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A CASE STUDY ON SEWAGE TREATMENT PLANT

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ABSTRACT: Users must concentrate their Sewage/Wastewater treatment process to ensure that it complies with regulatory guidelines. The main purpose of Sewage treatment process is to remove the various constituents of the polluting load: solids, organic carbon, nutrients, inorganic salts, metals, pathogens etc. Effective wastewater collection and treatment are of great importance from the standpoint of both; environmental and public health. Sewage/Wastewater treatment operations are done by various methods in order to reduce its water and organic content, and the ultimate goal of wastewater management is the protection of the environment in a manner commensurate with public health and socio-economic concerns. In this article, Sewage/Wastewater treatment techniques, factors affecting selection and design Sewage/Wastewater systems are discussed briefly.

Index Terms* – *Waste Water Treatment, Design of STP, Emerging Technology.

I. INTRODUCTION

Sewage/Wastewater are essentially the water supply of the community after it has been fouled by a variety of uses1. From the standpoint of sources of generation, wastewater may be defined as a combination of the liquid (or water) carrying wastes removed from residences, institutions, commercial and industrial establishments, together with such groundwater, surface water and storm water as may be present.

Generally, the wastewater discharged from domestic premises like residences, institutions and commercial establishments is termed as “Sewage/Community wastewater”. It comprises of 99.9% water and 0.1% solids and is organic because it consists of carbon compounds like human waste, paper, vegetable matter etc. Besides community wastewater/sewage, there is industrial wastewater in the region. Many industrial wastes are also organic in composition and can be treated physio-chemically and/or by micro-organisms in the same way as sewage.

Before the late 1800s, the general means of disposing human excrement was the outdoor privy while the major proportion of the population used to go for open defecation. Sewage treatment systems were introduced in cities after Louis Pasteur and other scientists showed that sewage borne bacteria were responsible for many infectious diseases. The early attempts, in the 1900s, at treating sewage usually consisted of acquiring large farms and spreading the sewage over the land, where it decayed under the action of micro-organisms. It was soon found that the land became 'sick'. Later attempts included the discharge of wastewater directly into the water bodies, but it resulted in significant deterioration of the water quality of such bodies. These attempts relied heavily on the self-cleansing capacities of land and water bodies and it was soon realized that nature couldn’t act as an indefinite sink.

Methods of wastewater treatment were first developed in response to the adverse conditions caused by the discharge of wastewater to the environment and the concern for public health. Further, as cities became larger; limited land was available for wastewater treatment and disposal, principally by irrigation and intermittent filtration. Also, as populations grew, the quantity of wastewater generated rose rapidly and the deteriorating quality of this huge amount of wastewater exceeded the self-purification capacity of the streams and river bodies. Therefore, other methods of treatment were developed to accelerate the forces of nature under controlled conditions in treatment facilities of comparatively smaller size. In general, from about 1900 to the early 1970s, treatment objectives were concerned with: -

- The removal of suspended and floatable material from wastewater,
- The treatment of biodegradable organics (BOD removal) and
- The elimination of disease-causing pathogenic micro-organisms.

From the early 1970 to about 1990s, wastewater treatment objectives were based primarily on aesthetic and environmental concerns1. The earlier objectives of reduction and removal of BOD, suspended solids, and pathogenic micro-organism continued, but at higher levels. Removal of nutrients such as nitrogen and phosphorus also began to be addressed, particularly in some of the streams and lakes. Major initiatives were taken around the globe, to achieve more effective and widespread treatment of wastewater to improve the quality of the surface waters7. This effort was a result of -

An increased understanding of the environmental effects caused by wastewater discharges and

A developing knowledge of the adverse long-term effects caused by the discharge of some of the specific constituents found in wastewater.

Since 1990, because of increased scientific knowledge and an expanded information base, wastewater treatment has begun to focus on the health concerns related to toxic and potentially toxic chemicals released into the environment. The water quality improvement objectives of the 1970s have continued, but the emphases have shifted to the definition and removal of toxic and trace compounds, that could possibly cause long-term health effects and adverse environmental impacts. As a consequence, while the early treatment objectives remain valid today, the required degree of treatment has increased significantly and additional treatment objectives and goals have been added.

