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Sewerage Scheme Analysis of Sagar (M.P)

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Abstract— *Sewage treatment is the process of removing wastewater and household contaminants. It involves various processes to remove chemical, biological and physical contaminants. The main function of this treatment process is to reuse of treated effluent and sludge back for agriculture purpose as fertilizer. The unawareness about such project directly relates to wastage of such water and leaving same in natural water stream which ultimately alarming situation for universe. The increment in awareness and concerns in recent years gave birth to this concept to reduce direct load of rain water on every aspects and distribute such treated water to agriculture purpose and drinking purpose up to some extent, if permitted by World Health Organization. Recent study showed that sewerage system reduces diarrhea by about 30% [1]. In Sagar city, the total sewer network divided in different zones and will be collected to their zonal pumping stations [Hereafter mentioned as PS] and from PSs it will be collected at Sewage Treatment Plant [STP] for further process. The achievement of removal of 95.5% BOD, 90% COD, 75% Total Nitrogen, 95.67%TSS & 81.25% is possible. The paper mainly focuses on design considerations, planning, costing and challenges in the sewer project and practical solutions for same.*

Keywords— *BOD, Challenges, COD, Costing, Design, Planning, SBR Technology.*

I. INTRODUCTION

To minimize the wastage of natural water and reuse of such treated water, preferably for agriculture purposes is the concept behind this treatment process. Due to intensive development of industrial sectors in Sagar city, there is also increment in domestic, industrial effluent and runoff which ultimately increases the wastewater of this city. Generally, wastewater creates through sources like washrooms, bathrooms, kitchens, etc. This water contains biological, chemical and physical contaminants and to remove such contents, sewage treatment plant is designed [2]. In general, activated sludge process type treatment is preferred, but for this city, Municipal Corporation of Sagar designed Sequential Batch Reactor[SBR] type sewage treatment plant. The reason behind designing Sewage Plant is to stop dumping wastewater into famous LAKHA BANJARA LAKE and take that to treatment plant for further process and leaving into nearby nallah. The sewage treatment plant is designed at the peak factor of 2.25 i.e., 43 Million Liters per day [MLD]. The efficiency of sewage treatment plants can be determined by a study of pollutant levels of the influent and the effluent at the treatment plant of sewage treatment plants discharging into the environment [3].

1. *In the Present*

Sagar city is increasing tremendously due to established military stations, universities, police training exercise stations, nearby Rajghat Dam, asthetical view of centrally placed lake and well connection of roads to capital city, Bhopal [M.P]. Besides it is strange to say that this city being most important city of Madhya Pradesh has not yet provided proper and adequate sewerage system.

Residents of Sagar city produces both liquid and solid waste. The waste water generally produces from residentials, commercial, institutional and industrial establishments.

The sewage water contains toxic components which are harmful for agriculture, building purpose [4]. Also, such wastewater contains various harmful compounds, bacteria and pathogens which stimulates the growth of plants. Till date, such sewage was mixing with the city lake and polluting it in massive proportion hence the idea of sewage treatment plant is developed. Due to such water, lake is producing foul smell in nearby area and also harming flora and fauna of lake. With the march of civilization growing social consciousness there has been incessant demand to dispose of liquid waste in a proper and sanitary manner i.e. collect them in system of sewers.

II. DESIGN

The main components of sewerage project are 221 kms of pipeline, 9260 manholes, 10028 house service chambers, 494 kms of PVC pipeline from house to property chamber, 7.8 kms of trunk main line and a 43 MLD sewage treatment plant.

1. *Design Parameters*

Sewage flow: As per CPHEEO manual, the rate per capita should be taken at the rate of 80% of water supply. The water supply is 135 LPCD. So 80% of 135 LPCD is 108 LPCD and it is assumed.

Peak flow: Peak flow depends upon density of population, topography of site, hours of water supply and hence it is variable for different sites. So as per density of population considered, the peak factor is taken as 2.25.

Slope of network lines: Slope for network line as per guidelines:

TABLE 1. Network slope.

Sr. No.	Diameter of Pipe (mm)	Min. slope
1	150	1 in 170
2	200	1 in 250
3	250	1 in 350
4	300	1 in 450
5	375	1 in 670
6	450	1 in 830
7	Greater than 450	1 in 1000

Design period: As per recommendation on sewage system following design period is adopted.

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TABLE 2. Design considerations.

