

24 x 7 Water Supply and Distribution

Dr Madhusudan D. CHAUDHARI

*Senior Manager-Projects, Jain Irrigation Systems Limited, Jalgaon, Maharashtra
Chaudhari.Madhusudan@Jains.com*

KEYWORDS

24 x 7 Water Supply, sustainable cities, PE pipes, water meter, leak-proof pipe joints, KUWASIP

24 X 7 WATER SUPPLY AND DISTRIBUTION

The case study shares Jain Irrigation's experience on "Sustainable Cities" achieved using effective & efficient "Water Supply & Distribution Systems". The demand for clean water is a big challenge to the municipalities worldwide. As cities continue to expand, the demand for cost-effective water supply and distribution becomes important. In water supply system the objective of safe, reliable and affordable water supply is achieved using efficiently managed water supply & distribution arrangements, and over the years it has been learned that these objectives are difficult to achieve using conventional-intermediate water supply networks and the continuous water supply (24 x 7) with constant pressure is the most appropriate way to achieve the objectives. The supply of potable water to end users is ensured through pipe network which is always full of water and with a positive pressure so that user may draw the water 24 hours a day, & 7 days a week. The 24 x 7 scheme can ensure better quality of water for the public health, un-interrupted water supply at desired pressure, reduction of water consumption by 30 to 50%, and the success of 24 x 7 scheme lies in choosing the right pipe-material. The water distribution network requiring leak-proof joints with 100 years of maintenance free pipe-life can be only achieved using pipes made of Polyethylene (PE) material. Jain is the largest manufacturer of PE pipes and a total solution provider (concept to commissioning) in the field of water supply and distribution. Paper further details the 24 x 7 pilot water supply project using PE pipes installed by Jain Irrigation in Karnataka for Hubli, Dharwad, Belgaum, & Gulbarga cities under the scheme Karnataka Urban Water Sector Improvement Project (KUWASIP).

1. PROJECT DETAILS

In this demonstration project, the three cities (all of which are municipal corporations) of Hubli-Dharwad, Belgaum, and Gulbarga in northern Karnataka, India with a total population of around 2 million people are selected. The main objective was to undertake capital maintenance on the distribution network to prove (to the public and to the institutions in the water sector) that it is possible to deliver 24x7 continuous, clean water in India using leak & corrosion-proof piping material (made of PolyEthylene). And also to prove that such a supply is affordable, that it can be sustained over time, that it does not require additional water resources to keep the pipes full, and that households, even poor households, are willing to pay a fair tariff for a consistently acceptable service. Ensuring 24x7 water supply in selected zones of Belgaum, Dharwad, Gulbarga, Hubli (Karnataka State) through Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC), as the nodal agency of the State Government under the World Bank sponsored Karnataka Urban Water and Sanitation Improvement Program (KUWASIP). The Operator-Consultant is M/s Compagnie Generale Des Eaux-Seureca JV, and all 24 x 7 water supply polyethylene pipelines, water meters and house service connections are manufactured, supplied, hydro tested and installed by Jain Irrigation Systems Limited, Jalgaon, Maharashtra.

2. USE OF PE PIPES IN 24X7 WATER SUPPLY AND DISTRIBUTION

The urban water supply situation in India has a lot of scope for improvement, since just about 60% households have direct access to drinking water within their premises, with about 14% having access away from the premises. About 78% urban households in Karnataka have tap water source while remaining households are served with wells, ponds, etc. Karnataka Urban Water and Sanitation Improvement Program (KUWASIP) was initiated under the aegis of the World Bank. KUWASIP had a component for carrying out technical studies in the cities of Belgaum, Gulbarga and Hubli-Dharwad. Karnataka Urban Infrastructure Development & Finance Corporation (KUIDFC), acted as the nodal agency of the State Government to undertake multilateral assisted and financed infrastructure projects. The demo zones selected for 24x7 water supply from four cities were:

