

# Water audit and inevitability of water meter

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**Abstract** - Water, it is basic requirement for humans as well as the living creatures on the earth to sustain their life. As water is available for free, the people who are getting water are using it haphazardly without seeking future consequences. In current study, the water auditing is carried out considering the quantity of water. This paper focused on analysis of total water usage for the study area which is found more than the capita limit. Hence it is necessary to optimize this excess water usage. To minimize the use of excess water, water meter were installed in some location of study area. Comparative study has been carried out to analyze the water usage after and before water meter installation for the study area. Some of the suggestion has been discussed to minimize the excess usage and water losses.

**Key Words:** Water audit, Water meter, Residential area water use.

## 1.INTRODUCTION

Water is essential for the living creatures. One can sustain its life without food for several days but cannot survive without water. Water is used in everyday activity like brushing, cooking, drinking, faucets, farms, big industries etc. Its importance can be known from the past that ancient cities were established on the bank of the river where water was available easily which was useful for transportation and other activities. As water is available for free, all have lost its importance in life and are using it chaotically. Population explosion has increased demand for water. But due to industrialization the water resource are getting polluted as industries dump their waste water in water resources. So before utilizing water it is required to treat and make it free from pathogenic bacteria. As the people are not using water conservatively, some regions face scarcity of water. Some actions are required for conservative use of water. Awareness should be spread to use water systematically. Different countries started taking steps on their own for conservation of water. In 1881 it was decided for uniform rule in world for the conservative use of water. Water meters were installed and nominal charges were applied for the usage of water. Due to mentality of paying bill on amount of water use, the water usage was decreased comparatively. It was also resolute to measure the water use and water flow in the system regularly. If there is change in flow or use of water, the fault or unauthorized connection may be detected and can be rectified before huge loss occurs.

The purpose of this study is water auditing when water meters are not installed. When the water usage is found above water use limit, water meters are installed. After water meters are installed water auditing is carried out and comparison for analysis in both the case is concluded.

## 2.LITERATURE REVIEW

### 2.1Brief of water audit

Water audit is the accounting procedure to find the water loss in the system. From it, the unaccounted use of water, unauthorized supply etc is known. The water is trace from the place it enters the system till it exits the system and the water loss in each component of the system is found. It can be useful to find the potential use for other sources of water.

### 2.2Steps for water audit

1. Water inflow and outflow in each component like intake well, water treatment plant, water distribution system, elevated service reservoir or underground service reservoir should be known. The capacity and the velocity at each component are needed to be known. The rain water harvesting should also be known.
2. The readings of various components of the system the efficiency of the system should be checked and if the fault is found it is needed to be upgraded.
3. The water from the irrigation and the domestic should also be known.
4. The water audit report based on this reading should be known and the theft of water, unaccounted water is found. Also it can be found by the software given by American Water Works Association.

Water audit helps to know what is happening after the water leaves from a treatment plant, if there are losses occurring, where the losses are occurring etc. is known, according to that the leakage detection program and other program to reduce loss takes place. These programs have outcomes as follows: Optimization of water losses, Financial Improvement, Knowledge distribution system, increases reliability of supply system, improve public relations, improving service system etc.

Readings from the water meters and at various components like intake well, water treatment plant, elevated service reservoir, water distribution system are aggregated

and excel sheet is prepared and the various reading compiled are placed and water auditing is done. Cities are planned differently and according to it the procedure of water auditing should be carried out. The number of days for the water auditing should be decided, it is generally taken as one year so that all the seasons are covered. Primarily the water audit is done to find the water loss after the water loss is known its detailed study is done. Losses are of two types: real losses in which the loss is due to the leakage, friction in pipes etc. and apparent losses due to theft of water, inaccuracy on water meter reading etc. by all this the chart is prepared so detailed further analysis can be done.