Sewage/Wastewater treatment involves breakdown of complex organic compounds in the wastewater into simpler compounds that are stable and nuisance-free, either physio-chemically and or by using micro-organisms (biological treatment). The adverse environmental impact of allowing untreated wastewater to be discharged in groundwater or surface water bodies and/or land is as follows -

- The decomposition of the organic materials contained in wastewater can lead to the production of large quantities of malodorous gases,
- Untreated wastewater (sewage) containing a large amount of organic matter, if discharged into a river/stream, will consume the dissolved oxygen for satisfying the biochemical oxygen demand (BOD) of wastewater and thus, deplete the dissolved oxygen of the stream; thereby, causing fish kills and other undesirable effects.

II. LITERATURE REVIEW

PUSPALATHA ET.AL (2016) REVIEWED ON DESIGN APPROACH FOR SEWAGE TREATMENT PLANT. A CASE STUDY OF SRIKAKULAM GREATER MUNICIPALITY.

The present study involves the analysis of parameters like BOD, raw sewage, effluent. The construction of sewage treatment plant will prevent the direct disposal of sewage in nagavali river and the use of treated water will reduce the surface water and contaminated ground water.

Pramod sambhaji patil et.al. (2016) studied on design of sewage treatment plant for Dhule city.

Some treatment units are designed like screens, grit chamber, storage tank, settling tank, aeration tank and skimming tank. The effluent can also be used for artificial recharge of ground water, flushing, foam control, fire protection, lawn sprinkling.

Murthy polasa et.al (2014) reviewed about design of sewage treatment plant for gated community.

In this project three types of treatment unit operations are conducted. Like physical, chemical and biological processes. By increasing the detention time of sewage in each treatment unit increases the efficiency of removal unwanted impurities.

Chakar Bhushan et al. (2017) reviewed about design of sewage treatment plant for Lohegaon village, Pune.

This project studied that social and environmental pollution issue due to sewage is disposed in some part of village and directly sewage drain in open land. It is used for recharging sub surface water level at Lohegaon and used for irrigation purpose.

M. Aswathy et al. (2017) studied on analysis and design of sewage treatment plant of apartment in Chennai.

This project is studied that domestic and commercial waste and removes the material with possess harm from generated public. To produce an environmental sewage fluid waste stream and solid waste suitable from disposal of use.

S. Ramya et al. (2015) reviewed on design of sewage treatment plant and characteristics of sewage.

The growing environmental pollution need for decontaminating water results in the study of characterization of waste water especially domestic sewage. The waste water leads to developing and implementing new treatment techniques to control nitrogen and other priority pollutants.

Sequential batch reactor (SBR) Lin et al. (2004), investigate the municipal sewage wastewater treatment by chemical coagulation and sequencing batch reactor (SBR) methods with an aim to elevating water quality to meet the standards required for agricultural irrigation. Both the conventional and modified SBR methods are considered. The conventional SBR technology is a batch process based on a single activated sludge treatment reactor. Chemical coagulation alone was able to lower the wastewater COD and color by up to 75 and 80%, (COD and NTU to below 20 and 2mg/l). The water quality was consistently excellent and was deemed suitable for agricultural irrigation.

Arrojo et al. (2005)

Gave a study on SBR process, in SBR process with help membrane process completely removes coliform bacteria and suspended solids, thus providing a higher quality effluent with respect to conventional processes. After SBR treatment neither found faecal coliforms nor E. coli were found in permeate. The removal efficiency of both bacteria and suspended solids by membrane filtration was 100%, suggesting that the experimented compact system (SBR + membrane filtration) could produce an effluent suitable for reuse in agriculture and could be a suitable technology for rural communities.

Subbaramaiah and Mall (2012),

This study show Use Based on the experimental results obtained, Sequencing batch reactor (SBR) was an attractive alternative to conventional biological wastewater treatment systems, optimum value of MLSS concentration to be maintained in the reactor is found to be 5000 mg/l. treatability of SBR for BA is good for higher concentrations (< 200 mg/l), and also removal percentage was increases with increase in initial concentration. The optimum value of temperature was found at 30oC. The optimum value of aeration time during fill phase is found to be 3 h, at full aeration rate of removal is rapidly increasing compare with anoxic condition in fill phase.

Sirianuntapiboon et al. (2005),

Gave a study based on Sequential Batch Reactor used in dairy wastewater treatment, in dairy waste treatment most of time we are use membrane coupled sequencing batch reactor (MSBR). After treatment our wastewater effluent concentration effectively decrease. Its efficiency COD, BOD5, total Kjeldahl nitrogen (TKN), and oil and grease removal efficiencies of 89.3, 83.0, 59.4 and 82.4%, respectively, when treatment was done at high organic loading rate (OLR) of 1.34 kg, BOD5/m^3d.

