A Proposed Methodology of Sewage Treatment Plant For Malkapur City

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Abstract- *As per CENSUS 2011, Malkapur town population is 68,431 out of which S.T. Population is 1,568 and S.C. population is 12,342. The population growth trend for the past few decades has been calculated. Population has average 25% growth rate from 1971 to 2011. The reason for rise in population during 1970 to 1990 is due to district headquarter establishment of Malkapur. People migrated to Malkapur and settled due to recruitments in govt. job. Apart from these large numbers of people are engaged in trade and business, small and micro entrepreneurship. No further economic activates took place to generate employment opportunities for the growing population in the town.*

Administrative jobs have absorbed required employees to manage the town or district level responsibilities. Due to saturation in job opportunities and no further employment generation after 1990, out migrations started causing decline in population growth. Drastic decline in population growth rate can be observed; more than 50% from 2001 to2011.

Keywords- sewage, malkapur, facultative, BOD etc.

I. INTRODUCTION

The primary treatment generally comprises primary sedimentation tank. The purpose of sedimentation of sewage is to separate the settle able inorganic solids so that the settled wastewater, if discharged in to water course, does not form sludge banks and when used for land disposal does not lead to clogging of soil pores and excessive organic loading. Primary sedimentation of sewage also reduces the organic load on secondary units.

Sedimentation is used in waste water treatment to remove

- Inorganic suspended solids or grit in grit chambers.
- Organic and residual inorganic solids, free oil and grease.
- Bio-flocculated solids or bioflocs from effluents of secondary biological treatment units.
- Chemical flocs produced during chemical coagulation and flocculation in secondary settling tank.

The settle able solids to be removed from wastewater in primary tanks alter grit removal are mainly organic and flocculent in nature, either dispersed or flocculated. The specific gravity of organic suspended solids may vary from 1.01 to 1.2. For primary sedimentation tanks, both, surface overflow rate and detention period (Hydraulic Residence time) are important design criteria as the solids to be settled are flocculent in nature and undergo flocculation. The detention period of 2 to 2.5 hours is generally provided for primary settling tanks. An overflow rate of 35 -50m3/m2/d is provided for primary treatment followed by secondary treatment.

Secondary Treatment

Secondary treatment consists of biological unit processes which are bro classified as suspended growth systems or attached growth systems depending whether the microbial population remains suspended in the liquid medium or attach to inert support medium. Bioreactors in which biomass grows attached to a medium such as rocks, slag or specially designed ceramic, plastic material synthetic materials under aerobic conditions constitute aerobic attached gm systems (e.g.) Trickling Filters, Rotating Biological Contactors. The +suspends growth system comprises Activated Sludge Process, having Aeration tanks, MMBR, etc. Aerobic and facultative bacteria are the predominant micro-organisms will carry out the oxidation and synthesis of organic matter. Their cellular masses come about 12% Nitrogen and 2% Phosphorous.

The selection of various treatment methods depends on various factors as so earlier. Following are the treatment alternatives considered for comparison to the most suitable and best treatment option or the sewage generated in the town.

1) Facultative Waste Stabilization Pond

Stabilization ponds are open, flow-through earthen basins specifically designed constructed to treat sewage and biodegradable industrial wastes. They are commonly known as oxidation ponds.

Figure1.1 :- Sewage in Town

The treatment comprises of:

a) Screening to remove floating material.
b) Degritting to remove grit particles of size greater than 0.15 mm and specific gravity 2.65.
c) Biological oxidation in the ponds.

Stabilization ponds provide comparatively long detention periods extending from a few to several days. During this period putrescible organic matter in the waste is stabilized in the pond through a symbiotic relationship between bacteria and algae.

In warm climate countries, pond systems are cheaper to construct and operate compared to conventional methods. They also do not require skilled operational staff and their performance do not fluctuate from day to day. The only disadvantage of pond systems is the relatively large [and requirement, but this is sometimes over-emphasized. The land on the outskirts of a growing city can be a worthwhile investment.

The facultative pond functions aerobically at the surface while anaerobic conditions prevail at the bottom. The aerobic layer acts as a good check against odor evolution from the pond. After screening and degritting, the sewage is taken to the stabilization pond. It is a large shallow lake with detention time of the order of 20-25 days. The oxygen required for BOD removal is supplied by algae that grow in the pond in the presence of sun-light. For depths beyond 1.6m in general, the sunlight cannot penetrate below due to non clarity. Hence Stabilization pond depths are limited to 1.6m. This leads to the provision of very large surface area. Such pond surface is subjected to wave action due to strong winds. Further due to high detention time, shallow depts. And large surface, the pond temperature is not significantly different from ambient. So if life summer and winter ambient varies too much, the reaction rates also very significantly. It is therefore necessary to design the pond for worst winter temperature when BOD removal will be slow due to low temperature as well as less sunlight. During the summer, the pond efficiency would increase and less detention time is required. So if the pond is constructed in isolated compartments, cleaning can be carried out compartment wise one after other.

