Works Association (AWWA) method :**

The AWWA method is basically divided into the following tasks :

1. Measuring the supply: The water sources are identified and the water output ismeasured from each source.
2. Measuring the Authorized metered use: The metered locations are identified andthe metered water uses are calculated..
3. Measuring the Authorized Unmetered use: The unmetered consumers are identified and the amount of water used by them is calculated. The uses could be composed of fire fighting and training, flushing mains, storm sewers and sanitary sewers.

4. Measure Water losses: The volumes of water that does not fit in the above three categories are the loss in the system. These losses can include accounting errors, unauthorized connections, evaporation of stored water, reservoir overflows, leaks or losses due to malfunctioning of the system.

<table>
<tr><td rowspan="8">System Input</td><td rowspan="3">Authorised Use</td><td rowspan="2">Billed Authorised Use</td><td rowspan="2">Revenue Water</td><td>Billed Metered Consumption</td></tr>
<tr><td>Billed Unmetered Consumption</td></tr>
<tr><td rowspan="2">Unbilled Authorised Use</td><td rowspan="6">Non Revenue Water</td><td>Unbilled Metered Use</td></tr>
<tr><td>Unbilled Unmetered Use</td></tr>
<tr><td rowspan="5">Water Losses</td><td rowspan="2">Apparent Losses</td><td>Metering Inaccuracies</td></tr>
<tr><td>Unauthorized Use</td></tr>
<tr><td rowspan="3">Real Losses</td><td>Leakage on Mains</td></tr>
<tr><td>Overflow on Storages</td></tr>
<tr><td>Leakage on Service Connections</td></tr>
</table>

5. Analyze Audit Results: Audit result comprises of calculation of two quantities, whichare potential water system leakage, i.e., difference between total water loss and allmeasured losses. The second quantity calculated is the recoverable leakage, which is halfof all the potential leaks that can be discovered and repaired.

- **International Water Association (IWA) Audit Method :**

The IWA method can be represented with the help of a water balance diagram in which each column is a different notation for describing the same volume of water at some point of the delivery cycle of utility system. The aligned row totals the same volume of water. When we perform IWA audit,we quantify each entry .i.e. volume of water. The IWA auditing is a “bottom up”approach. This type of audit requires sorting the most basic information that is gathered bya utility which is billing records, leak reports, information gathered during field visits etc.It is a costly affair and takes a lot of time but is able to identify all losses and is a highly efficient method.

III. CALCULATION OF PER CAPITA AND TOTAL WATER REQUIREMENT:

The per capita water requirement was calculated with the help of set standards by WHO, for domestic use and using estimated values for irrigation purposes and dairy. The total water requirements were obtained by multiplying the number of people in the distribution point, with the per capita water requirement for domestic purposes. For irrigation purposes, the total water requirement was obtained by multiplying the area of irrigation with the water requirement per area of the distribution point.

The total water requirement gave the ideal amount of water that needed to be pumped into the system and was calculated by following steps,

- Survey of the distribution points of campus.
- Finding the number of people contributing to water usage at every distribution point
- Finding out the areas of irrigated distribution points like farm.
- Finding out the number of animals in the farm dairy
- Finding out the standard values for domestic and irrigation uses
- Calculation of total water requirements with above data.

The standard values were obtained from the prescribed values of World Health Organization (WHO) and average irrigation requirements for shade houses and poly houses. The standard values of dairy were also obtained by per animal requirement values.

The standard values for domestic uses were as follows:

Table 3.1 Prescribed Water Requirement Standards

Type of Usage	Minimum water Requirement (lpcd)	Maximum water Requirement (lpcd)	Average water Requirement (lpcd)
Drinking	2	8	5
Sanitation	30	50	40
Cooking	2	6	4
Bathing	8	32	20
Washing clothes	10	30	20
Washing utensils	15	35	25

Average amount of water required for irrigation by drip systems in rain shelters and shade house was found out to be 1.5 mm per day on an average. For garden use, it was taken as 2 mm per day. For the farm dairy, average water requirement per animal was found out to be 135 liters per day, including the drinking and washing purpose.

Thus, the ideal water requirement for the campus was found out and a comparison was made between the actual water usage, ideal water requirement and the amount of water supplied.

IV. RESULTS:

Water is a basic nutrient of the human body and is critical to human life. It supports the digestion of food, adsorption, transportation and use of nutrients and the elimination of toxins and wastes from the body (Kleiner, 1999). Water is also essential for the preparation of foodstuffs and requirements for food preparation are included in the discussion of consumption requirements. Domestic water supplies are one of the fundamental requirements for human life. Without water, life cannot be sustained beyond a few days and the lack of access to adequate water supplies leads to the spread of disease. Children bear the greatest health burden associated with poor water and sanitation.