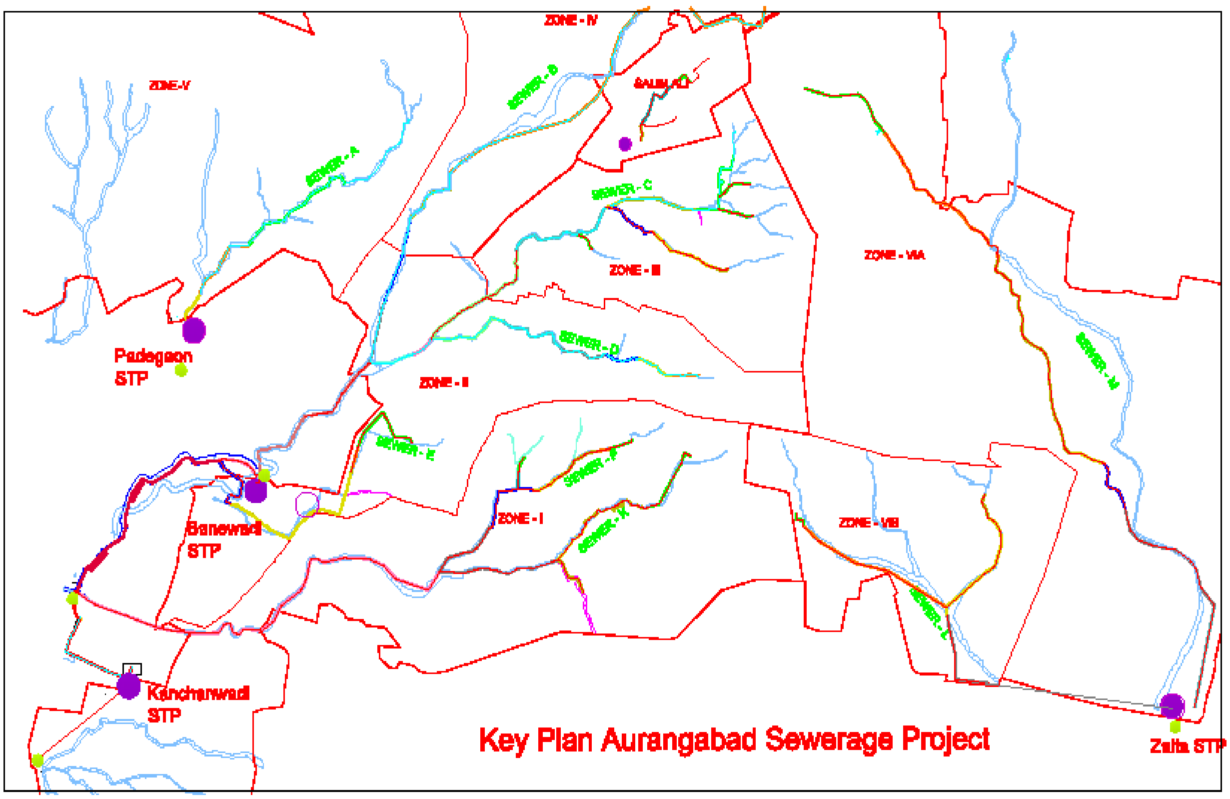
III. Case Study

Aurangabad Municipal Corporation as part of its strategy for infrastructure development in the City has prepared the DPR of Underground Sewerage Scheme under UIDSSMT.

The DPR has been technically sanctioned by Maharashtra Jeevan Pradhikaran for the cost of Rs. 365.69 Cr.

The main component of the Underground Sewerage Project is 260.12 Kms of proposed Sewerage collection Network of Pipes ranging from 150 mm to 2000 mm diameters and 60 km of main sewer network.6 Terminal Sewage Pumping Stations and One Intermediate Pumping Station at Ward No. 98. Proposed STPs at 6 different locations for the total capacity of 216 MLD.

The STPs proposed at the locations of Kanchanwadi -161MLD, Zalta - 35 MLD, Banewadi- 30 MLD, Siddarth Garden – 4.5 MLD, Padegaon – 10 MLD, CIDCO – 15 MLD



Name of the project	Aurangabad Sewerage Project, Aurangabad
Name of The Developer	Aurangabad Municipal Corporation
Project Management Consultant	Fortress Infrastructure Advisory Services, Mumbai
Contractor	M/s Khilari infrastructure Pvt. Ltd
Cost of Project	464.00 Cr.
Area of City	138 Sq. Km
No of STP's	4 Nos.
Location of Site	Backside of Dhoot Bunglow, Paithan Road, Kanchan wadi, Aurangabad
Date of Starting Training	15TH JUNE 2018
Date of Completion of Training	30TH JUNE 2018

Project description:

Under Aurangabad sewerage project components, the Kanchanwadi Sewerage treatment plant (STP) is designed for 161 MLD on Sequential Batch Reactor process (SBR).

