Urban Water Supply Management

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ABSTRACT

Population growth and rapid urbanization lead to considerable stress on already depleting water resources. A great challenge for water authorities of urban cities is to supply adequate and reliable safe water to all consumers. In most of the developing countries water scarcity and high demands led the water authorities to resort to intermittent supplies. The direct consequences of intermittent supplies and poor sanitation practices are responsible for several incidence of water borne diseases posing public health risk. In order to minimize the supply demand gap and to assure good quality of water, new techniques can be used to manage the water distribution system (WDS) in a better way. The objective of this paper is to discuss and analyze various issues such as remote detection of leaks and water losses, early detection of component events, real time data acquisition & analysis, demand forecasting, energy optimization so that a efficient management plan may be prepared. A revise is carried out on the existing urban water supply management methodologies and proper management of water supply system.

Keywords: Water supply, water quality, water quantity, pricing, technique.

1. INTRODUCTION

Management of water supply has become a challenge task owing to population growth, expression in institutional, industrial, agricultural activities, changing climatic scenarios, rapidly depleting water resource, increased demand for water, deteriorating infrastructure and water quality[1]. The two important source of water in most of the urban cities are piped water and groundwater, in city piped water is intermittent with unacceptable pressure, high leakage rates and poor maintenance of system from source to consumer with large gap b/w supply and demand .Further this inadequate quantity of water is not distributed equitably among consumers of different categories .A clean supply is the single most important determinant of public health .however the contamination of source aging infrastructure of WDS, leakages, cross contamination and poor sanitation practices have caused water quality deterioration, Diarrheia is the leading cause of illness and death and 88% of death are due to inadequate availability water[1]. India has been well endowed with large fresh water reserves. But poor management practices of this resource have resulted in improves the quantity and quality of water supply through improved water management techniques. Traditional

Management tools and policies have to some extent, achieves the quite efficiency in this current scenario, however key are not completely foolproof in making the network more reliable, A smart network is one which is transparent and flexible in meeting future challenges, and carries out efficient asset management, as a whole it provides a reliable source of water to the consumer remote detection of leaks and water losses, early detection of contaminant events, real time data acquisition, data analysis, demand forecasting and energy optimization etc are the key features of smart water network. This paper focus on the different conventional and smart techniques to manage quantity and quality of water supply.

2. SPECIFIC CONSIDERATIONS

The long team national water demand management is aimed at influencing and controlling water demand and water usage to achieve a better utilization of available water resources while meeting the objective of social and economic development and creating positive environmental impacts. The WDM is consistent with the water strategy and confirms to its long term objectives. WDM address the management of water in all sectors residential, University, agriculture etc.

There are following ten specific policy considerations[2].

1. Water metering and less control.
2. Fulfilling “unsacred” water demand.
3. National pumping standards and water conservation codes.
4. Water pricing and cost recovery.
5. Compreherive water use information program.
6. Public awareness and education.
7. Best management conservation practices.
8. Public building efficiency improvement program.
9. Water demand management research and development.
10. Recognition of individuals, institution and industry. Other aspects of WDM will read to address a number of legislatives initiatives and implementation of water demand management programs.

3. MANAGE WATER QUANTITY SUPPLY TO AN URBAN AREA

Almost all Indian cities have intermittent water supply. Only for few hours per day in most of the cities, water is pumped from a large distance to a high elevation and in this process huge amount of energy is used to move the water from source to consumer. To meet water demand, several approaches should be looped in to by developing models and with the proper usage of modern techniques

3.1 Equal water supply

Often a large quantities of water are supplied to only few consumers, while other consumers have supplied water below their basic needs. So, leading to inequitable water supply. Equitable water to different consumers can be provided by operating the system in an efficient manner[3]. Equitable water distribution done by proper management of water using other source of water more procession of funds, using proper technologies and policies, recession of tarrif structure of private sector .No much work has been carried out in this regard for supplying equitable water to different consumers in different categories.

3.2 Controllers

Used to water supply system mainly to control flow in pipes (to achieve equitable water distribution or to get the target flow) level in tanks and for pump speed control . A control system compares measured value of flow with the target value and gives the error, which is difference between two[4].