Table 1. Demo zones selected for 24 x 7 from cities *

City	Zone number	Ward numbers
Belgaum	9 (south) VI (north)	3, 4, 5, 6, 7 (part) & 8 (part), 44, 45, 46 (part) & 48 (part)
Dharwad	-	8, 9, 10 & 11
Gulbarga	27	6 (part), 17, 19 (part), 23, 24 (part), 32, 33 (part), 42 (part), 43 (part), 44, 49 (part)
Hubli	-	27, 28, 29 (part) & 32 (part)

*Source: Brochure on continuous water supply (KUWASIP) circulated by KUIDFC, Regional Office, and Dharwad

The zones were selected after a feasibility study which considered possibility of measurement of water and wastewater at single entry and exit points. The zones were also selected to ensure a cross-section of economic strata, including economically weaker sections. The zones represented at least 10% of total households in the city. Details on number of connections (as on the date of commencement of the project) and the proposed new connections are given in the table below:

Table 2. Number of existing and proposed water connections **

City	Total number of wards selected	Ward numbers	Population coverage (2001 census)	Properties with new water connections	Existing water connections	Proposed New connections
Hubli-Dharwad	08	8, 9, 10, 11, 27, 28, Part 29, 32	82,337	12,327	9,458	1,767
Belgaum	10	3, 4, 5, 6, 44, 45, Part 7, 8, 46, 48	74,361	7,518	4,918	2,163
Gulbarga	11	17, 23, 33, 44, Part 6, 19, 24, 32, 42, 43, 49	62,982	3,810	1,996	2,014
Total	29		219,680	23,655	16,372	5,944

**Source: Brochure on continuous water supply (KUWASIP) circulated by KUIDFC, Regional Office, and Dharwad

After a two stage tender process, an water operator known as M/s Compagnie Generale Des Eaux-Seureca JV was selected, and from them Jain Irrigation Systems Limited received contract for manufacturing, supply, installation & hydro testing of PolyEthylene (PE) water distribution pipelines plus fittings and related accessories including installation of water meter & replacement of individual customer house service connections in the selected demonstration zones of cities of Hubli-Dharwad, Belgaum, & Gulbarga. The PE pipelines & fittings installed city wise are as given below:

Table 3. Length of PE pipes in meters installed in each city ***

PE pipe outer diameter (mm)	Hubli (m)	Dharwad (m)	Belgaum-South (m)	Belgaum-North (m)	Gulbarga (m)	Total (m)
20	30,744	-	23,485	23,355	13,485	91,069
32	292	-	742	584	574	2,192
63	40,673	20,846	19,648	29,382	22,159	132,708
110	18,206	7,246	13,204	10,760	14,356	63,772
160	5,875	3,528	4,046	4,662	4,506	22,656
200	1,315	627	761	423	2,324	5,449
315	1,677	1,217	880	987	1,549	6,310
400	-	-	-	-	1,438	1,438

***Source: Jain Irrigation Systems Limited, Jalgaon, Maharashtra

3. SUSTAINABLE AND SUCCESSFUL 24 X 7 WATER SUPPLY SYSTEM

The urban water supply situation in Karnataka has a lot of scope for improvement, since just about PolyEthylene (PE) pipes have played a major role in transportation of water in 24x7 project across the world. Today new pipeline installations, in India and in most other countries 100% water supply distribution pipes are made from PE. The material has shown its merit in many past earthquakes, is ideal for water distribution as well especially when reducing NRW (Non Revenue Water) and UFW (Unaccounted For Water) has become so critical. The 24 x 7 water supply system is sustainable and successful because of major advantage of PE pipes which are illustrated below:

Pipe Material and hydraulics

1. Corrosion resistance - PE pipes due to its non polar nature do not rust. Hence there is no need of: Internal or external coating, cathodic protection or use of chemicals in water supply pipelines.
2. PE is resistant to corrosion and hence the pipe bore/internal diameter remains the same throughout the service life. PE pipe behaves as an "ideally smooth conduit", offering extremely low resistance to the flow of fluids. The C value of PE pipes is 150 which remain constant throughout the service life. PE pipes by far have the best hydraulics when compared with any conventional piping materials.
3. UV resistance - PE pipes compounded with 2.5% finely dispersed Carbon black have excellent resistance to sunlight / UV.
4. Permeability - PE pipes are not permeable for water as well as natural gas which are established by Indian as well international standards like ISO 4427 and ISO 4437. PE pipes are the best options today in marine atmosphere (seawater intake / outfall lines), corrosive chemicals and for industrial applications.
5. Chemical resistance - The resistance of PE pipes to strong acids and alkalis are phenomenal, not susceptible to attack by inorganic acids and alkalis. Hence for diverse composition of sewage, PE pipes are often an excellent option.

