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# Efficient water supply system

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## ABSTRACT

The increase in population and living standard increases the demand of drinking water. Lifting more water from tube well lowers the water level which ultimately needs more energy for lifting water and more maintenance cost due to more wear. According to U.N. study 50 % 0f the potable water is wasted or lost in developing world through leakage in water supply system. Another report published by M.M.Joshi[1] indicates that numbers of villages suffering from water crises are increased in Five Year Plans, in spite of increased financial budget from 33 crores to 2485 crores. It is observed that water crises is due to water leakage, poor maintenance, poor water management and lack of financial budget.The conglomerated problem accrue huge financial expenditure on water supply system. The wastage of water is more at high-pressure. It can be reduced by appropriate water pressure as reported by O.William[2]. A case study of water supply system in K.N.I.T. campus is conducted during actuate water crises problem. It is observed that more 50% of total water is wasted through valve and tapes leakage. The water leakage is mainly due to high pressure and poor maintenance[3]. The financial expenditure is much higher due to more wear in supply system. In this paper, causes of water crises in water supply system are analyzed and a water supply system with water conservation technique is also discussed, which indicates much saving in water, energy and revenue.


## KEYWORDS

Water supply system;
Water conservation;
Water crises.

## INTRODUCTION

Among 35 states in India only 7 have availability of drinking water. Country water system is facing a lot of water crises problem. New Delhi demands 36 million cubic meters of water/day. Jal Board New Delhi supplies just over 30 million cubic meters per day but only 17 million cubic meters reaches the consumer due to infrastructure problem such as leakage. Poor maintenance of pipeline causes major inefficiency in use. The Jal Board sends tankers to New Delhi with water. People have to wait in long lines to get water. 27% homes in New Delhi receive tap water for less than 3 hours per day. People have begun to dig neighborhood wells, depleting ground water[4].

Non-revenue water due to leakage etc. in Indian cities is 50-60 Percent. Un-authorized and non-metered connections are around 1.3 lakhs in MCC. Reducing these leakages, would increase water supply by significant extent. Banglore charges Rs. 5/kiloliter

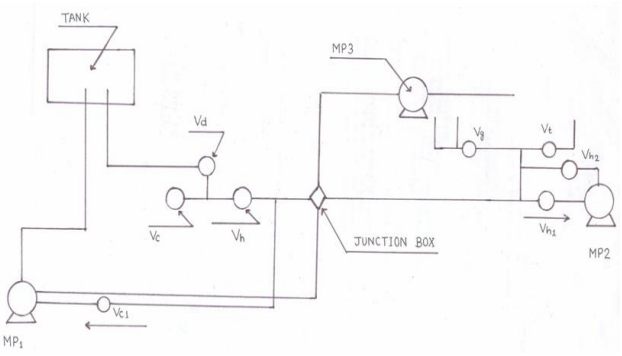


**Figure 1 : Computerized network of water supply system**

while actual cost incurred is about Rs. 35/kiloliter. In Mumbai it is also in even worse Rs. 2/kiloliter. MCC is spending Rs.30 crores for maintenance of water supply in the city while revenue is only 18 crores with monthly collection of water charge standing at Rs. 1.5 crores[5].

Under such condition JUSCO has agreed to 24×7 water supply to entire city ensuring sustainability of achieved service standards. Under the agreement, JUSCO will manage and maintain the supply system for six years for which it will be paid Rs.16.2 crores annually. It indicates that water crises can solve by reducing water wastage and improving water supply system.

Kamla Nehru Institute of Technology Sultanpur is also facing water crisis problem. It is situated near the bank of river Gomti. Geographical area of the institute is very typical containing various ditches and campus level is nearly 3 meters below the normal roadside. Total area of the campus is around 100 acre. The water level is below 30m and discharge of the well is also very low. The institute has presently one overhead tank of capacity of about 150 kiloliters, water storage height is 4m. The tank is 18 meter above the ground level. The tank is filled by 10 H.P. submersible pump in 6-7 hours. The water is supplied to multi- storied staff colony and student hostel by 100mm pipe separately. Campus has large no. of small capacity of large no. of water storage tank placed on roof of each building and block. Total capacity of such tank is more than 150 kiloliters. As the no student is more, large quantity of water is needed which is supplied by small pump. This pump is operated round the clock as per need. In spite of all effort students face a lot of water problem even for drinking specially in odd hours and crises period. Some hand