It is important to distinguish quantities of water required for domestic purposes (which primarily influence health and productivity), and quantities of water required for other purposes (such as agriculture, industry, commerce, transport, energy and recreation). Overall, the requirements for domestic supply typically constitute a very minor component of total water withdrawals (Gleick, 1993; 1996).

In the WHO Guidelines for Drinking-Water Quality, Guideline Values for chemical contaminants are based on the assumption of a 60 kg adult consuming 2 liters per day from drinking water, which would be equivalent to 3 liters per capita per day including food consumption (if the ratio cited by Kleiner were applied) as shown in Table 4.1. Where specific guidance is needed for vulnerable populations, a figure of 1 liter per day for a 10kg child or 0.75 liter per day for a 5kg child is used (WHO, 1993; p31).

Table 4.1 Daily fluid intake reference values in litres per capita (IPCS, 1994)

	Normal conditions	**High average temp.**	**Moderate activity**
Adults	1.0-2.4, average 1.9 (including milk); 1.4 (excluding milk)	2.8-3.4	3.7
Adult male	2	-	-
Adult female	1.4	-	-
Child (10 years)	1.0	-	-

To prepare rice using the adsorption method (i.e., only sufficient water to cook the rice is added), 1.6 liters is required for 600 g per capita per day.

More water may be required to ensure that other foodstuffs can be cooked, although defining minimum quantities is difficult as this depends on the nature of the food being prepared. For instance, Gleick (1996) suggests that on average 10 liters per capita per day is required for food preparation, whilst Thompson et al. (2001) show that in East Africa only 4.2 liters per capita per day were used for both drinking and cooking for households with a piped connection and even less (3.8 liters per capita per day) for households without a connection. Taking into account drinking needs, this suggests that between 1.5 and 2 liters per capita per day is used for cooking.

- **CALCULATION OF THE ACTUAL WATER SUPPLY AND USE:**

The water use by various users in the campus was estimated based on the standards given by World Health Organization (WHO) as given in Table 4.2.

Table 4.2 Per capita water requirement as per WHO

Litre per capita per day (lpcd) minimum, maximum and average water requirement as per World Health Organization (WHO) -			
Type of Usage	Minimum water requirement (lpcd)	Maximum water requirement (lpcd)	Average water requirement (lpcd)
Drinking	2	8	5
Cooking	2	6	4
Bathing	8	32	20
Sanitation	30	50	40
Washing of clothes	10	30	20
Washing of utensils	15	35	25
Average Per Capita Water Requirement Per Day (lpcd)			114
Minimum Per Capita Water Requirement Per Day (lpcd)			67
Maximum Per Capita Water Requirement Per Day (lpcd)			161

- **Calculation of the main supply**

There are 2 main supplies

1) 3 Bore wells
2) Corporation connection

Discharge of the bore wells are 20 liter for 15 second

- **Calculation of discharge in men's hostel water tanks**

No. of tanks = 3
Storage of tank = 5000 liter

- **Estimation of water requirement**

Number of Inmates of Men's Hostel = 197
Total Average Water Requirement in liter per day for Men's Hostel = 197 x 114 = 22,458l Lit.

- **Calculation of discharge in ladies hostel water tanks**

No. of tanks = 2
Storage of tank = 10,000 liter

- **Estimation of water requirement**

No. of inmates in LH = 110
Average per capita water requirement per day = 100 l
Total Average Water Requirement in liter per day for Ladies' Hostel = 110 x 114 = 12,540 l Lit.

- **Canteen**

No of Tanks = 2
Storage of tank = 3000 liter
Estimation of water requirement
No of inmates in canteen = 125
Total Average water requirement in liter per day for canteen = 125 *188 = 23, 500 liter

- **Degree and Diploma Building**

No of Tanks = 4
Storage of tank = 50,335 liter
No of inmates in Degree and Diploma Building = 1860*45
Total Average water requirement in liter per day for degree and diploma building = 83,700 liter

➢ SUGGESTIONS TO MINIMISE LOSSES:

