STUDY OF WATERWORKS OF PHUNTSHOLING THROMDE

Phuntsho Samdrup[1] Thinley Gyelmo[2] Kencho Tobgay[3] Tadashi Takahashi[4]

Research and Publication Board, College of Science and Technology.
* E-mail: pemac@cst.edu.bt[1], cwangmo@cst.edu.bt[2], dechen@cst.edu.bt[3], dril@cst.edu.bt[4]

Abstract

The study is undertaken to assess the current situation of the Thromde water supply and suggest measures to improve the system. As per the data collected and a thorough analysis, the quantity of water available from the treatment plant should be sufficient to meet the current demands of the consumers, but the current situation says otherwise. The water available to the users was insufficient. This incongruity in the supply and demand was attributed to excessive leakage form the old and corroded water pipelines and poor management. The most severely affected areas are the Public Works Department (PWD) and Royal Bhutan Army (RBA) colony. After carrying out an extensive and detailed survey of the water supply system in these areas, replacement of old pipes with new ones were suggested with increased diameters and also addition of intermediate storage tanks. It was also found out that most of the distribution and service G.I pipe lines were old and corroded which might contaminate the water. However, the water quality test conducted showed that there is no contamination in the distribution system. The data also suggested that the management needs to continuously and supervise the water distribution for an effective water supply system. A new source also needs to be identified for meeting the expected population increase.

Key Words : Water treatment plant, Performance evaluation, Demand, Consumption

1. INTRODUCTION

The available raw water must be treated and purified before supplying it to the general public. The various stages of treatment methods used are screening, filtration, sedimentation, aeration and disinfection. However, the methods adopted for the purification depends mostly on the character of the raw water.

After the water has been made safe from the treatment, it has to be supplied to the consumers in their individual homes. The function of carrying the water from the treatment plant to each individual home is accomplished through a well-planned distribution system. A distribution system consists of pipe lines of various sizes to carry the water, meters to measure the discharges, pumps for lifting and forcing the water into the distribution pipes, distribution or service reservoirs for storing the treated water to be fed into the distribution pipes. The water may be supplied to the public continuously for 24 hours, or it may be supplied intermittently during certain fixed hours of the day.

The most preferred distribution of water is the continuous water supply- water for 24 hours a day, but currently Phuentsholing Thromde follows an intermittent water distribution. Intermittent water supply is the case in which water is supplied at regular intervals throughout the day and is used when the available supply and/ or the hydraulic capacities of the water supply system are too weak.

The duration of water in Phuentsholing town is limited to 2 to 3 hours. There are some places with 24 hours water supply, while in some places the water is very scarce with only 1 hour a day. This problem could be associated with the insufficient capacity of the treatment plant or due to excessive leakages. The data collected suggest that even though the water at the plant is enough for its respective area, there is still limited water supplied to these areas. Thus this accounts to the poor management practices that lead to the insufficient supply.

2. METHODOLOGY

2.1 Assesment of current water supply system

The evaluation of the current water supply system was carried out through site visits, questionnaire survey and data collected from the Thromde office. The city supply system consists of treatment plants, storage tanks, distribution tanks, distribution networks and appurtenances.

2.2 Population and demand survey

The initial phase of the research was to understand the current situation of the distribution network of the Phuentsholing Thromde. A questionnaire survey was carried out to achieve that goal. A total of 110 questionnaires were prepared and the area of interest was the area where the water was being supplied by the three-treatment plant. Since most of the areas were divided into colonies, 9 to 10 households were chosen from each colony for the survey. The questionnaire was mainly focused to understand the current duration of water that was being supplied and to check if the quality of water was up to the standard set by the Thromde. From these questionnaires, the problems associated with the distribution could be determined for the research.

The next important phase was the collection of data that was necessary to move forward with the research. Although the questionnaires helped us determine the problematic areas but they do not provide any hard evidences to support the statements provided by the public. Ergo this became the most important phase during the research. For the initial analysis, data such as the current population served by each treatment plant and the production of each treatment plant was collected to check how the water demand is fulfilled. The general consumption of water by the public was also determined. From this information, a general conclusion could be drawn as to whether the exact water produced is available for consumption or lost during the conveyance. We were able to avail most of these data at the Phuentsholing City Corporation.