**TABLE 1 : Analysis of water system per year**

| | | |
|---|---|---|
| 1 | No. of users | 800(approx) |
| 2 | Energy consumed | Rs. 1.67 lac |
| 3 | (a) Water supplied | 9.3 laclit./day |
| | (b)Water required | 2 laclit./ day |
| 4 | Expen on diture salary | Rs. 2.76la c |
| 5 | Interest on asset such as tube well, tank and pipe and fittings are not considered | |
| 6 | Maintenance expenditure | Rs.0.25 lac |
| 7 | Revenue collected | Rs. 0.144 lac |
| 8 | Approximate saving as estimated | Rs. 1.00 lac |

**(Note: Details are collected by regular observation, slight variation may occur)**

pumps are also fitted but simple hand pump are ineffective due to fall in water level. Only India mark 2 hand-pumps are found suitable. The KNIT position is also same in water tariff and revenue collection. Water charges are about Rs. 5 per family in a month. Revenue collected is very low as indicated in TABLE 1. Under such circumstances it is very difficult to maintain the water supply system.

## Analysis of water supply system

A detailed study is carried out to analyze the problem of much wastage. Main cause of water wastage is unreliable water supply system. This needs suitable water storage in each house. We store more water than required due to uncertainty in water supply. When fresh water comes people throw the stored water and fill the empty tank by fresh water. The stored water also becomes hot or cold depending upon weather, which becomes unsuitable for direct use. So size of domestic water tank and location of water tank is also important for reducing water wastage. If water is made available round the clock, no body will store, and there are no chances of contamination in water. When water is supplied for few hours, the outside water enters through seepage, which causes contamination. When domestic tank are used, people tries to fill up these tanks at very fast rate, which lowers the height of water in main tank in very short time. This causes water crises for people who use water directly from taps. This creates uncertainty in water availability. Due to this taps remains open for longer duration for need of water.

Water supply department solves the water crises problem by lifting more water. Due to more lifting water, tube fails to supply clear water. Failure of pumps

**TABLE 2 : Demand rate of fixtures**

| S.No. | Type of fixtures | Demand liter/minute |
|---|---|---|
| 1 | 15 mm bib taps in kitchens, wash hand basins | 9 |
| 2 | 15 mm bib taps in kitchen sinks, washing place | 13.5 |
| 3 | 25 mm bib taps for public baths | 45 |
| 4 | 20 mm Bib taps used in domestic bath | 27 |
| 5 | Ball valves in flushing cisterns of W.C.S. | 6.75 |
| 6 | Showers with 10 cm Rose in residences | 18 |
| 7 | Showers with 15 cm Rose at public baths | 36 |

**The actual flows obtained however depends pressure head available behind the futures**

**TABLE 3 : Water conservation devices**

| S.No. | Name of components | Typical savings |
|---|---|---|
| 1 | Fill cycle diverter | 0.5-0.8 gallons per flush |
| 2 | Tank dam | 2.5 -gallons per flush |
| 3 | Tank bank | 0.8 gallons per flush |
| 4 | Flapper | 3.5 gallons per flush |
| 5 | **Other devices** | |
| | Bathroom aerators | Saving 1.5 gpm |
| | Kitchen aerators | Saving 1.5 gpm |

takes place due to lifting of sandy water. Due to limited fund frequent maintenance of water supply system is not possible.

It is indicated that nearly 50% water leakage or wastage takes place. Without reducing the water wastage water crises problem cannot be solved. Auditing and metering of water supply is also essential to reduce the water wastage. Water wastage takes place in two steps:

1 Main pipe line
2 Domestic pipe and fittings

Generally water is supplied to ground floor or 1st floor by water supply department. It may be supplied to multistoried building. In multistoried building water is supplied at higher water pressure. In case of any fault or break down much water wastage takes place. It is very difficult to sense and stop the leakage immediately. This may create water crises.

In domestic water supply system, water is supplied by same type of tape for each application. Pressure and discharge is not considered. This causes much water wastage in houses.

By intermittent water supply, peak water requirement in increased, which also causes water crises. It is necessary for efficient, reliable, and economical water supply system that:

(1) Duration of water supply must be increased to optimum value to reduce the requirement of water during peak hours. It also reduces the capacity of water storage. More reliable continuous water supply may reduce the capacity of storage tank to the greater extent, which may reduce water wastage due to seasonal variation.
(2) Water wastage may be stopped or controlled immediately without any delay. Information system must be very prompt Computerized system is needed, considering the cost of water wastage.
(3) Water conservation system and technique is also needed to conserve water and reduce water wastage.
(4) System must incorporate some means to supply drinking water specially in water crises or emergency.
(5) Water tariff must be modified to fulfill maintenance and energy needs.

Considering the above, an efficient water supply is designed which may be very helpful in reducing water crises.

## Design of water supply system

Water is a basic need for survival of human beings. Without water, life is not possible. Due to increased life standard water consumption is increased much. Water is also needed for fire fighting equipment and machines. More reliable water supply system is needed for continuous water supply.