Design, Installation and jointing

6. PE pipes are joined using butt fusion or electrofusion jointing/welding. Homogenous fusion joints of PE pipes are always stronger than the pipe. In case of any piping network the joint is its weakest link and it always fails / leaks from the joint.
7. PE pipes do not need anchor blocks at bends/change in direction due to much higher joint integrity.
8. Flexibility is an advantage of PE. Due to its flexibility, even large diameter pipes can take the shape of curved trenches without the need for any fittings / bends.
9. Flexibility also makes it possible to supply PE pipes in large coils thereby eliminating need for jointing and installation can be much faster. Conventional pipes have to be joined every 6 or 12 meters, all of which are potential area for water loss due to leakage. Whereas in PE pipes up to 110mm diameter are available in coil form up to 1 km length.
10. Due to flexibility and high elongation at break (>600%), PE pipes can shed stresses to surrounding soil by temporarily deforming or expanding and recovering when the stress is removed. Hence it can take high burial load and surge pressure (even 4-5 times operating pressure) without breakage.
11. PE pipes do not break under impact, they just temporarily deform and recover from short loading. All specified PE pipes are tested for 50 years minimum lifetime with factor of safety of 1.25. Hence they are fit for purpose for both short and long term loading.
12. In case of loose backfill, chances of PE pipe joint failure / leakage is virtually nil due to flexibility and high elongation at break. In case of conventional socket jointed pipes loose backfill can cause misalignment in the joint arising out of self weight / short term loading, causing leakages.
13. PE pipes do not require special bedding or well defined compaction during installation.
14. Today PE100 materials are available with very high resistance to slow crack growth, which can be installed even in rocky terrain without special bedding.
15. PE pipes (Medium Density PolyEthylene – MDPE & High Density PolyEthylene-HDPE) and related fittings are available from 20mm to 2,000mm outer diameter.

4. INSTALLATION OF 24X7 WATER SUPPLY PIPING NETWORK

Figure 1 to Figure 6 shows the installation of PE piping network for the 24x7 water supply network.

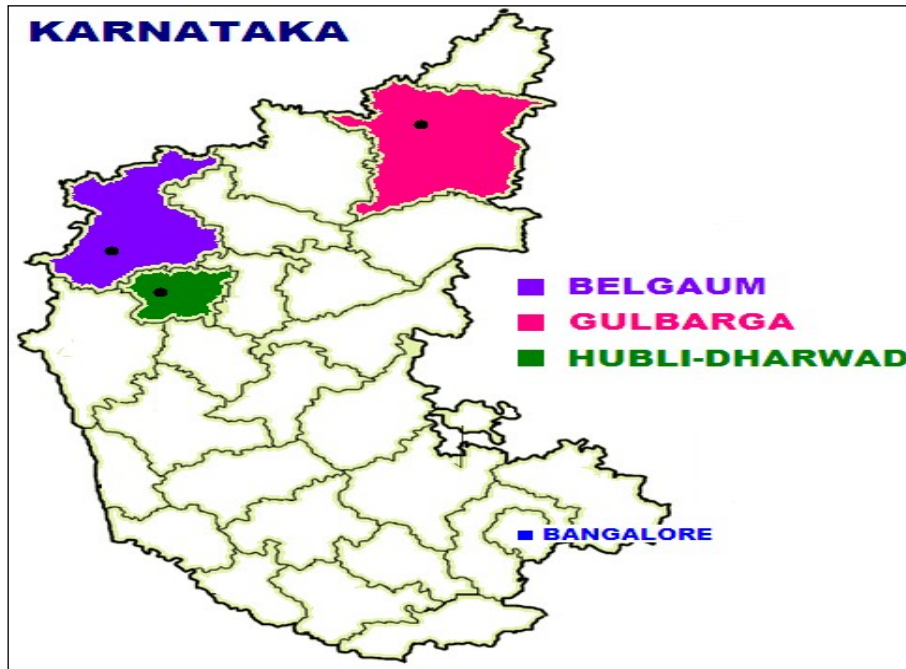


Figure 1. Project key plan showing demo zones selected from four cities in Karnataka State, India.