### 2.3 Water meter, it's use and working

It is a mechanical device used to measure amount of water flow from it. Various types of water meters are available like displacement water meter, velocity water meter, compound water meter, multi-jet water meter, electromagnetic water meter, ultrasonic water meter etc. They are selected according to economy, capacity, size, accuracy. As the water flows the amount of water flowed is measured from the screen or the digit system according to the water meter designed. Usually the water meters are installed by the governing body for the uniformity in the city so uniform charge can be levied on the certain amount of water.

### 3. WATER AUDITING IN RESIDENTIAL BUILDING

Due to population boom, industrialization, urbanization the living standard of people has increased and it has increased demand for water. But the fresh water is only 2.5% of the total water available on the earth; hence it is required to use water conservatively, so all can get water to sustain their life. Due to lack of importance of water, there is unsystematic use of water which supports in increment of scarcity. Hence, it is necessary to determine whether the water usage is according to the limit or not. Also theft of water or unauthorized connection is needed to be stopped. For a study purpose the 5 study areas are selected. These areas are selected of the people helping in this study, as people know more about their own house. The water tank readings are taken. And this reading is divided by the number of people living in the house and we get the water meter reading.

#### 3.1 Analysis of water usage in residential area:

The readings were taken from 29<sup>th</sup> August 2016 to 7<sup>th</sup> September 2016, during the monsoon season. The change in water level in the tank is measured at the end of every 24 hours for 10 days. The water used per capita is as follows:

**Table -1: Water usage of residential building**

Study areas	Average lpcd of 1 day
1	152.0
2	155.0
3	147.0
4	139.0
5	139.4
Average of all	146.5

Study area 1: Raman Park apartment, Nirmala park society, Katargam Surat

Study area 2: Lekhadiya Sheri, Saiyedpura, Surat

Study area 3: Behind Gabani Kidney Hospital, station to Laldarwaja, Surat

Study area 4: Rajdeep Society, Ved Road, Surat.

Study area 5: Abhinav flats, honey park road, adajan, Surat.

From the above table it can be concluded that the water used is 146.5 lpcd which is much more than 135 lpcd (Source : SMC). It is necessary to take serious step for the optimizing use of water.

The self awareness should be spread or water meter should be installed or the various recycling technologies should be implemented.

#### 3.2 Requirement of water meter for study area:

1. Water usage is higher than the specified limit.
2. There is no information about unauthorized connection.
3. The leakage in various systems is not known.
4. To stop wastage of water.
5. For conservative use of water.

#### 3.3 Water meter for study area:

To optimize the use of water, water meters are installed and small amount of charges is levied. Minimum bill of it is 135/-Rs as the cost of installation is levied. The cost of water use from 0-30000 is 4.5/-Rs Per liter for 30000-45000 liter it is 6/-Rs, for 45000-90000 it is 9/-Rs per liter and above 90000 liters it is 12/- Rs. Per liter is levied. The water meters installed are mechanical type and are of Itron Company. This type of water meters are selected as they are economic and in household the water flow is less so this type of water meter are efficient.

After the water meters are installed, it is necessary to check the success of this step. So again 5 areas are selected and water meter readings are taken for 10 days. The average

water use of particular house is calculated and it is divided by the number of people living in that house, average lpcd of water used after the water meters are installed is obtained. The average lpcd of water after water meters are installed is as follows:

**Table 2:** Water usage after water meters are installed.

Study areas	Average lpcd of 1 day
1	136.00
2	134.00
3	133.93
4	132.50
5	137.50
Average water used	135.00

Thus, from the test result we can say that the water use has decreased to 135 lpcd which is huge decrease in water use.

**3.5Comparative study:**

1. After installation of water meter there is 11 lpcd decreases in water use. So considering the population, it leads to million liters of conservation of fresh water per day.
2. Before, only approximate data for unauthorized connection was available but after installation of water meter, unauthorized connection are removed and it present, they are detected easily.
3. The water loss by leakage is easily known after installation of water meter.
4. Water auditing has become easy after the installation of water meter.
5. The step of water metering is very useful, as there is only initial cost of installation then only maintenance is required and by nominal charges this method is benefited for optimizing water use.