For designing water system of K.N.I.T., whole campus is divided into three zones depending upon water requirement pattern.

1 Residential area
2 Administrative and academic building area
3 Student hostel areas

Water is supplied at higher pressure or lower pressure as per need of occupants. Water supply at lower pressures reduces water wastage to greater extent Water crises mostly arises from public utility points.Due to water crises water wastage and breakage in pipeline and pipefitting is increased much. Generally water taps remains open round the clock The water supply at these points must be very reliable at least drinking water must be available round the clock These points must be connected to water tank for continuous water supply to

**TABLE 4 : Details of saving in water supply in percentage (Approximate)**

| Details of work | Financial status before implementation | Financial status after implementation (%) |
|---|---|---|
| **Repair of pumps** | | |
| Centrifugal | Extreme expenditures in all heads, repairing difficult. Saving zero. | 50 |
| Submersible | | 50 |
| Pipeline and pipe fittings | | 40 |
| Water supply with tanker | | 100 |
| Employees | | 30 |
| **Energy** | | |
| Diesel | | 100 |
| Electricity | | 30 |

these point. Water leakage from main valves supply valve may be easily utilized. A separate water supply pump may also be installed and connected in this water line so that it can be started easily when water pressure in the line is reduced much.

Theft of water fittings is also a cause of much water wastage at public places. It is also advised to design water fittings from low cost material whose resale value is less. Installation of fitting is also done in such way that theft of components is difficult.

## Water conservation devices

In campus water is supplied through main tank at higher pressure. The demand rate of different fixture used in water supply[6] is given TABLE 2. In campus no water fittings supplies water as per standard norms. In ground floor water discharge from tape is about 50 liter/minutes. Same type of water tape is used for all purposes. Discharge is not regulated as per norm given in TABLE 2. Thus much water wastage takes place from ground floor. Several types of water conservation devices[7] are available which can save much water. However cost of the devices is slightly higher. Water saving by different water saving devices is given TABLE 3. This is not suitable for public places due to theft. A very cheap orifice plate of suitable hole size may be easily placed inside the pipe before fixing the required common fittings. An orifice plate is very simple in construction and installation. Replacement is also very simple. Side of orifice is slightly made taper so that it can be fitted inside of pipe near fitting. Suitable size of hole is made of 3mm to 6 mm diameter depending upon water pressure and demand of water. This type of orifice plate/water supply valve is essential to supply water to different zones. Water quota must be fixed and valve must be regulated as per requirement. Such orifice plate is fitted at various points and a study is conducted for evaluation of performance and economics of water supply system.

## Computerized water supply system

Water is precious and costly. Each drop of water must be economically and efficiently used. This needs computerized water supply system. The system is designed by considering pressure and quantity of discharge. Pumps may be operated by Sensor control. Sensing the level of water in main tank and pressure of water in pipe may operate main pump $MP_1$. When main pump $MP_1$ starts, it increases the pressure in pipeline. $MP_2$ and $MP_3$ sense this pressure. $MP_2$ starts first. If the pressure of water is still low, the pump $MP_3$ starts. If the pressure increases much higher, pump $MP_3$ stopped by sensing the pressure. If pressure is still high, pump $MP_2$ stops by sensing the pressure. Very high discharge from valves $V_c$, $V_h$, $V_{h1}$, $V_t$ or $V_{h2}$ indicates misuse or wastage of water. Proper action may be taken after closing the valve. Water conservation devices are also fitted at various points to reduce the wastage. Pump $MP_3$ is used to supply water at low level specially for drinking in crises period. Layout of water supply system is given in figure 1.

## Performance study

Wastage of water is controlled which reduces the duration pump operation. Thus saving of nearly 50% energy can be easily achieved. Use diesel in generator set is also reduced to 50%. Pump operation time is reduced; thereby pump maintenance cost is reduced. Due to low water supply pressure, pipe maintenance cost is also reduced. Life of the tube well is also increased. Estimated saving by modifying the water supply system is given in TABLE 4. By proper metering and tariff collection, quantity of water wastage may also be reduced much. Ultimately precious water is saved and water crises problem can be solved to greater extent. Problem can be solved without much increase in tariff. Fewer employees are needed to operate the water system due reduced operating time of pump and

reduced maintenance. Extra employees may be engaged for preventing leakage and wastage.

## CONCLUSIONS

It is very difficult to implement the project due to water crises. However this can be controlled in rainy and winter season when there are no water crises. Separate water supply line is also needed to fulfill the need of person who depends only on public tape. This may be used as a substitute hand pump and water may be continuously supplied. Water saving techniques and water awareness camps are also essential for water conservation. Actual cost of water supply is very high. So for efficient and reliable water supply 24×7 system water conservation is essential.

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