- **Inspection of complete water distribution system to detect leakage**
  Leakage on main line can be calculated by taking the difference between the system supply and the discharge received by the main tank. The leakage and losses in the intermediary distribution lines can be similarly found out by subtracting the discharge of water received by all the small tanks in various buildings from the supply of main tank. The amount of effort needed to perform a leak detection survey depends heavily on the information available, such as system aps, inventory of pipes and fittings, and history of repairs.
- **Replacement of old fittings and joints**
  If the fittings and joints in the pipelines are too old, they have to be replaced in order to mitigate losses due to leakage.
- **Replacement of corroded pipes**
  If it is seen that the pipes are corroded, they have to be replaced immediately so that leakage losses are prevented.
- **Recycling the waste water for further use**
  Waste water, for instance the water used for washing the floors of the dairy barn, can be recycled and used again.
- **Spread awareness among workers, staff and students**
  This is important as if awareness is spread about the loss of water in our campus among all the people who are a part of it, losses due to over usage of water can be prevented to a great extent.
- **Close the outflow valves of the OH tank during the night time**
  It has been estimated that about 21000 l of water leaves the OH tank from 11 pm to 4.30 am when there is only little usage of water. The valves can 4 be closed during this time period and opened again at the time of pumping in the morning.

➢ CONCLUSION:

Water as we know is the most important entity required for the existence of life on the planet. Globalization and technological development have taken mankind leaps and bounds in most of the aspects but have also deteriorated the natural resources, essential for life, one of them being water. The project of water audit carried out in the VVP College Campus, Solapur. Aims to counter the depleting water resources and ill usage of water by identification of the problems, leak points, losses, wastage and giving suggestions to minimize the same.

The evaluation of water sources which pumped water throughout the campus was the foremost step of the water audit of the campus. The source of water in the campus were mainly wells (both open and filter point wells) and there was no supply from outside. The evaluation of water sources helped in the identification of the heart of distribution system and helped learn the nature of supply in the campus. The open well was the major source of water, operational for most part of the year and pumped water into the overhead tank near the ladies' hostel. The underground tank and above ground tank supplies water to most of the distribution points in the campus including men's hostel, farm nursery and gardening, degree and diploma building, ladies hostel.

The water supply, usage and requirement were required to be measured at distribution points. The methods used were metering the supply and calculation of water usage by falling and increasing depth of water in storage tanks while pumping and no pumping. A total of six Class 'B' single jet, 15 mm water meters were used in order to meter the supply to canteen, , farm nursery and gardening ,diploma and degree building . The readings of these water meters were taken at an interval of 24 hours, for a time period of 1 month. At other points like the ladies' and men's hostel and the overhead tank the difference in depths were noted during pumping and no pumping for a few days at time intervals of 1 hour, in order to obtain the discharge with the help of measured areas of the tanks. For finding out the ideal requirements at all the distribution points, the WHO standards for per capita were used for household supply, while the garden and irrigation use was measured by FAO standards per area.

The total supply to the distribution points of the overhead tank was calculated by measuring the difference in depth of the tank levels at pumping and no pumping and thereby calculating the volume. The supplies at men's and ladies' hostel were measured in the same way. The supply to rest of distribution points were measured with the help of meter readings obtained at a day's interval. For calculation of the total supply at places like apartments and houses where only one or two of them were metered, the discharge values were estimated by taking the total discharge as the product of the discharge a single point and the number of points. The per capita requirement was found out with the help of product of standard

average usage with the number of people contributing to the usage at the distribution point. The irrigation and garden requirements were found out by product of the standard value with the area irrigated or watered. The dairy requirements were also found out similarly by taking the product of number of animals and the standard usage per animal.

The difference between the supply from overhead tank and sum of the usages at the distribution points, yielded the amount of water losses occurring per day, which amounted to 50000 l for one day, approximately. The comparison between the water required and the actual water used was also made at every distribution point. The canteen used about 100 l of more water per day. The water supplied to quarters exceeded the requirement by a whopping 9000 l. The apartments used an extra water of 600 l per day. The farm supply exceeded the requirement by 150 l, while the excess was 600 l and 4000 l for PFDC and KVK respectively.

The results depicted a bulk of water wasted by leaks or real losses and over usage of water at most of the distribution points. Methods like inspection, replacement and repairs of corroded pipes and ill fittings were suggested. Generating awareness to limit wastage of water at households and hostels were also suggested.

Water audit study is indeed a very efficient way towards water and thereby environment conservation by keeping a check on the losses incurred and finding out ways to minimize them. It can also help reduce the capital and operating costs of pumps as an added advantage. Thus, a water audit should be performed in almost all major water supply systems in order to conserve the most precious resource for mankind which is water.

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