Waste Stabilization Ponds are the simplest of all waste treatment technique available for sewage wastewaters. They are extremely simple to operate and are reliable but have some environmental issues i.e. odor and mosquito problem and ground water pollution.

Merits

- Achieving acceptable levels of treatment
- Requiring low capital treatment and maintenance costs.
- Requiring low ongoing operation and maintenance cost.
- Requiring less skilled operator knowledge than much conventional technology.
- Potentially having longer lifecycles than conventional electromechanical technology.
- In USA 1/3rd of all wastewater treatment plant are WSP, usually population up to 5000. [1]

2) Facultative Aerated Lagoon

The pond systems, in which oxygen is provided through mechanical aeration than algal photosynthesis, are called aerated lagoons. The aerated lagoon generally provided in the form of simple earthen basins with inlet at one end out the other to enable the waste water to flow through while aeration is usually prove by mechanical means to stabilize the organic matter. The major difference been ASP and PAL is that in the latter settling tanks and sludge recirculation re absent.

FAL are those in which some solids may leave with the effluent stream and settle down in the lagoon since aeration power input is just enough for oxygen and not for keeping all solids in suspension. Aerated lagoons are earthen be generally 2.5m to 5m deep, provided with mechanical aerators installed on floats fixed columns. Simple process with minimum of mechanical and electro equipment is required.

The treatment steps involved in this process axe:

a) Screening to remove floating material.
b) Degritting to remove grit particles of size greater than 0.15 mm and specification gravity 2.65.
c) Biological oxidation in the lagoons.

After screening and degritting,the sewage is taken to facultative lagoons,biodegradable organic matter is oxidized by mechanical means i.e.by surface area andgets stabilized and accumulates in bottom layers.The sludge thus accumulated in thebottom layers is removed once in 4 to 5 years for disposal.To avoid carryover ofsuspended solids from the lagoons,compartment is provided for settling of solids at theend of each lagoon.To maintain plug flow conditions,required numbers of baffles areprovided in each lagoon.

Merits

- Least susceptible to process of mechanical and electrical equipment & requirements are quite low as compared to ASP/TF/UASB.
- The process can be well controlled to achieve required effluent quality.
- Large land area is required.Compared to conventional electro mechanical plants.

3) Up Flow Anaerobic Sludge Blanket Followed By FAL

The Up How Anaerobic Sludge Blanket Reactor (UASB), maintains a high concentration of biomass through formation of highly settle able microbial aggregates. The wastewater flows upwards through a layer of sludge. Any biomass leaving reaction zone is directly re-circulated from the settling zone. The process has been used for treatment of municipal wastewater at few locations and hence limited performance data and experience is available presently. The reduction in BOD is about 60 to 70% but has the advantage of methane generation, which leads to power generation. We could think of this technology followed by FAL for villages having 20000 and above population and enough land available.

The treatment steps involved in this process are :

a Screening to remove floating material.
b Degritting to remove grit particles of size greater than 0.15 mm and specific Gravity.
c Anaerobic degradation in UASB Reactor.
d Biological oxidation in the lagoons.
e Sludge Drying [2]

After screening and degritting, the sewage is taken to UASB. In this anaerobic stabilization of organic matter is achieved in a specially designed reactor, called up flow anaerobic sludge blanket (UASB) reactor. After screen degritting, the sewage is fed to the bottom of reactor ensuring that the flow is distributed over the bottom of the reactor. Then sewage flows upward thought of anaerobic sludge in the lower part of the reactor called sludge zone stabilization of organic matter takes place by the anaerobic bacteria and converted into bio-gas and a small fraction converts into new bacterial cells. Biogas provides gentle mixing into the sludge bed. In the upper part a three phase liquid solid separator is installed. The biogas produced is collected in the hood from where it is withdrawn and collected in gas holder for end use by provide necessary equipment. Sewage being a low strength waste, it is not economic viable to install equipment of reutilization of gas as its capital investment will matched with the revenue available from the gas generated.

The effluent from the UASB Reactor is collected in Facultative Aerated Lagoon further treatment. In lagoon, the sewage is further oxidized by surface aeration the sludge is settled at the bottom. The effluent form lagoons, after passing through settling basin which is provided at the end of the lagoon to prevent carryout suspended solids along with the treated effluent.

