UP GRADATION OF THE SUKHNAG WATER TREATMENT PLANT BY MEANS OF TUBE SETTLERS.

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ABSTRACT

The objectives of the project is to augment 45.00 mld of water for providing water supply for Zone-IV i.e. Bemina and Soibugh areas in Greater Srinagar by tapping raw water from Sukhnag Nallah and providing distribution system in Zone IV area to supply water as per CPHEEO's norms.The present project is for augmentation of water supply and providing distribution system in Sukhnag zone in Greater Srinagar for the present 2007, Intermediate (2023) and ultimate (2038) stages are 15.36 Lakh , 26.50 Lakh and 33.75 Lakh respectively.

Key words: Design methodology,assessing demand,estimation of future demand,tube settlers.

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1.INTRODUCTION

Srinagar is located in between two hills, the Shankaracharya Hill or Takht-i-Suleiman and the Hari Parbhat. The city is located on the two sides of Jhelum River. The total area of Srinagar is 114 sq.km.and it is located in an elevation of 5200 feet.Srinagar is adorned with beautiful lakes. Dal Lake needs no introduction; this is the central attraction of Srinagar city. An extension of Dal Lake is Nigeen Lake which is beautifully fringed by numerous trees. Organized water supply facilities were introduced in Srinagar in 20th century by impounding Dachigam Nallahand transmitting the water by a masonry aqueduct up to Nishat. Thereafter, water supply facilities developed gradually, but always falling behind requirement of a rapidly growing population. In 1971-72, three surface water treatment plants were in use: Nishat(7.2MGD), Alustang(4.8MGD), and Doodh Ganga(2.25MGD), totaling toa supply of 14.25MGD.It was estimated in 1961 that the per capita level to supply, in the areas them covered by the system was around 91 lpcd (20 gpcd). The distribution system has extended in haphazard fashion without system level planning, resulting in poor residual pressure and low supply. As per available estimates, the present population of Greater Srinagar is 15.36 Lakhs (2007).

The existing water supply treatment systems in 2007 are designed as Nishat, Alustang, Doodhganga, Rangil, Sukhnag and Pokhribal systems and together they have an installed capacity of 57.55MGD for the population of 15.36 Lac, providing thus 37.47 Gallons per capita per day.

Table i: Present various existing systems along with information pertaining to the source, type of system and installed capacity in Greater Srinagar City.

table (i)

S.No.	System	Source	Type	Installed Capacity In MGD
1	Nishat	Dachigam Nallah/Dal Lake	Lift/Gravity	19.00
2	Alustang	Sindh Nallah	Gravity	6.80
3	Doodganga	Doodganga Nallah	Lift	10.00
4	Rangil	Sindh Nallah	Gravity	30.00
5	Pokhribal	Nigeen Lake	Lift	4.00

6	Sukhnag	Sukhnag Nallah	Gravity	10.00
		Total		79.8

2. Future demand projections and projects

The future demand of water depends upon various factors. Some of these are discussed below in order to gain an understanding of the dynamics involved in demand estimations.

WATER SUPPLY PROGRAMME FOR GREATER SRINAGAR						
YEAR		2008	2023		2038	
Population		16.08lac	27.95lac		36.40lac	
Demand		62.00 MGD	106.50 MGD		139.50 MGD	
Capacity		Existing MGD	Existing (MGD)	Proposed (MGD)	Existing (MGD)	Proposed (MGD)
1	Rangil	30.00	30.00	…..	30.00	20.00
2	Alustang	6.80	6.80	10.00	16.80	…..
3	Pokhribal	4.00	4.00	…..	4.00	…..
4	Harwan	0.00	0.00	10.00	10.00	0.00
5	Nishat	19.0	19.00	…..	19.00	10.00
6	Doodganga	7.75	10.00	0.00	10.00	2.00
7	Sukhnag	10.00	10.00	…..	10.00	3.50
8	Tangnar	…..	10.00	0.00	10.00	6.00
Total installed Capacity		77.55	89.80	20.00	109.80	41.50
			G.Total=89.80+20.00 =109.80MGD		G.Total=109.80+41.50 =151.30MGD	

The total installed capacity of plants at present is 69.8MGD. The details of location, capacity of WTPs and the raw water sources are as under.

S.No.	Location of WTP	Capacity of WTP	Name of the sources
1.	Rangil	30MGD	Sindh Extension canal
2.	Alustang	6.80MGD	Sindh Extension canal
3.	Nishat	19MGD	Dal Lake
4.	Doodganga	10MGD	Doodganga Nallah
5.	Pokhribal	4MGD	Nageen Lake
6.	Sukhnag	10MGD	Sukhnag Nallah
7.	Tangnar	10MGD	River Jhelum

Total Installed Capacity	69.8MGD	

3. Brief of present project

The project envisages construction of 10.00MGD (45MLD) water treatment plant, 15 MLD storage Reservoir and distribution system to cover the entire area of Sukhnag Zone.