Sr. NO.	Units	Period (Yrs)
1	Sewer Network	30
2	Pumping Main	30
3	Pumping machinery	15
4	Sewage treatment Plant	15
5	Pumping station	30
6	Effluent disposal	30
7	Effluent utilization	15
8	Project utilization period	4

Design features:

TABLE 3. Design features.

Particulars	Requirement
Population	273357
Design population	428986
Per capita sewage flow	108 LPCD
Peak flow factor	2.25
Self-cleansing velocity	0.6 m/s
Total Avg. flow	43 MLD
Zone I	19.53 MLD
Zone II	17.92 MLD
Zone III	8.87 MLD
Pumping stations	3

2 Sewage Treatment Plant:

Treatment Units

A. Primary Treatment System

i. Inlet Chamber
ii. Fine Screens
iii. Grit Removal Unit
iv. Oil And Grease Removal Chamber
v. Parshall Flume

B. Sequential Batch Reactor

C. Chlorination System

D. Sludge Handling

i. Sludge Sump and Sludge Transfer Pump
ii. Mechanical Dewatering Unit
iii. Centrate Sump and Pump

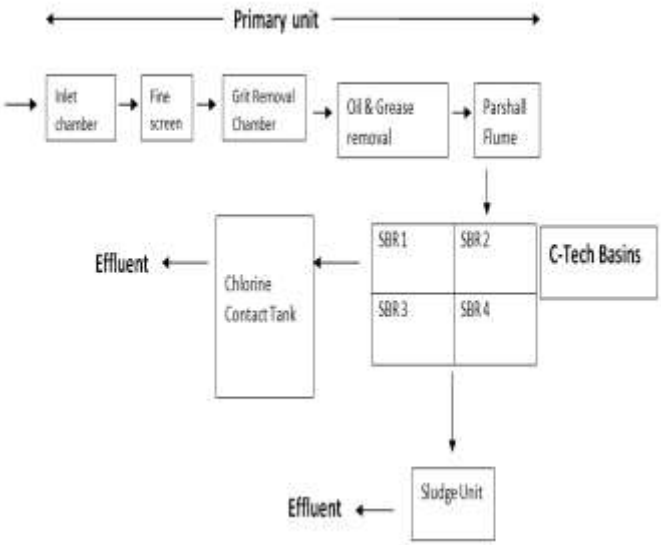

Fig. 1. Typical flow diagram of STP (SBR) Technology.

3. Design considerations for Treatment Plant:

TABLE 4. Inlet parameters.

Sr. no.	Parameter	Unit	Design Value
1	Suspended solid	mg/l	231
2	BOD	mg/l	224
3	COD	mg/l	500
4	Total Nitrogen	mg/l	40
5	Free Ammonia	mg/l	25
6	Total Phosphorus	mg/l	8

TABLE 5. Outlet parameters.

Sr. no.	Parameter	Unit	Design Value
1	pH		6.5-9
2	BOD	mg/l	≤10
3	COD	mg/l	≤50
4	Suspended solid	mg/l	≤10
5	Total Nitrogen	mg/l	≤10
6	Total Phosphorus	mg/l	≤2

3. Pumping Station:

Sewage has to be lifted somewhere as it cannot pass under gravitational force upto the STP hence zone wise three pumping stations designed.

TABLE 6. Pumping stations.

Sr. No.	Pumping Station	Peak flow in lps	Capacity of PS for peak flow in cum
1	PS 1	555.21	124.92
2	PS 2	494.39	111.25
3	PS 3	1297.66	291.97

III. PLANNING

The sewerage network consists of following units:-

1. Collection and conveyance of sewage from all zones to treatment plant.
2. Treatment units.
3. Effluent and disposal and utilization.

For the purpose of sewer network, these three zones will be named as:-

1. Zone I
2. Zone II
3. Zone III

It has been decided upon contours, built up area and residential area of the city.

