International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 6, Issue 6, June 2019
Website- www.aarf.asia, Email : editor@aarf.asia , editoraarf@gmail.com

Drinking Water Distribution System in Vidarbha Region, India: Problems and Solutions- A Review

Swapnil K. Gudadhe
Department of Environmental Science,
Arts, Commerce & Science College, Tukum, Chandrapur-442401 **Email id**:
swapnil.k.gudadhe@gmail.com

Abstract:

It is the principal importance to ensure availability of pure and clean drinking water to the peoples, it is equally important to establish a well-connected centralized water distribution system across the country. The present water distribution system is age old, which can cause the contamination due to various factors. Drinking impure water can cause health hazards, which could be fatal to human lives. The objective of this studyto review the existing distribution systems in cities of Vidarbha region, study the various factors that pose problems in distribution system and possible solutions that help tackle these problems.

Keywords*:* Drinking Water, Distribution, System, Problems and Solutions and Vidarbha.

Introduction:

Food, clothing and shelter are the three basic human needs, while water is one of the major human needs. No human action can take place without water. Freshwater is a finite resource and is a basic requirement for human body. Human activity adherent with water. For the survival of human being, water must be along with them forever. Wise use of available water becomes the need of time.

Just more than 60 % of households are connected with regular water supplies in the cities in India. Average duration of water supply is found between 1-6 hours [1]. Agricultural sector needs most of the available fresh water. Residential, agricultural and industrial area is expending day by day as a result increasing human population. The water distribution systems have to bear this burden by using a proper and economic technique.

India is a mosaic of pluralistic diversity with a landmass of 3.29 million square kilometers and a population of just over a billion [2]. Urban areas in India have been experiencing unprecedented growth in population. Faced with highly variable and yet uncertain rainfall, limited reservoir storage, aging piped network infrastructure, and rapidly growing demand, no Indian city today has 24/7 water supply; instead water supply is intermittent, available for only a few hours each day, a situation strikingly different than that in other Asian countries where 24/7 supply has been achieved in at least some major cities [3].

Adequate distribution of fresh water in various sectors is an urgent need of time. It needs a good planning in the management of water distribution. The policy should be managed in a decentralized way and in partnership between communities and the state governments concerned. Thus, each state requires its own state-specific water policy [4].

This paper reviews from the available literature how the water distribution system can be a major cause of contamination of drinking water in cities of Vidarbha regionand views for management of water distribution system.

Inadequate pressure at supply point: Inadequate pressure and resulting reverse flow or back siphoning of water is a common cause of distribution system contamination worldwide. Insufficient or negative pressure has been known to result from a number of events such as insufficient water supply, power losses, hydrant flushing, rapid closing/opening of valves, the addition of residential booster pumps, transmission main breaks, and pumps ceasing or starting to function [5]. Hydraulic pressure, or water pressure in the pipeline may start off high but drop off rapidly, with those in the end zones very little pressure or water supply. Thus, the people living nearby to water treatment plant get much benefit of receiving water, than those living farthest. A drop or differential

in pipeline pressure can result in the reversal of flow, with water flow in the direction of lower pressure as a result backflow occurs which is defined as the flow of undesirable water back into the potable drinking water supply. There are two types of backflow that may occur. The first is back-siphon age, which occurs when the pressure drops sufficiently to cause a vacuum effect in the pipe which can then draw in contaminants through leaks in the pipes or through cross-connections. The cross-connection are attachment of potable water pipeline with any undesirable contaminated water flow. The other type of backflow is called back-pressure, which occurs when 'a pressure is created in the system that is greater than the supply pressure due to pumps and storage tanks installed into the system by users. Normally peak demand is considered ranging from 2 to 3 times in day, whereas the water supply is given only for a different duration, leading to large peak factors and hence affecting the pressures in the distribution system. This is a common with most water supply systems [6]. In Nagpur and Amravati, there was found to be huge pressure difference in the water distribution system, which was later resolved by applying the modified network analysis tool [7].

Intermittent system: Intermittent water service has become the norm in India. Since treatment plants often encounter water shortages consumers are provided with service for a restricted time period each day [5]. A serious problem arising from intermittent supplies, which is generally ignored, is the associated high levels of contamination [7]. A sporadic water supply means that, for the majority of the time that water is not provided to households, pressure in the system is drastically reduced and stagnant water remaining in the pipelines draws surrounding contaminants into the potable supply [8]. During non supply hours polluted water may enter the supply mains through leaking joints and pollute the supplies. Intermittent systems and systems which require frequent valve operations are likely to affect equitable distribution of water mostly due to operator negligence [6]. Due to intermittent supply chances of water to become unsafe increases. The collected data favor's the significance in continual water supply than to intermittent water supply.But in Nagpur City, India, all samples were negative for total coliforms in the intermittent mode. Moreover, in a sample of alldistrict places of Vidarbha region (i.e. Nagpur, Amravati, Akola, Yeotmat, Gondia, Chandrapur, Gadchiroli, Washim, Buldhana, Bhandara and

Wardha) In Vidarbha Region, the water supply is intermittent mode because, lack of water resource and high demand.