4. Design Methodology

All piped water supply system, are to a greater or lesser extent, hierarchical systems. In other words, water comes from a centralized source and is transmitted and distributed through a network that breaks into smaller branches, at each level, rather a tree branches out from the trunk through a major branches to smaller branches, twigs and leaves

ASSESSSING DEMAND: The demand for the water is sum of the demand from individual households. In order to estimate the demand, it is therefore necessary to assess the population to be served by a scheme and then to multiply this by the average per-capita water consumption.

The steps in assessing demand are as follows:

- Assess the existing population in the project area.
- Estimate the likely population at the end of the design period.
- Establish the existing per-capita consumption, allowing for both house connections and stand posts and allowing for any commercial and industrial demand

Detailed design

The steps in detailed design are as follows:

- Establish detailed design parameters
- Decide the system layout, taking into account the proposed source and any existing mains and topography to equalize pressures
- Analyses the scheme and revise main diameters as necessary
- Decide the location of valves and other appurtenances
- Record final decisions on main sizes ,location of valves etc. on either an actual or a diagrammatic plan of the system

Each of these steps should be recorded in the design calculations.

Hydraulics of conduits

Pipelines normally follow the profile of the ground surface quite closely. Gravity pipelines have to be laid below hydraulic component.

The design of supply conduits is dependent on resistance of flow, available pressure or head ,allowable velocities of flow, scour, sediment transport, quality of water, and relative cost. There are a numbers of formulas available for use in calculating velocity of flow. However we Use HAZEN – WILLIAMS formula for pressure conduits.

It is expressed as:

$V=0.849*C*r^{0.63} *S^{0.54}$ (Ref: 6.2.1.9 of manual of water supply and treatment and CPHEEO manual, page 104)

$V=4.567*10^{-3}C*d^{0.63}*S^{0.54}$

3.4 Overview:

General features of treatment plant

- Location:
  - State : Jammu and Kashmir
  - District : Budgam
  - Tehsil : Budgam
- Source : Sukhnag Nallah
- Location : Parthan Budgam
- Location of Reservoir : Dadina
- Type of scheme : Gravity

- Per capita supply rate : 135 LPCD+15%UFW
- Population : 3.66 lac souls
- Present Supplies : 10.00MGD
- Proposed up gradation : 3.5MGD via tube settlers
- Type of treatment : Pre settling, Coagulation Sedimentation Rapid Sand Filtration Post Chlorination
- Areas under scope : Warrapora, Haran, Dharmuna, Soibug, Sabdan,Reshipora, Doru, Narakar, Galwanpora, Rakhi hakermulla, Humhama Khumani chowk, Zainakote, Bemina, Goripora, Pratabgarh, Chowdribagh etc.
- Population [lacs]
  - Year 2001 : 1.16Lacs
  - Year 2008 : 1.45Lacs
  - Year 2023 : 2.82Lacs
  - Year 2038 : 3.66Lacs

Broad Technical details

- Capacity of plant : 10MGD
- Capacity after up gradation : 13.5MGD
- Source : Sukhnag Nallah
- Type of Treatment : Coagulation, Sedimentation, Rapid Sand Filtration, Post Chlorination

Treatment Details

Flocculation and Sedimentation
Mixing of alum dose by means of
Flash mixer and Clariflocculator.

- Detention time for flash mixer : 44.3 Secs
- Detention time for flocculation : 22 Minutes
- Detention time for Clarifier : 2.5 Hours
- Area of tube settlers proposed : $134.64m^2$
- No. of tube settlers proposed : 53860
- Surface loading for clarifiers : $38.23m^3/m^2$/Day
- No. of clariflocculators : 2 no.
- Filtration
  - Type : Rapid sand gravity type
  - Shape : Rectangular
  - No. of beds : 8
  - Size of each bed : 8.15m*10.5
  - Filter media : Sand and Gravel
- Disinfection Chemical proposed : Bleaching powder, liquid chlorine
- Population : 3.66 lac souls
- Present supplies : 10.00MGD
- Up gradation : 3.5MGD{total=10+3.5=13.5mgd}
- Maximum discharge : 17.84Cumecs
- Minimum discharge : 3.88Cumecs
- Intake works : diversion weir, escape, supply channel
- Raw water conductor : DI-800mm dia
- Clariflocculator : 33m dia
- Pipe mains : DI-100-800mm dia