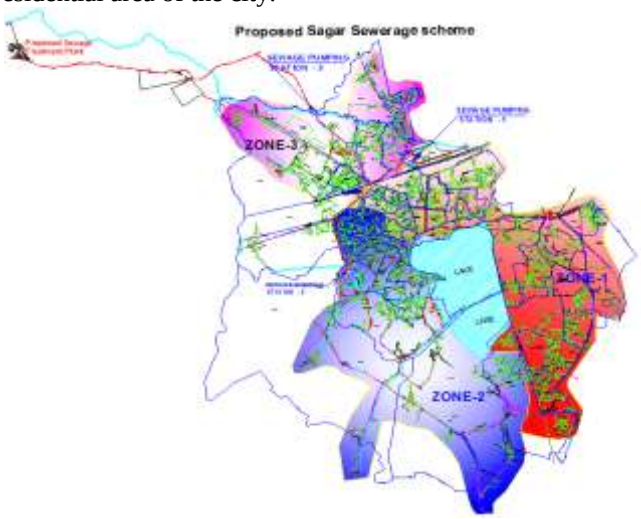

Fig. 2. Proposed sewer scheme.

1. Planning and defect liability

TABLE 7. Overall planning of various components.

Particulars	Time period
Survey, Design & Drawing Approval	6 Months
Network	3 years (Including Monsoon)
STP	674 days (Including Monsoon)
Pumping main	3 Months
Defect Liability period	
STP	5 Years
Road restoration	One rainy season

IV. COSTING OF THE PROJECT

As network has to be laid through city and carrying out this sewage towards STP, this involves variable ground data, variable topographical situations, according to cost has been allotted. Due to heavy cost of project, Sagar Municipal Corporation given permission to contractor on the basis of pro rata share. If contractor unable to process for large advance from itself, he can get part payment for each and every component like design and drawing approval, survey, bring pipes of various diameter, laying and road restoration, etc. Cost of project in brief;

TABLE 8. Overall cost in brief.

Sr. No.	Particulars	Cost
1	Estimated cost of project	Rs. 29279 lacs
2	Estimated cost as 2011 census	Rs. 11074.89
3	Estimated cost as per design population	Rs. 7057.10
4	Maintenance cost/Year	Rs. 865.41 Lacs
5	Domestic connection charge/month	Rs. 200
6	Cost of STP	Rs. 4000 Lacs

If contractor unable to keep progress as per requirement of Municipal Corporation even after having sufficient resources, then heavy liquidated damages to be fined as per situational effects till the end of project.

V. CHALLENGES AND ISSUES ON SITE

- *Effect of local people influence:* Local people create more nuisance on site due to unawareness of such project which is being difficult for working conditions.
- *Unawareness of sewerage scheme:* Till date in India, sewerage scheme is observed as negative scheme due to lack of knowledge and awareness. People don't want to see their area is excavated for sewer line or manhole and property chambers which creates negative points in peoples mind ultimately hampering the project progress.
- *Presence of black cotton soil:* As having lowest soil bearing capacity and difficult for working conditions, the working in black cotton soil is most challenging task observed on site. Proper care and safety provisions are required on site when working in such conditions. There is provision of angle of repose for safe working conditions in such soil.
- *Geographical topography of city:* As per observation, lot of level difference and undulation on site which makes task of sewer line laying difficult. It is possible to give proper slope to line so sewer water pass by gravity purpose.
- *Strata:* Due to hard strata and metamorphic rock conditions observed on site, it is hampering the daily progress report. Use of advanced machineries can tackle the same. There is search for chemical powder which creates cracks into such rock making excavation easy.
- *Existing utilities:* Existing utilities like water supply lines, telephone cables, drains nallah river etc. makes working conditions difficult e.g., if railway crossing is there, need to go by trenchless technology only.
- *Illegal encroachment:* Another issue is encroachment which creates problems for working conditions and due to improper handling from Municipal corporations working progress is hampering. There is occurrence of delay if such encroachment is not tackled at earliest. Such encroachment has also support of local political influence so it becomes also difficult to remove such works. Such things can be avoided if Corporation of cities are centralized and duly aware about such things which makes such cities clean and clear with proper law and order which gets appreciation for them only.

VI. CONCLUSION

Involvement of local community, stakeholders, local leaders for implementation and monitoring of sewer activities are requirements to improve sanitation in upcoming rapid urbanization. One should have enough experience of this project as person have to deal with geographical conditions, topographical conditions, site management, quality standards, labor management, material management, etc. We can assume a better future of sewage treatment through advanced technologies so that there will be less wastewater discharging into the river. We can use solar energy for complete process in upcoming years so that there will be no need of electricity in treatment plants. We can use disposal called as 'sludge cake' for fertilizer purpose. There should be established team of R & D for new inventions so we can build energy efficient and energy generation plants in future. Future of sewage plants is not only pure waste management but also recovery of clean water, minerals and energy.

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