4) Activated Sludge Process

This is conventional method of treatment. The plant consists of an aeration tan secondary settling tank; a sludge return line and an excess sludge waste line lead a digester. The BOD removal in the process is 85-92%. The aeration is either flow type or mixed flow regime. The completely mixed plant has capacity to hold a high MLS'S level has increased operational stability at shock load and also increased capacity to treat toxic biodegradable wastes like phenols. This is the basic aerobic treatment system, which gives good removal efficiency system is properly operated and maintained. Ibis alternative mainly consists of following activities.

a) Screening to remove floating material.
b) Degritting or remove grit particles of size greater than 0.15 mm and specific gravity 2.65.
c) Primary sedimentation to remove suspended solids
d) Aerobic Biological Oxidation
e) Sludge recirculation
f) Sludge thickening
g) Sludge digestion
h) Sludge drying

After screening a regretting, the sewage is taken to the aeration tank and settling tank In this process, after primary sedimentation where BOD and SS are removed respectively at 30% and 70% efficiencies, the sewage is fed to the aeration tank to oxidize organic matter. The settled sludge form secondary clarifier is re-circulated to the reactor to maintain the MLSS at desired level. The excess sludge will be thickened in the sludge thickener along with primary sludge and taken to digester to digest the sludge by maintaining proper sludge retention time.

The digested sludge is then taken to centrifuge for drying and sludge cake produced in the centrifuge is used as manure. Gas generated in the sludge digester can be collected in the gas holder and utilized by providing necessary equipment.

The process requires skilled operation and maintenance since it involves number of units like thickener, digester, gas holder etc. which adds complexity to the system.

5) Extended Aeration Process

The flow regime of the extended aeration process and its mixing regime are similar to the completely mixed process except that primary settling tank is omitted. The process employs low organic loading, long aeration time, high MLSS concentration and low FIM ratio. The BOD removal efficiency is higher than ASP. Because of long detention in the aeration tank, the mixed liquor solids undergo considerable endogenous respiration and get well stabilized The excess sludge does not require separate digestion and can be directly dried on sand beds. The excess sludge production is also mimmum. The alternative Involves the following steps during its treatment process:

a) Screening to remove floating material.
b) Degritting to remove grit particles of size greater than 0 mm and syravity 2.65.
c) Biological Oxidation by extended aeration
d) Sludge drying.

After screening and degritting the sewage is taken to aeration tank and settling. This process is similar to that of activated sludge process except the extended as to avoid thickening and digesting stages. Excess sludge form secondary tank is directly taken to centrifuge for drying in the sludge drying beds. The cake produced in the cenrifuge is used as manure.

II. LITERATURE SURVEY

1. The wastewater generated by a community is called “sewage” which is amixture of domestic wastewater, industrial wastewater (where the industry is discharging its wastewater in the same sewage system) and rain water,(where a single sewer system exists for the wastewater and storm water (Garg S.K., 1976 : Environmental Engineering). In the developing/underdeveloped countries of the world, more than 90% of the sewage is discharged untreated in the environment due to lack of proper waste water collection and treatment facilities (Kerri, K.D. 2002}. The quantity and strength of wastewater is governed by the size and socioeconomic status of the population of the community. The composition of sewage varies greatly and its characterization is important for determining the size and designing of treatment plant (Amar M. Dliere, Chandrasekhar B.Pawar, Pratapsingh B. Pardeshi and DhanrajA.Patil, “Municipal waste water disposal in Pune city - An analysis of air and groundwater pollution", current science, vol. 95, no. 6, 25 September 2008}.
2. The first water disposal system was developed very early in history. The first known sewer was a Babylonian seal cylinder which dates back to the Seventh Century BC(Metcalf & Eddy, Wastewater Engineering, 1972}. Remains of wastewater disposals and sanitary sewers have been found in the cities of ancient Crete and Assyria, as well as in the city of Jerusalem. The Ancient Athens reused their sewage for irrigation purposes.Storm water sewers built by the Romans are still in use even today. Yet, it is thought that very few personal homes were connected to the sewers, and instead, most of the facilities were public.
3. A few centuries later, storm sewers in the form of gutters and open channels were developed. Following multiple Cholera outbreaks in large cities such as London,the19thcentury saw the development of modem sewer systems. By 1910, the United States had built 25,000 miles of sewer lines, though most had proportions that were unnecessarily Large. Through the 19th century, people were much more concerned about how the polluted water was obstructing their agricultural and manufacturing ventures than their health. In 1880, Eberth discovered bacillus in typhoid fever and began, for the first time, to provide a link between bacteria found in pollution and disease (Metcalf & Eddy,Sewerage and Sewage Disposal: A Textbook, 1930). Yet, it was not until the 20 century that people truly became more aware of the importance of treating wastewater for health reasons, and, hence, built more sewers and wastewater treatment facilities.
4. OnJanuary1st of 1970, the National Environmental Policy Act (NEPA) was signed to protect the environment. In 1972, the Water Pollution Control ActAmendments extended the role of the federal government in water pollution control, which greatly

increased the federal funds for the construction of waste water treatment plants.