3.3 Pressure and leakage management

Pressure management in a supply system is of atmost importance for optimal operation of the system. Presssure management can reduce the leakes and quantity of consumption, reduce the number of bursts, energy minimization and related costs[5].

Leakage is the largest component of unaccounted for water (UFW). The loss of water due to leakage is a major problem. Aged and poorly maintained pipes lines, corrosion of pipe lines, improper maintenance of joints (like valves and bend), mechanical damage are some of the major factors contributing to leakage.Studies on optional location and operation of control valves are carried out to minimize leakage. Some cities have automatic leakage logger which monitor the continuous acoustic signals. Leakage control is regular maintenance activity and needs to be given priority.

3.4 Water supply management

Water supply and needs varies daily, seasonally and for different type of consumers. The supply side management involves infrastructure optimization, preventives maintenance minimization of UFW and other water losses, monitoring of all connections, pressure management and energy efficient system. The demand management involves social awareness and effective usage of water supplied, pricing, billing and minimization of losses due to overflow of tanks[6]. A good relationship is maintained between supply and demand for an efficient system.

3.5 Pumping

Pump operation plays a major role in WDS . Water is pumped to a higher elevation. High energy is consumed in this process which can be pumps are used . Without making any changes to basic operation pattern of a WDS, remarkable reduction in operation costs can be achieved by proper pump scheduling .Pump scheduling by using modern techniques is necessary in all urban WDS where reasonable quantity of energy can be saved thus the operation becomes economical[7].

3.6 Asset Management

Ensuring protection of existing system and management of assets for future use requires analysis of system for wider set of parameters analysis of risk assessment scenarios with all contributing factors, supplemented with real time data collection, visualization and simulation for sustainable management .Two types of failure management strategies can be applied . Proactive asset condition assessment to prevent a failure detection and location to minimize the reaction time and losses associated with a failure[8]. Proper asset management of the system is essential to meet the consumer demand.

4. WATER QUALITY MANAGEMENT

Human health and well being depends on the water quality that is supplied. The increased dependence on bottled water or treated at point of use in recent years throws light on the deficiencies of WDS in supplying safe drinking water to the end consumer. The WDS constitutes an important component to consumer but the contamination of sources due to point and non point pollution loads, inefficient treatment and storage varying hydraulic conditions, leaky pipes/joints resulted in intrusion assents. Cause serious public health risk. Water born disease, loss of life and economic burden on individuals, community and government. Therefore best management strategies long with latest tools and techniques are required for misprocessing water quality which will be received in following section.

4.1 Source protection

Ground water are main source for supply . However percolation from agriculture land disturbs the quality of ground water, which pollutes usable water supplying (WWAP) or water assessment programmed[9]. However ground water is contaminant with various hazardous elements. In order to comply with microbial and disinfectant by product (DBP) regulation water utilities can invest in advanced treatment process. However there is an increasing concern to microbial and chemical contamination owing to geogenic and anthropogenic activates high level of nitrates (beyond permissible limit of 45mg/l, fluoride (greater than 1.5 mg/l) and arsenic (in excess of 0.05 mg/l) have been found in many parts of India[10]. Substantial research on chemical and microbial transport in natural sub surface system is being carried out in order to have a better understanding of various physical, chemical and biological factors involved in contaminated transport.

4.2 Water distribution system

The water distribution system constitute a major infrastructure asset to water utilities all over the world, supply treated water from source to supply to consumer. There are many issues and concern regarding the water quality supplied by the distribution network. Most distribution system infrastructure is reaching the end of its expected life span[11]. There is need to address the WDS integrity. WDS integrity can be descried as having three components[12]:

1. Physical integrity – refers to the maintenance of a physical barrier between the distribution system interior and the external environment.
2. Hydraulic integrity – refers to the maintenance of a desirable water flow, pressure and water age.
3. Water quality integrity – refers to the maintenance of finished water quality via. Prevention of internally derived contamination

4.3 Disinfectant barrier

Disinfection is the final barrier to protect consumer from water borne disease once the water has been released into WDS from the treatment plant for domestic water requires a minimum chlorine residual of 0.2mg/l to be maintained throughout the WDS. Though large doses are applied to water leaking the treatment plant, this disinfectant decay as they travel within the WDS because of various hydraulic, chemical and microbiological factors[13].