2.3 Water quality test

Every individual the rights to clean water and in order to provide this right consistently, the treatment plant and the distribution network should be maintained to be a 100% effective. To check if the water is clean, tests were conducted at the three treatment plants and also at the tap point. Tap point, included the areas where the water is being supplied by the treatment plant. Since most of distribution pipes are very old, such measures were taken to conclude whether the water is being contaminated or polluted during the conveyance from the treatment plant to homes.

The parameters chosen for the quality analysis is the turbidity, hardness and pH. An additional chlorine test was carried out at the tap point to ascertain whether the chlorine was added regularly or not. The result obtained was compared to the IS 10500 and the standards used by the Phuentsholing City Corporation (PCC) to determine if the water quality is up to the required standard.

2.4 Construction of maps

Maps were of particular interest during this research. These maps were constructed using ArcGIS (Geographic Information System) and AutoCAD. The maps of the distribution network of the Phuentsholing Thromde, supply areas and the areas with limited water supply were limited.

2.5 Population Survey

The Phuentsholing City Corporation doesn't have a record of the people residing in each colony, so a population survey became a necessity. Due to time constraints and many phases of the project to cover, the survey was narrowed down to the colony with severe water supply problems- PWD colony and RBA colony.

3. RESULT AND ANALYSIS

3.1 Production Vs demand of South Treatment Plant

In order to design a water supply scheme for a particular section of the area, it important to

calculate the amount of water available and the amount of water demanded by public. Per capita demand (Singh, 2003):

Table 1: Calculation of demand of South Treatment Plant

Sl No.	Type of Institute	Demand (litres/capita/day)
1	Domestic	135
2	Fire Demand	14
3	Losses and Wastages	54
	Total per capita demand	203

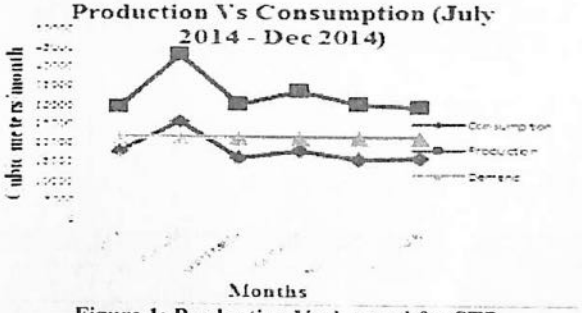

Figure 1: Production Vs demand for STP

According to Figure, the production is proportional to the demand, so it can be concluded that the water produced at the South Treatment Plant should be enough for the distribution as demanded. But the data retrieved from the Thromde shows that the water consumption is less. The consumption of water lies below the demand curve. This suggests that although the production meets the demand, there are losses occurring in the distribution process.

3.2 RBA colony

From the survey, RBA has an estimated population of approximately 496. According to calculation, the demand of RBA colony was 100.7 m^3/day or 3020.7 m^3/month per head.

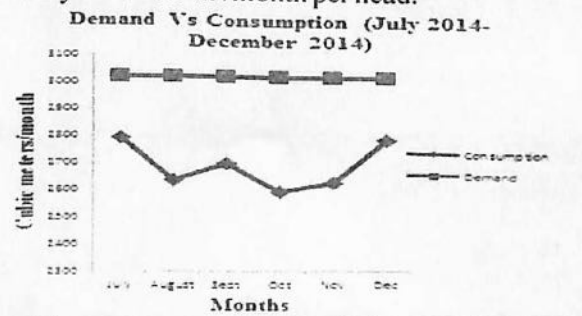

Figure 2: Demand Vs consumption of RBA colony

As depicted in Figure 9, the consumption curve lies below the demand curve, which indicates that the demand of RBA colony is not met. Figure 9 clearly shows that the water available at the treatment plant should have been enough, that brings us to one conclusion-the water is lost during conveyance from the treatment plant to the respective households at the RBA colony or there isn't enough storage to store the water supplied by the treatment plant.