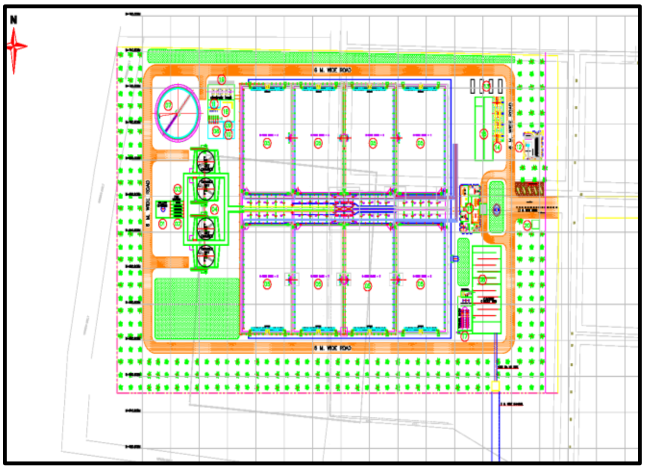
The Kanchanwadi STP consisting of main six unit's namely Primary unit – 1no. SBR basins – 8nos, Gravity Sludge thickener-1no., Sludge Sump -2nos., Centrifuge House 1 no., Chorine contact tank -1no.& Administrative Building – 1 no.

Basically, raw sewage from Sewage Pumping Station to Inlet Chamber of Primary is taken by pumping. The Sewage then enters into the Screen Chamber & passes through the Mechanical Screens. After screening the major particles, the sewage goes to the grit removal chamber where girt separated outby Grit Mechanism. After the Process of primary treatment (Fine Screens and Grit Chambers) the Sewage is taken to C-Tech basin. The entire Process of Primary unit to SBR basin is done by gravity.

The C-Tech basins are equipped with air blowers, diffusers, Return Activated Sludge (RAS) pumps, Surplus Activated Sludge (SAS) pumps, Decanters, Auto valves, Programmable Logic Controller (PLC) etc. All cycles will be automatically controlled using PLC. The treated effluent from the C-Tech Basins will then pass-through Chlorination tank where it is disinfected before its ultimate discharge.

<u>Specifications:</u>

1. **Primary Unit**
   - RCC Inlet Chamber (10M X 9M X3M) & 4.10 M above ground level
   - RCC Screen Chamber having 4 nos. Fine screens & 1no. Manual screen
   - RCC Grit Removal Unit (2nos.) having 1nos Grit Mechanism & Rack Mechanism
   -
2. **SBR basin- 35 M X 65 M X 6 M (8 nos.)**
   - RCC water retaining Walls of M40 grade concrete
   - MS pipeline of 200mm to 600mm dia.for air piping
   - Aeration assembly including UPVC Air piping 80 mm, Membrane & Diffuser
   - Decanter
   - Knife gate 100mm to 400mm dia.& Butter fly valve 600mm dia.
   - Return activated Sludge Pump (RAS) & Surplus activated Sludge Pump (SAS)



3. **Chlorination system**
   - RCC Chlorine Contact tank (48M X20 M X3.5M) with baffle walls
   - Chlorination House with chlorination system

4. **Gravity Sludge Thickener**
   - RCC circular tank (29M & 3.5 M depth)
   - Mechanical Scrapper

5. **Administrative building**

Brick work
- External Wall: 6" thick well finished brick work/block work
- Internal Wall: 4"/6" thick well finished brick work/block work

Plaster
- External Wall: Glass cladding
- Internal Wall: Plaster with Putty finish of superior quality

Windows
- Type: Powder-coated aluminium sliding window
- Granite window sills

Electrification
- Wiring: Concealed with main circuit breakers

Plumbing
- Type: Concealed plumbing in C. PVC & C. P. fitting
- Dry Terrace: Provision for washing machine, water and utility tap

Flooring and tiling
- Conference, Offices& PLC room - Vitrified tiles of superior finish
- Terrace: Anti-skid Ceramic tiles Staircase: Granite
- Lobbies: Vitrified tiles IInd class
- Parking: Chequered tiles/Pavered blocks

Doors
- Main, Conference & Office Door: Glazed glass door
- Store - Flush doors with both side laminates