Leakage of pipeline: Leakages in water distribution system is a regular problem occurred due to broad material and unskillful operation. Large quantity of water are wasted through leaking pipes, joints, valves and fittings of the distribution systems due to either bad quality of materials used, poor workmanship and corrosion age of the installations or through vandalism. This leads to reduced supply, loss of pressure and deterioration in water quality [9]. If leaks occur in the pipeline and fecal contamination exists in the environment because of inadequate sewage collection or leaking wastewater pipes, a route exists for contaminants to be introduced into the water supply. Leaks in distribution systems have been found to result in poor quality water. New or reconnection of water supply exhibits the hectic experience to the people. It is clear that the problems of leaking and deteriorating pipelines are important means for pathogen intrusion in the water supply. In most of the places pipelines are underground most of the time these pipeline crosses roads. It is observed that, most of pipelines of water supply are leaked during road construction etc.

Corrosion and ageing of system: All distribution systems deteriorate over time; corrosion is an essential factor in the natural ageing process. With age, there is considerable reduction in carrying capacity due to incrustation particularly unlined CI, MS and GI pipes. In most of the places the consumer pipes get corroded and leaks occur resulting in loss of water and reduced pressure and pollution of supplies [6]. The cement based materials used in the pipelines exhibits the validity of 15-25 years.

Unauthorized connections: Illegally connected users will contribute to the reduction in service level to authorized users consumers and deterioration of quality of water. Sometimes, even legally connected users draw water by sucking through motors causing reduction in pressures [6]. It is observed, that unauthorized connections were found at all over in Vidarbha region especially in summer session.

Contamination of the Water Distribution System: Contamination of water distribution system can occur either from an outside source or withinthe distribution system. Outside source, contamination is mainly due to exposure of water before entering the distribution

system or due to improper treatment of water. The formation and quality of these soft deposits mainly depends on the microbiological and chemical quality of produced drinking water and on the circumstances prevailing in the distribution system. The accumulation of microorganisms on the pipeline surfaces and the formation of biofilm depend on many factors prevailing in the water system, e.g. type of surface material, microbial occurrence in water, concentration and quality of nutrients and disinfectants, temperature, and hydraulics of the system [10]. Contaminations of lead leaching are as follows:

Lead Leaching: Lead (Pb) is a dangerous and important environmental pollutant. Lead has been used for thousands of years and its poisoning effects have been recognized for several centuries. The lead sources in daily life are mainly leaded paint and dust, leaded gas and lead in drinking water. Among them, lead in drinking water is a very important lead source [11]. The concentration of lead in natural water is generally below 0.01 μg ml-1. Drinking water standards ranging from 0.05 to 0.1 μg/m1 have been set by various national and international authorities [12].

Analysis of Distribution System: Analysis of distribution system is necessary to check any flaws in the system and to rectify the flaws so that any kind of risk associated with contamination and failure of system in providing regular water supply can be avoided. The various tools available for analysis ok distribution system are given below:

Probability of pipe failure: There is a high degree of uncertainty associated with all the factors contributing to pipe failure, and especially corrosion rates because of large spatial (even in moderate size networks) and temporal variability. The physical mechanisms that lead to pipe breakage are often very complex and not completely understood [13]. The proposed technique, although probabilistic in nature is numerical rather than analytical, and it permits Monte Carlo simulations (MCS) and allows for fitting of results to a probability distribution, which can be used to develop hazard function of time to failure [14].

Design tool for intermittent water supply systems: The following model consists of main innovative components:

- Demand Model: for forecasting the end-users demand profile.

- Secondary Network model: for modeling networks to the level of an individual house connection
- Network Charging Model (prior to pressurized flow): For prediction of the time at which different users receive, water after supply resumes and highlights the time lag experienced by tail-end users in the network.
- Modified Network Analysis Method: to model the demand based on pressurized flow.

GIS based tool to find risk associated with contamination of water distribution system: During the non-supply hours, contaminants from pollution sources such as sewers, open drains and surface water bodies mixed in drinking water distribution pipelines through crack and leakages. This risk associated with contamination can be found by using the software Improved Risk Assessment of Water Distribution Systems (IRA-WDS). The software consists of three models:

- The contaminant ingress model
- The pipe-condition assessment model
- The risk assessment model

The models likeIRA-WDS assesses the risk of contaminant intrusion into the water distribution system by modeling the process of contaminant transport from pollution sources such as sewers; open drains and foul water bodies [15].