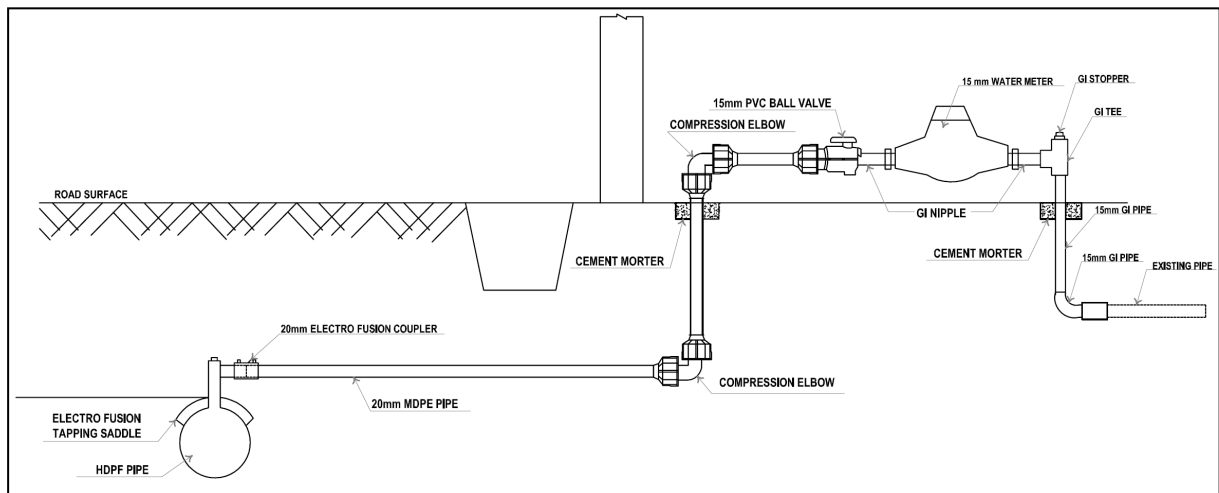


Figure 2. Typical House Service Connection using PE pipes (MDPE & HDPE) and fittings, water meters. Water wastage by consumers reduced substantially by adopting metering and volumetric based billing.



Figure 3. No heavy lifting equipments needed for secondary site transportation of PE pipes.



Figure 4. Easy and fast installation of PE pipes in crowded area. Joining carried out outside the trench requires lesser trench width, saves trenching cost.



Figure 5. Inherent flexibility of PE pipes simplifies installation without disturbing existing utilities.



Figure 6. PE pipes are available in coil up to 1km length, results in lesser joints and faster installation in congested area.

5. WATER TARIFF AND BILLING

Government of Karnataka revised the water tariff for 24x7 supply of continuous water in the demo zones. Prior to KUWASIP every household who were not served with water on volumetric basis were required to pay Rs. 1,000 per annum irrespective of volume of water supplied. After 24x7 continuous water supply, they are required to pay according to actual water consumed. As per the Government Order the minimum charge per connection for a domestic consumer who consumes a maximum of 8,000 liters each month is Rs. 48 per month. It is estimated that monthly consumption of 10% consumers in the demo zone is between 10,000 to 20,000 liters, 30% is less than 10,000 liters and nearly 60% consume more than 25,000 liters per month. Whereas, a domestic consumer in non-demo zone who is not served with volumetric basis water supply is required to pay a minimum amount of Rs. 90 per month. It was learnt that some consumers (especially small families) in the demo zone due to less consumption of water (about 8,000 liters) receive Rs. 48 per month as water charges when compared to a similar family in non-demo zone who is paying Rs. 90 per month that too for receiving water once in three days.