Our main aim is to stop the wastage of water. Water loss is not always due to consumers, there may be leakage in pipe or may be fault in treatment plant. So while taking steps for the optimization of water use we cannot underestimate water loss in various components of water supply system. Water audit of the full system from the intake well to the consumer is required. For that the readings are required from intake well, Water Treatment Plant, Water Distribution System and the Elevated Service Reservoir.

The following are the readings taken to the following components with the help of Surat Municipal Corporation staff from 15<sup>th</sup> of January 2017 to 21<sup>st</sup> of January 2017.

**Table 3:** Water measurements of water supply components.

Comp	Day 1 MLD	Day 2 MLD	Day 3 MLD	Day 4 MLD	Day 5 MLD	Avg Loss %
IW	35.75	34.78	37.89	36.87	37.10	
WTP	33.52	32.28	35.02	34.54	35.00	4
WDS	28.25	27.85	30.00	29.54	30.65	12
ESR	27.54	26.98	28.96	28.52	29.45	3
CON	26.840	25.890	27.650	27.360	28.940	3

From the above table it can be obtain that total loss is 22%.

Intake well contains 4 pumps which are closed or opened according to the requirement. The reading for the water taken from river Tapti is obtained from the ultrasonic water meter. The flow from the pumps varies from 1260-2700 m<sup>3</sup>/hr.

Water Treatment plant, the water intake readings and the water outlet readings are obtained from electronic flow meter.

The pipe for the flow of water to ESR and WDS are generally of 500mm. At ESR the readings for the inlet and outlet is obtained from ultrasonic flow meter of Siemens Company. The pump lifts the water up and releases the water whenever needed.

The lost from intake well to the WTP and from WDS to ESR may be due to the old pipes, as old pipes may have been wore out and more friction may have occurred in pipes to pass water. Also it may be due to gathering of dust or other particles in it so water is unable to pass. Also it may be possible that the leakage has occurred and the water is moving out instead of moving ahead.

- Loss of water in WTP may be due to loss of head, the pores are jam and water is unable to pass from it in filter. Much water is lost during the back washing.
- The loss in ESR may be due to inefficient pump, the head loss and due to clogging of pipes in ESR.

The water audit of the system is as follows:

Water Volume Into the System (100 %) 35.465 MLD	Volume to customer (72 %) 25.535 MLD	Billed water and Service (67 %) 23.765 MLD	Metered water (67 %) 23.765 MLD	Revenue water (67 %) 23.765 MLD
			Not metered water (0 %) 0 MLD	
	Unbilled water and service (5 %) 1.770 MLD	Metered But free (5 %) 1.770 MLD	Non-revenue water (27 %) 9.575 MLD	
		Not metered but free (0 %) 0 MLD		
	Loss water (22 %) 9.930 MLD	Losses to customer (0 %) 0 MLD	Stolen water (0 %) 0 MLD	
			No metered and no billing (0 %) 0 MLD	
Losses out of system (22 %) 9.930 MLD		Leakage from reservoir (4 %) 1.42 MLD		
		Leakage on trunk pipes (15 %) 5.320 MLD		
	Leakage in branch pipes (3 %) 1.064 MLD			

#### 4.CONCLUSION

From the above study it is inferred that, after water meter are installed the water usage limit has decreased up to 8%. The difference of water usage limit before and after the installation of water meter is 11.6 lpcd, so if we consider for whole Surat city with population of 4466826, there is approximately decrease in 52 MLD of water which means 0.18 million Rupees (3.5 Rs per 1000 liter) which is a great amount. Water meter installation cost 2 million Rupees, which is apparently recovered in single month. Also this amount can be useful in development of efficient upgraded water supply system. When water meters were not installed, there was no consideration in pipe losses. But after these criteria, the water losses in pipes and other system can be known.

Thus we conclude that water meter is one of the essential step for optimization of water loss.

#### 5.NOMENCLATURE

- WTP – Water treatment plant
- WDS – Water Distribution System
- IW – Intake Well
- CON – Consumers
- Comp - Components
- ESR – Elevated Service Reservoir
- Lpcd – liter per capita per day
- SMC – Surat Municipal Corporation

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