The analysis for taking into account the change in diameter of the pipe for the ease of flow and for increase in discharge of water is shown below:

Table 2: Recommended size for the pipes

Storage Tanks (m)		Pipe Diameter (mm)	
Current	Recommended	Current	Recommended
26.8	34	50	60

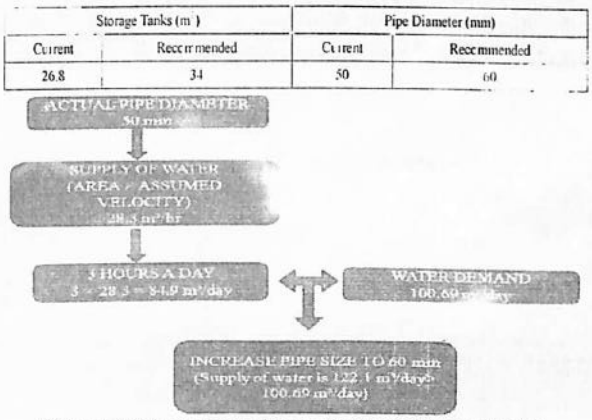

Figure 3: Flow chart for analysis of Pipes of RBA colony

Thus for RBA colony, the following analysis has been made as per their current storage capacity and population.

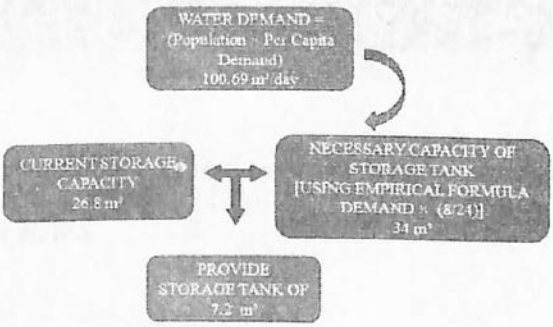

Figure 4: Flow chart for the analysis of storage capacity of RBA colony

3.3 PWD colony

As per the survey, the most severe case was recorded at PWD colony. The duration of water supply is limited to one hour a day. The estimated population of the PWD colony was 240. So the calculated water demand is 48.7 m^3/day per head, which is approximately equal to 1461 m^3/month per head.

The figure below shows the graph of the consumption data retrieved from the Phuentsholing City Corporation and the demand of the PWD colony. Similar to RBA colony, here the demand is not met by the treatment plant; in fact the situation is much worse compared to RBA colony. The water consumption is very low and lies much lower than the demand curve as depicted in the Figure.

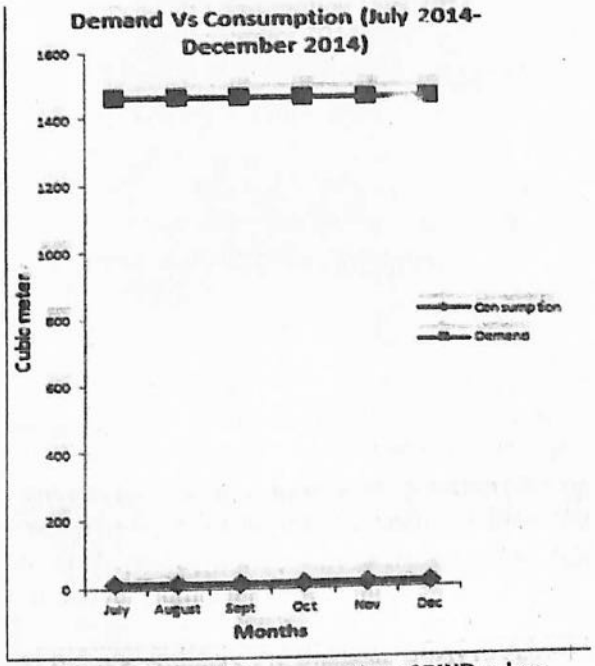

Figure 5: Demand Vs consumption of PWD colony

One plausible reason could be the lack or absence of storage facility in the PWD colony. Thus for the PWD colony, the following analysis was carried out and concluded that a storage tank of capacity 16.24 m^3 was required.