6. BENEFITS OF THE 24X7 WATER SUPPLY PROJECT

- 1) Overall the project has been quite a learning experience with bringing in the latest technology for pressure testing, leak-proof PE pipes up to the consumer points which is jointed together without any leakage/loss of precious water. Since it is developed as a single network in a demo zone, there is no need for a valve man to open and close valves as there are no valves in the system. At the beginning of the system which is opened and water supplied at a given pressure which is usually more than 6 metres. There are 6,500 connections now and the revenue has gone up from Rs. 3.5 Crores to Rs. 16 Crores.
- 2) The present loss in the demo zone is measured at about 3% whereas it is nearly 50% in non-demo zones.
- 3) There are more applications now being received for water connections. Nearly 3,120 new connections have been given in Hubli Dharwad cities in addition to old connections. Some people are requesting for two connections due to assured water supply. Due to increased pressure, the water reaches up to 20 feet (1st floor) without need for water to be stored in overhead tanks or to be pumped with electric motors as is usually done in the urban areas elsewhere in the Karnataka State.
- 4) Almost all public stand posts are now removed except a few more for the purpose of usage for non-drinking purpose or for use by cattle etc.
- 5) Because of metering and volumetric charging on the water consumed low quantity users like 6,000 litres to 10,000 litres per month under Type I have been getting the minimum base water charge of Rs. 48 whereas the Type II users who are using more than 10,000 to 15,000 liters are getting little higher than Rs. 100, which they have accepted without much problem. However, the Type III users who were the large users and taking water for gardens, washing cars etc., are complaining because of higher bills. Though they realise that it is as per consumption yet earlier their bill was fixed per month of Rs. 48 which has gone up to Rs. 400 to Rs. 600 per month based on the consumption of 15,000 litres and beyond. Such users are slowly realising that this type of billing is based on realistic consumption and therefore are reducing their consumption of water.
- 6) Due to availability of water 24 hours all through the week, many people are not storing water any longer. Earlier when there was intermittent supply (once in three days), people used to throw away stored water when the water supply commenced so as to take fresh water. Now this wastage is not there. With metering and volumetric based billing consumers are not wasting water any longer.
- 7) Since most of the public taps are now closed because 100% water connections are given in the demo zones (all old regular water connections have been connected under the project). Many unauthorized connections are authorized now. Many people are coming forward for taking second connection for tenant or upper floors.
- 8) Volume of water consumption has come down due to the 24 hours water supply as there is no spillage in the demo zones. Due to lower and realistic consumption of water, KUWSDB is saving water and is able to divert the same to other localities.
- 9) Quality being checked on a regular basis indicates that there is greater confidence by the users as they feel there is no need to further filter the water supplied.

- 10) Earlier water used to let into an underground sump inside the consumer's premises and later pumped into a rooftop water tank. With 24/7 supply, the energy cost is saved.
- 11) Earlier large sumps used to be built while constructing houses, but due to 24/7 assured supply, it is no longer necessary to have a sump and its cost is saved by the consumer.
- 12) Nearly 12,000 houses are benefited by this system due to assured supply; it has been found that there is less consumption and saving of nearly 50% of water from bulk supply point.
- 13) Safe, corrosion and contamination free water supply is assured to all levels of society.

REFERENCES

Work Order (2006): From M/s Compagnie Generale Des Eaux-Seureca to Jain Irrigation Systems Limited, Jalgaon, Maharashtra.

Dr Sanjay Dahasahasran, Madhuri Mulay (2008): Solution for 24x7 Water Supply, Case study of Badlapur City, Maharashtra Jeevan Pradhikaran.

Priya Sangameswaran, Roopa Madhav, Clifton D'Rozario (2008): 24/7, 'Privatisation' and Water Reform: Insights from Hubli-Dharwad, Special article, EWP Economic & Political weekly.

Oscar Alvarado and N. V. V. Raghava (2010): 24x7 Water Supply is Achievable, WSP, Water and Sanitation Program, The Karnataka Urban Water Sector Improvement Project.

Administrative Staff College of India (ASCI), Hyderabad: 24X7 Urban Water Supply – A PPP Attempt in Hubli-Dharwad, Karnataka.

The Deccan - Karnataka Hubli-Dharwad (2011), Centre for Science and Environment, New Delhi