Hydraulic Design of Water Treatment Plant for Arvi City

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Abstract

Potable water treatment is one of the most challenging and complex systems that municipalities need to deal with considering limited resources. A study from mid-90s showed that the continuously deteriorating Canadian water supply system would require $3.1 billion to bring the system at satisfactory level. Drinking water treatment plants (WTP) include several components, such as tanks, basin, and pumps. Operators are able to spend a small portion of the available resources or their plant's infrastructure and equipment compared to water quality and day-to-day operational activities. The research presented in this technical paper aims at developing condition assessment model(s) for the WTP components. Essential condition parameters of WTP include technical, physical, environmental, and operational aspects. To determine the condition index of a WTP component, value additive multi-attribute theory has been used where average weights and scores are considered for the model parameters. Data on WTP conditions are collected from experts and consultants across Canada and the United States. It is concluded from the model results that the average condition index for settling basins, ranges from 9.6 (best scenarios) to 1.9 (worst scenarios) and from 9.6 to 3.4 for pumps. Analysis reveals that, for tank and basins, design and construction parameter is the most important parameter for WTP condition, while the operational parameter is the most important one for pumps. The developed models are expected to benefit academics and practitioners (municipal engineers, consultants, and contractors) to prioritize inspection and rehabilitation planning for existing water treatment plants.

Introduction

Water is a basic human need. Rapid development of human civilization and advancement of scientific and technological innovations are changing the condition or our planet giving rise to fundamental transformation of the environment in which water play a crucial role. The relentless increase in demand of water for various purposes brought about by population growth, and agriculture and economic development combined with increasing population of water supply have a raised serious problem. Water can no larger be taken for granted as it is limited and valuable resources. Available water, must therefore, be optimally harnessed and used most beneficially under appropriate priorities of use consistent with the requirements.

The aim of a water treatment to produce and maintain water that is hygienically safe, aesthetically attractive and potable, in an economical manner. Through the treatment of water could achieve the desired quality, the evaluation of its quality should not be confined to the end of the treatment facilities but should be extend to the point of consumer use.

The method of treatment to be employed depends on the nature of raw water and the desired standard of water quality. The unit operation in water treatment constitute aeration, flocculation and clarification, filtration, disinfection, softening, deflouridation and water conditioning and take many different combinations to suit the above requirements. The choice of any particular sequence of treatment unit will depend not only on the qualities of raw water available and treated water desired but so on the comparative economies of alternative treatment steps applicable.

Looking towards the increasing population and increasing demand of water, quantity of water distributed to the people of Arvi city (70 MLD) is not sufficient. Keeping in mind towards changing lifestyle of people and their day to day activities we have design the new water treatment plant by taking the capita demand of 205 LPCD as per IS 1172-1993 Cl. No 4.1.

A minimum of 70 to 100 liters per head per day may be considered adequate for domestic needs of urban communities, apart from non-domestic needs as flushing requirements. As a general rule the following rates per capita per day may be considered minimum for domestic and non domestic needs:

For communities with population up to 20,000 and without flushing system

a) Water supply through 40 lphd (min) stand post.

b) Water supply through 70 to 110 lphd house service connection

2) For communities with population 20,000 to 50,000; 110 to 150 lphd together with full flushing system.

For communities with population above 50,000 to 2,00 000; 150 to 240 lphd together with full flushing system.

For communities with population above 2,00 000 to 5,00,000; 240 to 275 lphd together with full flushing system.

For communities with population above 5,00,000 to10,00,000; 275 to 335 lpcd together with full flushing system.

For communities with population over 10,00,000; 335 to 362 lpcd together with full flushing system.

NOTE - The value of water supply given as 150 to 200 liters per head per day may be reduced to 135litres per head per day for; houses for Lower Income Groups (LIG) and Economically Weaker Section of Society (EWS), depending upon prevailing conditions.

Literature review

The aim of a water treatment to produce and maintain water that is hygienically safe, aesthetically attractive and palatable, in an economical manner. Through the treatment of water could achieve the desired quality, the evaluation of its quality should not be confined to the end of the treatment facilities but should be extend to the point of consumer use.