5. In today's cities, water is pumped from wells, rivers, streams,and reservoirs to water treatment plants, where it is treated and distributed to customers. After it is used, the water, which has now become wastewater, travels through customers' sewer pipes to wastewater treatment plants, where it is either treated and returned to streams, rivers, and oceans or reused for irrigation and landscaping. At the plant, equipment and processes remove or destroy harmful materials, chemical compounds, and microorganisms from the water. Pumps, valves, and other equipment move the water or wastewater through the various treatment processes, after which they dispose of the removed waste materials, first glance, the treatment of wastewater is actually a requires great care.

III. PROPOSED METHODOLOGY AND FINDINGS

The object of sewage treatment is to stabilize decomposable organic matter present in sewage so as to produce on effluent and sludge which can be disposed of in the environment without causing health hazards or nuisance. The treated effluence disposed in accordance with the standards laid down by MPCB (Maharashtra Pollution Control Board). The method of treatment adopted should, not only requirement of these regulatory agencies but also result in the maximum use of products consistent with economy.

The selection of type of treatment depends on the technical requirement economy in consideration to degree of treatment required and disposal, capital recurring cost of Operation and maintained, land requirement, power requirement mechanical equipment involved and availability of skilled man power, mode effluent discharge, topographical condition, benefits that accrue from environmental sanitation etc.

The treatment process may be bifurcated in to four steps –

1) Pre-treatment
2) Primary treatment
3) Secondary treatment
4) Tertiary treatment

1) Pre-treatment

Pre-treatment consists of separation of floating and suspended organize inorganic material by physical processes such as

a) Screening - Materials larger in size than the openings of the screening are stained out Screening is an essential step in sewage treatment for removed materials which would otherwise damage equipment; interfere with the satisfied operation of treatment unit or equipment; interfere with the satisfied operation of treatment units of equipment. Screens are used ahead of stations, meters and as a first step in all treatment works. A screen is a divided opening generally of uniform size for removing bigger suspended or floating in sewage. The screening element may consist of parallel bars, roads; grating and the opening may be circular or rectangular. The screens may be coarse, or fine.

b) Grit Removal – Grit removal is necessary to protect the moving mechanical equipment and pump elements from abrasion and accompanying W631 and removal of grit also reduces the effect of rags and other large floating materials on the mechanical equipment. The minimum size of the grit to be removed is 0.2 mm although 0.15 mm is preferred for conditions where considerable amount of ash is likely tobecarried in the sewage. The specific gravity for design purpose is taken as 2.65.

Pipe Material and Classification

The pumping mains proposed are CI/DI pipes conforming to IS 1536 1989 IS 8953 respectively for diameters up to 1000 mm.

Minimum Permissible Velocity

At the ultimate peak flow rate of pumping, the velocity shall be about 1.0 m/s or higher so as to flush out any solids that may have settled in the pumping mains during non - Pumping hours. The pumping main size shall be designed for the ultimate year Sewage flow.

Maximum Permissible Velocity

Maximum permissible velocity shall normally be restricted to 2.25 to 2.5 m/s to maintain the frictional head (which is proportional to the square of the velocity) within reasonable limits to minimize the potential surge problems and to prevent scouring of pipes.

Optimization of Pumping Main

Analysis is carried out to determine optimum size of pumping main. The optimization study is based on the least cost combination with the following parameters:

- Capital cost of the pumping main and pumping machinery.
- Discounted cost of the energy charges over the life of the pumping main.
- Discounted cost of the establishment charges.
- Life and scrap value of the pipe in case different materials are considered for pipeline.
- Magnitude of surge pressures and the cost of its control devices.
- Discount for ease of maintenance.

IV. CONCLUSION

The proposed location of Sewage Treatment Plant is wakodi,malkapur.SewageTreatment Plant is proposed to construct for waste water generation for forecasted population of further 25 years.Thus it is designed for 13.435 MLD which is much larger quantity than current. The pumping station consists of screen chamber, circular sump with submersible pumps and pump house. The sewage treatment plant comprise of MMBR technology. The treated effluent shall be discharged into Painganga River. The locations of pumping stations are shown to Municipal Council officials and got approved.The sumps are designed such that in no case the detention period shall not exceed 30 min. Pumping stations will not cause any environmental nuisance for the people.

It is assumed that able contractors would be hired for doing the works and there should not be any problem for laying of sewers.In order to prevent the overflow from the pumping stations,necessary generator sets shall be provided.

Regarding sewage treatment plant, the lands have been already identified and shown to Municipal Council officials.The locations are such that,they are away from developed areas and hence should not be objectionable.As the Sewage Treatment Plants is proposed near agricultural areas,it would be advantageous to the farmers as the treated effluent may be used for agriculture.

Provision of sewage system is going to improve the overall environment of the city and also improve indirectly the public health conditions.This indirectly facilitates not only to achieve better health condition of the people but also helps to considerably reduce the loss of man days of work force.

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