- Distribution System : 100mm dia

4.**Up gradation of the Sukhnag treatment plant by means of Tube settlers**

Usually up gradation involves construction of new units of clariflocculator, filter house etc. It will involve new land for construction, which may or may not be available plus the construction cost of units. Keeping in view these, the present project can be easily upgraded by using the new technology of tube settlers.Tube settlers offer an inexpensive method of upgrading existing water treatment plant, clarifiers and sedimentation basins to improve performance. They can also reduce the tank age/footprint required in new installations or improve the performance of existing settling basins by reducing the solids loading on downstream filters. Made of lightweight PVC, tube settlers can be easily supported by minimal structures that often incorporate the effluent trough supports. They are available in a number of module sizes and tube lengths to fit any tank geometry, with custom design and engineering offered by the manufacturer . Both new and existing plants can reap the benefits of intermediate cost saving and increasing efficiency by installing tube settler modules in partial section of clarifier only .

Fig: 4.1a: Tube settler modules placed in Clariflocculator

Fig 4.1b: Tube settlers showing contact

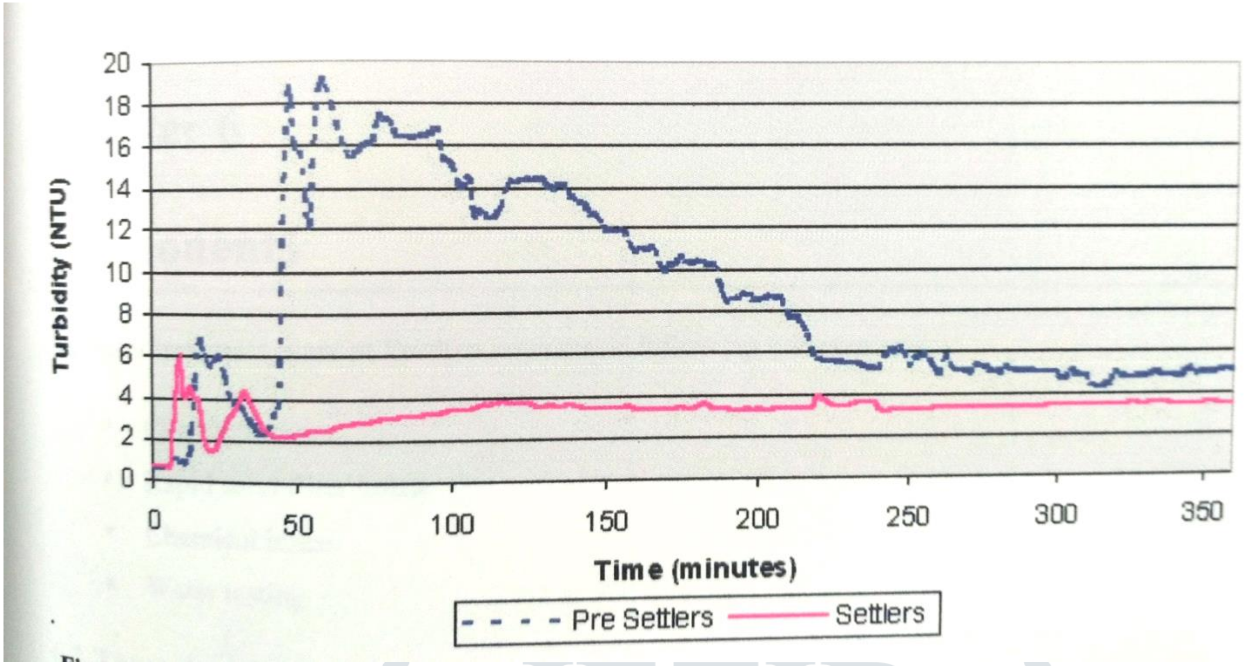

Fig 4.1c: clarifies water turbidity comparison graph from 2002 conference

5.Hydraulic design with installation of tube settler module

Hydraulic design

Capacity of plant = 13.5 MGD
Type of scheme = Gravity
Add 6% water on account of backwashing = 3677.4m^3/day
Total =64967.4m^3/day
Assuming half hour is lost in washing
Working hours in bed = 23.50 hrs
Q/HR = 2764.57 m^3/hr
Q/sec = .77m^3/sec