Maintenance and Rehabilitation: The major objectives when applying rehabilitation methods for water networks are to maintain the hydraulic capacity, to avoid future water quality problems and to avoid future bursts and leaks. Twenty percent of the mains in large city areas are located below central business districts and if they fail this will result in severe traffic disruptions. Critical in the event of failure are also pipes whose collapse would result in unavailability of potable water to hospitals and other important customers, unavailability of water for firefighting, contamination of the water supply and considerable third party damage from flooding. Other than the technique mentioned above, the following alternative techniques are also in use for maintenance of pipes [16].

- Open trench replacement- Conventional open cut trenching
- Replacement on new route- Pneumatic percussive moling (impact moling), Guided boring

- Replacement using existing route- Pipe pulling, Pipe splitting
- Slip Lining- Flexible tubing, Live insertion
- Pipe coating- Epoxy resin coating, Polymeric coating using aqueous solution Factory applied coatings.

Conclusion:

Pure drinking water is not freely available in all cities of Vidarbha region, despite persistent efforts from the concerned authorities to make it available. There is significant variation in the quality of drinking water available to the general public. Drinking water is mainly supplied through water distribution systems. However, due to deficiencies in the system, it is difficult to maintain the required level of purity, even though water is treated prior to distribution. Viable techniques have been successfully implemented in Vidarbha to deal with general deficiencies in water distribution systems. So far, lead leaching has not been reported in Vidarbha region despite the fact that the pipelines used for distributing water, are considerably old and we presume that such old pipes can cause lead leaching. Research work needs to be done in this area to ascertain whether or not any such case of lead leaching has occurred. Needless to mention that there is more work to be done in this field including deployment of latest techniques, to ensure availability of pure drinking water.

Nagpur NMC has initiated to provide 24 X 7 water supply for every house. In primary stage and on trial basis NMC started 24 X 7 water supply in some areas of Nagpur city.

References:

[1] Ahluwalia, I. J. (2001): Report on Indian Urban Infrastructure and Services.

[2] WHO, (2002): India Assessment -2002: Water Supply and Sanitation WHO- UNICEF Sponsored Study, Planning Commission Government of India.

[3] Srinivasan, Veena; Steven M. Gorelick, and Lawrence Goulder (2010): A hydrologic- economic modeling approaches for analysis of urban water supply dynamics in Chennai, India. *Water Resources Research*, 46.

[4] NWP (National Water Policy), (2012): Government of India, Ministry of Water Resources,

[5] Lee, Ellen J. and Kellogg J. Schwab(2005): Deficiencies in drinking water distribution systems in developing countries. *Journal of Water and Health*, 3(2), 109-127.

[6] CPHEEO (2005):Manual on Operation and Maintenance of water supply systems, January 2005, CPHEEO, Govt. of India, Ministry of Urban Development, New Delhi.

[7] Vairavamoorthy, Kalanithy; Akinpelu, Ebenezer; Lin, Zhuhai and Mohammed Ali, (2004): Design of sustainable water distribution systems in developing countries. *Water Development Research Unit.*

[8] Zhou Yi, Vairavamoorthy K. and Mansoor M.A.M. (2009): Integration of urban water services. *Desalination*, 248(1-3), 402–409.

[9] Dighade, R.R.; Kadu M.S. and A.M. Pande (2014):Challenges in Water Loss Management of Water Distribution Systems in Developing Countries, International Journal of Innovative Research in Science, *Engineering and Technology*, Vol. 3(6), 13838-13846

[10] Zacheus, Outi M., Markku J. Lehtola, Leena K. Korhonen and Pertti J. Martikainen, (2001): Soft Deposits, The Key site for microbial growth in drinking water distribution networks. *Water Research*, 35(7), 1757–1765.

[11] Hu Jie, Yuwei Ma, Liang Zhang, FuxingGan, Yuh-Shan Ho, (2010): A historical review and bibliometric analysis of research on lead in drinking water field from 1991 to 2007. *Science of the Total Environment*, 408(7), 1738–1744.

[12] Wong M. K., Gan L. M. and Koh L. L. (1988): Temperature effects on the leaching of lead from unplasticized poly (vinyl chloride) pipes. *Water Research*, 22(11), 1399-1403

[13] YehudaKleiner and BalvantRajini (2001): Comprehensive review of structural deterioration of water mains: statistical models. *Urban Water*, 3(3), 131-150.

[14] RehanSadiq, BalvantRajani and Yehuda Kleiner (2004): Probabilistic risk analysis of corrosion associated failures in cast iron water mains. *Reliability Engineering and System Safety*, 86(1), 1–10.

[15] Vairavamoorthi, K., (2007). IRA-WDS: A GIS-based risk analysis tool for water distribution systems. *Environmental Modelling & Software*, 22 (7), 951-965.

[16] Glen R. Boyd; Neil K. Tarbet; Roger J. Oliphant; Gregory J. Kirmeyer; Brian M. Murphy and Robert F. Serpente (2000): Lead pipe rehabilitation and replacement techniques for drinking water service: review of available and emerging technologies. *Tunnelling and Underground Space Technology*, 15(1), 13-24.