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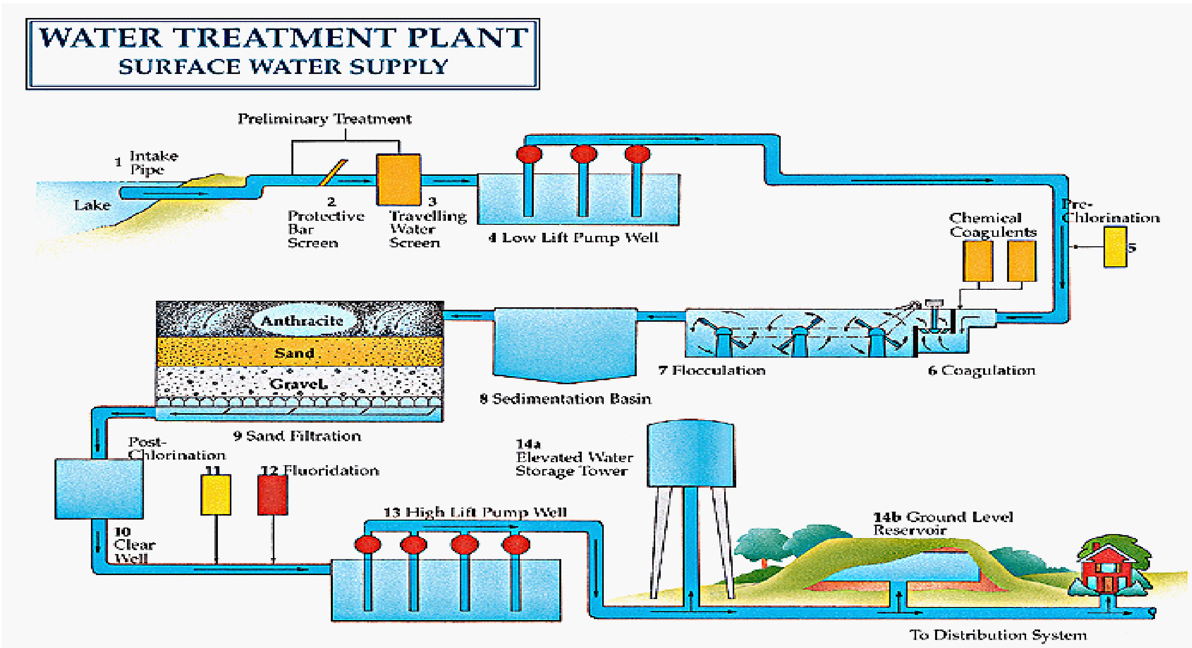

Silent features of project

Sr. No.	ATTIBUTE	DATA
1.	Name of Project	Hydraulic Design of Water Treatment Plant for Arvi City (68 mld)
2.	Population Year 1991 Year 2001 Year 2011	 1,97,997 1,92,667 2,82,358
3.	Method of forecasting	Incremental increase method
4.	Design population Base year - 2021	 3,95,560

	Intermediate year - 2031 Ultimate year - 2041	5,23,290 6,74,665
5.	Demand of ultimate year	138 MLD
6.	Demand of intermediate year	108 MLD
7.	Water demand available	70 MLD
8.	Requirement of water demand	68 MLD
9.	Intake Source	Lower Wardha Dam
10.	Site for WTP	Sai Nagar, Arvi
11.	Capacity	68 MLD
12.	Distance from source	30 Km (approximate)

Conclusion

A successful project involves integration of various fields. This is an attempt to combine several aspects of environmental, chemical and civil engineering. The project consist of complete components of water treatment plant of 68 MLD capacity which is to be design for the YAVATMAL city perfectly to meet the increasing demand of water, quantity of water distributed to the people.

The units are summarized as follows.

- Cascade aerator
  - No of steps :- 6 Nos
  - Rise of step :- 0.3 M
  - Tread of step :- 0.6 M
  - Flash mixer
  - Diameter :- 2.7 M
  - Power required :- 2 KW

- Clariflocculator
  - Diameter of flocculator :- 15 M
  - Diameter of clarifier :- 45 M
  - Internal dia. Of pipe :- 0.8 m
  - Free board :- 0.3 M

- Rapid sand filter
  - Size of laterals :- 80 mm
  - Size of manifold :-500 mm
  - Size of orifices :- 12 mm
  - No. of orifices per lateral :- 14
  - Spacing of twin orifices per c/s :- 120 mm c/c
  - Size of pit for manifold of 500 mm dia :- 0.8 m x 0.8 m
  - Sludge storage lagoon
  - No of compartments :- 2
  - Size of each compartment :- 32 M X 20 M

- Sludge drying bed
  - Size :- 32M X 10 M
  - Sand depth :- 0.3 M
  - Depth of gravel :- 0.3 M
  - Bottom slope of each bed :- 1%
  - Dia. Of outlet pipe :- 200 MM

- Pure water sump
  - Size :- 25M X 20 M

- Chlorine required
  - For 7 days :- 448 kg

- Alum required :- 2986.67 kg/d

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