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Assessment of leakages and wastages

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Industrialisation and job opportunities have created a tendency in rural population to migrate in large numbers to urban areas. When the cities and towns develop and expand at high rates, existing urban services tend to be constantly under strain. In Indian urban centres increase in water demand is therefore overtaking the augmentation projects. In fact many urban water supply augmentation projects are required to be designed so as to maintain at least the existing level of services rather than improve upon the service levels for want of adequate funds. Water as source for drinking water is also getting scarcer with additional demands for irrigation from available sources.

SOCIAL HABITS & CAPITAL & OPERATING COSTS OF WATER PROJECTS

2. Due to intermittent supply systems people do not always close water taps and there is considerable wastage at public standposts and elsewhere. The cost of augmentation projects are soaring thus making it difficult to implement projects and in reasonable time. In India the electric energy rates have gone up from 5 US \$ to 75 US \$ per thousand KWh in the last fifteen years. The cost of water is increasing due to increase in power tariff without corresponding increase in water charges, this further enhances the need for conservation. It has been demonstrated that it is far more economical to conserve water (upto certain minimum limit) than implementing new projects yielding equivalent additional quantity of water.

3. In many Indian cities the distribution systems are over 50 years old. The pipes are quite often corroded and broken. In such cases appreciable increase in supply quantity would not reach the consumer while the leakage losses would increase. Thus implementation of augmentation projects without controlling leakages would tend to become counter-productive. Controlling leakages is necessary as a part of routine preventive maintenance.

POLLUTION IN INTERMITTENT SUPPLIES

4. Water supply is intermittent practically in all the Indian cities. The mains remain empty over long periods every day. When the water supply is not 'on' the outside waste water tends to enter into the pipes through broken pipes and leaking joints,

thus polluting the filtered water supplies, making it unsafe for drinking. By controlling leakages, such entry points for waste water are minimised reducing the possibility of the contamination of water.

MANAGEMENT OF WATER DISTRIBUTION SYSTEMS

5. One of the pre-requisites for efficient management of water distribution systems is to have accurate and updated system records. Unfortunately such records are not always available in many of the Indian cities. As a part of leakage control programmes all system data has to be in the form of drawings and reports so that it can be referred by others for better organisation and management.

6. It has been found from case studies that after an area is tackled for leak detection and repairs, the pressures in the distribution system improve, leading to better consumer satisfaction.

7. Some of the problems faced by many urban water authorities of clandestine connections, faulty water meters, leaking disconnected service pipes and inadvertently closed valves get attended to during systematic efforts for controlling leakages.

METHODOLOGIES AVAILABLE FOR LEAK DETECTION

8. The approaches for leak detection are necessarily different for continuous and intermittent supply systems and are discussed below.

Continuous supply system

9. The probability of appreciable water lost due to leakage varies proportionately with the ratio of minimum night flow and total quantity used. Effort is therefore made to identify the areas of high night flows and concentrate leak detection work in such areas.

10. Zonal flow measurements are also useful as these provide guidance for future preventive work. Comparisons of remeasurements with previous figures provide useful information as to the probability of water lost due to leakage.

11. Detailed study has to be carried out in areas showing unexplained high night

consumption rates. This is done by subdivision of the area and measuring of the water consumption rate in stretches of the distribution piping between valves. These individual night rates of consumption must total upon the measured night rate for the zone as a whole. The areas showing excessive meter readings are investigated further to pinpoint the leaks with the help of sounding rods, electronic leak locators etc.

Intermittent supply system

12. The flow measurements during supply hours do not help to identify leakage in intermittent supply systems. The identification of areas for detailed investigation is much more cumbersome. A method which has been found useful for intermittent supply systems is as follows. A bypass arrangement is made to divert water to a zone to be tested. On the day of testing a zone for leakages, all the consumer connections in the zone are cut off as soon as the normal supply hours are over. The zone is isolated by closing all the boundary valves. Special supply is drawn and all the mains are charged with water till sufficient pressures are developed at remote ends of the zone, which is ascertained by fixing pressure gauges. Valves on fire hydrants in the zone are opened to allow the air in the mains to escape. Sluice valve on the main feeder is then closed and bypass opened. The consistent recorded flow in the meter indicates the leakage quantum in the zone. If this is excessive, step test is carried out wherein distributory mains are shut off one by one starting from remote end of the zone. Reduction of flow at each step indicates leakage in the last isolated main. The work of pinpointing the locations of leak points on the mains is done with sounding rods and electronic leak locators in the sections where leakages are high.

13. On completion of the test, special supply is closed and all the consumer connections are restored. This is completed before beginning of normal supply hours to the zone. All the boundary valves are opened and normal supply conditions restored.

14. During subsequent days all the leak points are repaired. Similar test is repeated and leakage is measured. If the leakage has come down within reasonable limits the work is stopped, or else the work is continued. At the end of tests the pressures in the zone are studied to observe the extent of improvement.

DIFFICULTIES GENERALLY ENCOUNTERED IN INTERMITTENT SUPPLY SYSTEM

15. In intermittent supply system special supply from nearby reservoir or transmission mains is required to be supplied even to

remote areas in a water distribution zone, for leak detection by stop-tap method. This poses considerable difficulties. Sometimes, large number of valve operations are required to be done enroute to the area. Moreover if these valves have not been operated for long periods there is every likelihood that these require maintenance and repairs before the test. Isolation of area comprising of 250 to 300 service connections is sometimes difficult for leakage assessment as appurtenances such as on-line valves and fire hydrants may not be available at proper locations. Valves may have to be provided in the zone at certain locations for carrying out the test.