4.4 Controlling Disinfectant By Product

The interaction of chemical disinfection with natural organic matter trihalomethanes and halo acetic acid. Though a few of these are regulated, recent studies emphasize the potential health hazards when exposed to unregulated emerging DBPs[14]. Alternative treatment process like lime softening or disinfection process like UV radiation, coronation or use of chloramines or chlorine dioxide.

4.5 Booster chlorination

It’s necessary to maintain free chlorine residuals between or specified minimum and maximum range so as to control the growth of pathogens and formation of DBPs throughout the WDS. However it is difficult to the reactions occurring in bulk and wall phase of the WDS[15].

4.6 Bacteriological studies

In the various cause of water quality deterioration in networks, bacteriological parameters are the most closely studied and monitors because of the short term risk to public health. Field and experimental studies by various investigators have established microbial ecosystem in networks. The factors influencing bacterial re-growth are presence of nutrients, corrosion and sediment accumulation in pipes, hydraulic effects, disinfectant residuals, long residence time age of biofilm[16].

4.7 Modeling methods and tools

Mathematical models can supplement monitoring as an effective tool for understanding the dynamics of water quality variations and complex processes occurring within the large networks of pipes. They help in predicting the spatial-temporal distribution of constituents in WDS[17]. The models help in assessing alternative operational and control strategies for improving and maintaining water quality, optimize disinfection process, design water quality sampling programme, help in evaluating water quality improvement projects.

4.8 Experimental studies

Water quality monitoring on various networks is usually done through sampling. However experimentation accessibility, few available representative sites and changing flow conditions in order to study water quality deterioration and calibrate water quality models, experimental set up like pilot pipe loop is useful as it offers the possibility to work in condition similar to those of actual network and to control the various parameters which affects water quality[18]. The pilot pipe loop facility consists of one or more pipe loops supplied with a feed tank, recirculation pump, and flow and temperature control.

4.9 Public health risk and water safety

Loss of WDS integrity makes the system vulnerable to external contamination through main breaks/repair sites, unprotected storage tank, cross connections. Improperly installed back flow prevention device, leaking pipes/joints back slow ascends due to loss of pressure. The most vulnerable systems are those with intermittent water supply often found in developing countries where the risk of contamination is higher with several incents of water borne disease.

5. CONCLUSION AND DIRECTION FOR FUTURE RESEARCH

The various recommendations contained in the strategy were the following ten which pertain to water demand management.

i. Priority of 100 liters per capita per day for basic human needs.

ii. Creation of a national water data bank.
iii. Full utilization of all waste water for irrigation purposes.
iv. Full but sustainable development of aquifer resources.
v. Adoption of five year resource development plan.
vi. Achievement of the “Highest possible efficiency” in water conveyance, distribution and use.
vii. Adoption of measures to” maximize the net benefit from the use of a unit flow of water”
viii. Definition and assignment of roles in water conservation to be played by the different sectors of society.
ix. Promotion of water saving systems and devices.

The aim is to examine conventional and non conventional and qualitative and quantitative management issues, a well as institutional and regulatory issues. The plan canceled that the gap between demand and available water supply will contain to exist.

The water demand management policy includes several programs.

- A program to promote a recognized industry for water efficient products.
- Setting national product standards & information.
- Modifying building codes to increase water use efficiency.
- A Training program for managers and operators.s
- A national program of audits for large consumers.
- A program to promote rainwater use and a gray water reuse program for areas with no reverse.
- A public awareness program to achieve long team awareness and change in attitudes of water uses.

In addition there are policies which aim at reduction of unaccounted for water. The water demand management includes the use of economic instruments for pollution central and technological changes. The aim is also recommends using public education as a way to increase understanding about water scarcity.

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