5.1 stilling Chamber :-

Stilling chamber is to be provided followed by weir.
Providing an inner pipe of 1500 dia with opening of dimension 600 square.
Area of openings = $4x0.6^2 = 1.44m^3$
Velocity .77/1.44 = .534 m/sec
Assuming 30 seconds detention period in chamber
Vol needed = 0.569x30 = 17.07m^3
Providing a circular stilling chamber
Let inner dia of central pipe = 1500mm
Wall thickness = 125mm
Providing dia of stilling chamber = 3m
Therefore depth = /4 $[3^2$ x $2^{2]}$h = 17.07
H = 4.34m
Area provided = $5^2 - /4(2)^2 = 21.86m^2$
Depth needed = 0.78m
Providing 800mm depth
A sharp crested weir with a minimum width of 3000mm is provided along one of the sides of stilling chamber.
L = 3m Q = 0.77m^3/sec
Q_{max} = 1.5 x 0.77 = 1.15 (@50% overload)
= 2 x 0.6 x32 x 9.81 x $H^{3/2}$
H = 0.7158m
Providing 1M x 1M channel section
Velocity in channel v = 0.569 x 1.5 = 0.85m/sec

5.2 Flash mixer :-

Volume provided = { x 9 x 4.83}/4 = 34.14m^3
Provided dia = 3.0m ; depth = 4.83m
Detention period = 34.141/0.77 = 44.33 sec
Power requirement = 0.25HP/MGD = 3.375 HP
Providing 4HP capacity motor coupled with suitable reduction gear mechanism to give 100RPM of blade.
Distribution chambers are provided adjacent to flash mixer. Inlet & outlet chambers of size not less than 1M x 1M. The depth of inlet chamber will be same as that of flash mixer.
The opening in the chamber will be at bottom while depth of outlet chamber will be up to the outlet channel joining flash mixer and the chamber at the clarifer wall.
Providing 900mm wide channel towards each flocculator from distribution box.
Q = 0.77/2 = 0.385m^3/sec
Q_{max} with 50% overload
Depth = 0.5m
Carrying capacity = 1.5 x 0.385 = 0.5775 m^3/sec

Velocity = 1.155 m/sec
Size of channel is to be provided with controlling gates & measuring devices.

Influent pipe to central cylindrical shaft
Flow in the pipe = 0.5775 m^3/sec
Dia. Required = 0.6m
Velocity in pipe = 2.042m/sec which is less than 2.5 m/sec hence ok

5.3 Clariflocculator

Q = 0.385 m^3/sec
Central shaft dia assumed = 900mm
A = 0.636m^2
V = 0.9m/sec
Flow in to flocculator = 0.385m/sec
Ports of water outlet are provided at top portion of shaft
Velocity through ports = 0.448m/sec
Total area of ports required = 0.385/0.448 = 0.86m^2
No. of ports already provided = 24 (3 rows of 8 ports each)
Area of each port = 0.265m^2
Size of each port = 0.15 x 0.2
Additional ports to be provided = 1.28/24 x 0.15 x 0.2 = 1.19 = 2
C/c spacing = 1.2)/8 = 0.47M = 470 mm c/c
External dia of pipe = 1.20m

Flocculator

Volume already provided = 513m^3
Depth of water = 4.0m
Area provided = 513/4 = 128m^2
Thickness of brick partition wall = 115mm
Outer dia of flocculator = 12.85 m
External dia. Of flocculator = 13.10m
Detention period in the flocculator = 22min

Clarifier

Instalment of tube settlers.

Average output required from tube settler = 0.385 m^3/sec
Let length of tubes = 1m
Cross section of tube settler = 50mm x 50mm
Angle of inclination of tube settlers = 60^0
Settling velocity of particle = 50 m/day
Assuming y/y_0 = 0.7 and 1/8
Kinematic viscosity of water = 1.007 x 10^{-6} m^2/sec

Relative length of settler = 1000/50 = 20
Effective length of tube = 20- .033V
Where v is the velocity of the flow through along the tube settler in m/day
$S_{c} = V_s/V$ [sina +(1+cosa)]
V = 247.05 m/day
Tube entrance area = Q/V = 0.385 x 24 x 3600/247.05 = 134.64m^2
No. of tubes required = 134.64/.05^2 = 53857.92 = 53860

Check for surface loading:-
Q = 0.985m^3/sec Area = $(35.77^2-13.10^2)$ = 870M^2

surface loading = 0.385 x 24 x 3600/870 = 38.23m^3

Conclusion

Tube settlers offer an inexpensive method of upgrading existing water treatment plant clarifiers and sedimentation basins to improve performance. They can also reduce the tankage footprint required in new installations or improve the performance of existing settling basing by reducing the solids loading on downstream filters.Made of lightweight PVC, tube settlers can be easily supported with minimal structures that often incorporate the effluent trough supports. They are available in a variety of module sizes and tube lengths to fit any tank geometry, with custom design and engineering offered by the manufacturer. Both new and existing plants can reap the benefits of of immediate cost saving and increasing efficiency by installing tube settler modules in partial section of clarifier only. This way as the demand of water increase modules can be added without constructing new basins.

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