16. Passage of water past boundary valves into adjoining areas could vitiate the results of tests specially when the pressures on two sides of the valves are quite different.

17. Thefts of stop-taps is a general complaint, and therefore in some areas it is preferred to cut the pipes at the connection's end and provide a plug. The connection has to be restored quickly after the test, before the supply time for the area begins. This appreciably increases the effort and cost.

A CASE STUDY : BACKGROUND

18. Jamshedpur is one of the leading industrial towns in India. Its population in 1986 was 0.52 million and covered an area of 46 sq.km. There are about 30,000 consumer connections and only 10% connections are metered. There are about 800 standposts in the system.

Distribution system

19. The town is divided into six water distribution zones. The distribution system is mainly dead end type. Most of the pipes are 35 to 40 years old. CI pipes are used for distribution system however few stretches are of hume steel and RCC pipes.

20. The supply to the town is given three times a day (morning, afternoon & evening) each time the duration of supply is about two hours. The Stop Tap Method was adopted for leak detection in this intermittent supply system.

Preparatory work

21. One leak detection zone (LD zone) was selected covering about 100 houses in each water distribution zone for carrying out leak detection test. Aspects such as feasibility of isolation of this area from other areas, conversion to tree type system, feasibility of giving special supply were taken into account while selecting the LD zone.

22. The distribution system details of the zone where the test was to be conducted

TABLE - 1STATUS OF PLUMBING FIXTURES OBSERVED PRIOR TO L.D. TESTS

Sr. No.	L D Zone	No. of houses covered	Approx. no. of taps	No. of float valves attended	Leaking taps replaced/ repaired
1.	Sidhgora, Tatanagar	121	350	NO OHTS	78
2.	B H Area, Kadma	117	450	46	52
3.	Bina Road/Mona Road, Burma Mines	152	450	70	49
4.	South Park, Central	82	300	46	55
5.	Vellor Road/Birupa Road, Sakchi	135	400	41	29
6.	'E' Sector, Sonary	66	300	*	*
<u>TOTAL</u>		673	2256	203	263

* 60% Float valves unsatisfactory, leaking tap survey not carried out.

were studied. Alignment of the mains and location of valves were noted with the help of operating staff. The drawing showing details of the distribution mains was prepared. Various valves and other appurtenances in this LD zone were surveyed and repaired. Sluice chambers which were found buried were exposed and raised upto the road surface. All the consumer connections/house taps were surveyed and repairs carried out wherever necessary. The boundary valves i.e. the valves separating adjacent area from the LD zone to be tested were checked for passing of water and made water tight as far as practicable. Operations necessary for isolating the LD zone and for drawing special supply for testing were identified. All the valve operations required for successively isolating the distribution mains for the step-test were also identified. Normal pressures in the zone at two to three points were measured and recorded. The daily consumption pattern in the zone was assessed from the water meters fixed on the connections of few sample houses or from the available meter records. From this the daily consumption of the LD zone was assessed. By-pass arrangement with flow meter (25 mm or 50 mm size) was assembled and its fitting points were identified on the field.

23. Before carrying out LD test, each LD

zone was surveyed to check leaking taps and float valves of the overhead head tanks. It was found that out of 673 houses surveyed, about 30% houses had faulty ball valves and about 12% taps were leaking. (Ref. Table 1). These were all repaired before the tests.

FINDINGS OF SAMPLE SURVEYS

24. The details of the LD zones and result of sample survey are shown in Table-2. It could be seen from the table that the leakage varied between 10% & 23% (except in Kadma LD zone where leakage was insignificant) the average being about 15%. It may be noted here that before the leakage assessment test a thorough inspection of plumbing fixtures and ball valves of the over head tanks was carried out and all these were put in order (Except in Sonary zone). Thus the losses on account of wastages in the house were substantially reduced and therefore the losses indicated by the tests can be attributed mostly to the leakage from the underground piping system.

25. A leakage loss to an extent of 15% of daily supply would normally be considered reasonable under continuous supply conditions. However, with prevailing short hours of supply in Jamshedpur leakage losses of the order of 15% are relatively high.

TABLE - 2
SUMMARY OF LEAKAGE ASSESSMENT TESTS

Sr. No.	LD Zone & W D Zone	T E S T D A T A					Leakage Flow rate (lpm)	Approx Leakage (%)
		No. of Houses	Popula- tion	Normal supply hours	Estima- ted per capita (lpcd)	Normal flow (Mld)		
1	2	3	4	5	6	7	8	9
1.	Sidhgora, Tatanagar	121	726	7.25	310	517	147.0	22.1
2.	B H Area, Kadma	117	585	5.0	180	351	3.5	1.3
3.	Bina Road/Mona Road, Burma Mines	152	912	7.0	220	478	60.0	11.1
4.	South Park, Central	82	574	6.0	200	319	55.0	14.7
5.	Vellor Road/Birupa Road, Sakchi	135	1080	6.0	245	735	110.0	13.0
6.	E Sector, Sonary	66	400	6.0	201	223	47.0	17.4

- Note :
1. Normal flow rate (Col.7) = (Col.4 x Col.6)/Col.5 x 60)
 2. Leakage (Col.9) = (Col.8 x 100)/Col.8 + Col.7)
 3. Contamination of filtered water was reported in LD zones at Sr.No.1,4,5 & 6.
 4. 1 Liter = 0.22 Imperial Gallons.

CONCLUSION

26. The Stop Tap method for intermittent supply system can be successfully employed for assessment of leakage, though it is cumbersome in comparison to methods available for leakage assessment in continuous water supply systems. Locating the leakages and the repairs of fitting and fixtures should be given due importance to reduce wastages in the water supplies.