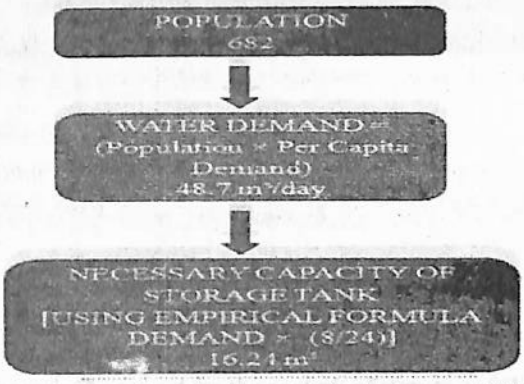

Figure 6: Flow chart for the analysis of storage of PWD colony

3.4 Water quality analysis

3.4.1 Treatment plant

The first water test was conducted at the three treatment plant viz. North Treatment Plant, South Treatment Plant and Kharbandi Treatment Plant. Water samples before and after the treatment were collected. The parameter chosen for the test were turbidity, hardness and pH. A set of three samples was taken for each parameter. Thus a total of six samples were tested for the analysis. As a standard, IS 10500 was chosen and the results obtained from the test were compared for any discrepancy in quality. The results obtained are shown below:

Table 3: Test result for the Kharbandi Treatment Plant

Particulars	Observations		Permissible Limits (BIS standard)
	Before Treatment	After Treatment	
pH	7.85	7.65	6.5-8.5
Hardness	210.21	214.21	Less than 500
Turbicity	1.6 NTU	1.3 NTU	1-5 NTU

Table 4: Test result for the North Treatment Plant

Particulars	Observations		Permissible Limits (BIS standard)
	Before Treatment	After Treatment	
pH	7.48	7.23	6.5-8.5
Hardness	190.19	185.69	Less than 500
Turbidity	1.3 NTU	1.1 NTU	1-5 NTU

Table 5: Test result for the South Treatment Plant

Particulars	Observations		Permissible Limits (BIS standard)
	Before Treatment	After Treatment	
pH	7.98	7.94	6.5-8.5
Hardness			Less than 500
Turbidity	1.2 NTU	1 NTU	1-5 NTU

3.4.2 Tap Point

The second water test was conducted at the tap point. The test was focused mainly on the areas connected to the three treatment plants. Around nine to ten households connected to each plant were chosen for the test. A total of three samples for each parameters; pH, turbidity, hardness and chlorine were obtained. The Phuentsholing City Corporation provided the portable instruments required for the test. The standard of test result was compared to the standard approved by the Phuentsholing City Corporation.

Table 6: Test result at the tap point supplied by North Treatment Plant

North Treatment Plant				
Location	pH (6.5 –8.5)	Hardness (< 200)	Chlorine	Turbidity (1 - 5)
Norgay Area	8.3	60	Nil	1.29
Trade Office	8.46	75	Nil	2.89
FCB Auction Yard	8.4	75	Nil	1.8

Table 7: Test result at the tap point supplied by Kharbandi Treatment Plant

Kharbandi Treatment Plant				
Location	pH (6.5 – 8.5)	Hardness (<200)	Chlorine	Turbidity (1 - 5)
Gompa Area	8.46	75	Na	1.3
RBA Colony	8.44	75	Na	1.89
Rinchending Checkpost	8.36	60	Na	1.75

Table 6: Test result at the tap point supplied by South Treatment Plant

South Treatment Plant				
Location	pH (6.5-8.5)	Hardness (< 200)	Chlorine	Turbidity (1-5)
RBA Colony	8.55	35	Nil	1.29
RBP	8.37	75	Nil	1.75
BOB Colony	8.45	75	Nil	2.49
PWD Colony	7.9	100	Nil	2.42
CWC Colony	8.45	90	Nil	1.83
PSA	7.89	40	Nil	2.32
Bhutan Telecom	8.18	90	Nil	1.38

4. CONCLUSION

The study shows that the water available at the treatment plant is sufficient for the current demand but the water consumed at the household was very less compared to the water that has been produced at the treatment plant. This suggests that the water might be lost during the conveyance or there is illegal tapping of the water pipes. Thus the water distributed to the areas decreases considerably. The losses could also account to the development of pressure in the pipes. This however can be improved by proper management of the water network; providing metered water or by providing pressure reducing valves at the junctions or by providing storage tanks and changing the diameter of pipes for the ease of flow of water through the pipes.

The study on the quality assessment of the distribution network of the Thromde showed that the water quality parameters; hardness, turbidity and pH were all within the permissible limits, thus the result indicate that there are no contamination during the conveyance. However it came into attention the addition of chlorine not being implemented daily.

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