Washrooms
- Floor Tiles: Anti-skid Ceramic tiles
- DADO for Bath& WC: Ceramic tiles up to 7.0' ht

Paintings
- Interior: Oil-bound distemper

Activities occurred at site:
- 1. Excavation
- 2. Plinth Filling
- 3. Column/Wall
- 4. Slab Beam
- 5. Footing/Raft
- 6. Formwork

Excavation

The process of removing rock or earth from a solid, broken, or unconsolidated layer of soil by means of an excavator, bulldozer, scrapper or any similar type of machine refers to the term excavation. In construction industry, earthwork is broad term used for excavation which includes the entire work cycle from digging, transportation and dumping of earth from construction site to the dumping area. Master checklist of the above activity was prepared on the basis of Checklists collected from Construction firms and few from online portals.

Column, Wall, Slab & Beam and Footing

Reinforcement Concrete has good compression strength but has low tensile strength and ductility. To counterbalance this, concrete is reinforced with steel bars to increase its tensile strength and ductility. Reinforcement is provided basically in all structural members which contributes towards strength of structure mainly slabs, walls, beams, columns, foundations, frames and more.

As per IS 456:2000, the structure can be under reinforced or balanced but cannot be over reinforced. In case of over reinforced, the structure may fail without any signs of cracks and hence should be avoided. Maintaining a quality becomes crucial for stability of structure. Master checklist of the above activity was prepared on the basis of Checklists collected from Construction firms and few from online portals.

Concreting

- A hard, strong construction material consisting of sand, gravel, pebbles, broken stone, or slag in a mortar or cement matrix
- Ordinary Portland cement - The cement and water form a paste that coats the aggregate and sand in the mix. The paste hardens and binds the aggregates and sand together.
- Water- Water is needed to chemically react with the cement (hydration) and to provide workability with the concrete. The amount of water in the mix in pounds compared with the amount of cement is called the water/cement ratio. The lower is the w/c ratio, the stronger the concrete. (Higher strength, less permeability).
- Aggregates- Sand is the fine aggregate. Gravel or crushed stone is the coarse aggregate in most mixes.

Formwork

Formwork is a temporary structure of mould into which reinforcement bars are placed and concrete is poured. It is upheld in position till concrete sets and removed dismantled after it. Formwork systems used concrete frame construction have continued to develop significantly. The major innovations have focused on on-site efficiency of production, health and safety, and environmental issues, driving the concrete construction industry towards ever-increasing efficiency. The modern formwork systems listed above are mostly modular, which are designed for speed and efficiency. They are designed to provide increased accuracy and minimize waste in construction and most have enhanced health and safety features built-in Formwork is also responsible for its aesthetical value as it going take the shape of the mould and should be placed with intense care. Master checklist of the above activity was prepared on the basis of Checklists collected from Construction firms and few from online portals.

Daily Work Progress report

Sr. No.	Category	Mason	Carpenter	Helper	Fitter	Helper	M/C	F/C	Total
1	Shuttering Work	0	6	9	0	0	0	0	15
2	Reinforcement Work	0	0	0	5	7	0	0	12
3	Curing	0	0	0	0	0	3	5	8
4	Concreting	1	1	2	1	2	6	9	22
	TOTAL MANPOWER	1	7	11	6	9	9	14	57

IV. RESULTS AND DISCUSSION

1. From the above discussion it can be concluded that in the developed countries much work has been done in the field of wastewater reuse system but we can't say the same about developing countries. In developing countries wastewater reuse is still in the beginning stage and much work is needed in that field.
2. Wastewater treatment performance now a day big problem if we improve our methodology, we definitely solved big problem.
3. There are plenty of emerging technology which are making increase performance of wastewater in reused system. But we used only appropriate technology whom suitable.
4. In Indian conditions, sequential batch reactor process is more economical and more efficient. It is a totally chemical process which is great for non-portable purpose. It needs less land but requirement of external energy source for its aeration and equalization along with chemical costs makes it costly.

5. Constructed wetland technology for water reuse in irrigation purpose is suitable because of its good efficiency and for its benefit to green belt areas. It's totally a natural process with no use of chemicals and hence there is no need of specialized supervision to run it. Its main drawback is its bad odour which becomes a breeding place for mosquitoes, requirement of more land and it's also a time-consuming process when compared to sequential batch reactor.

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13. Watson et al. (1989) and Kadlec and Knight (1996) studied on Constructed Wetland and found its multi-purpose sustainable utilization of the facility for uses such as swamp fisheries, biomass production, seasonal agriculture, water supply, public recreation, wild life etc.