# Characterization of sewage and design of sewage treatment plant for a Anakapalle town

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## ABSTRACT

A study on domestic waste water characterization has been performed followed by the design of sewage treatment plant. The present study involves the analysis of pH value, total solids, total suspended solids, hardness, acidity, alkalinity, chloride, chlorine, BOD, DO. A sewage treatment plant is quite necessary to receive the domestic and commercial waste and removes the materials which pose harm for general public. Its objective is to produce an environmentally-safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse. The samplings of the domestic waste water from residential have been done in different times of the day to have an average data of the measured parameters.

A sewage treatment plant has been designed with the treatment units, a bar screen of dimension 1.7m, an aeration tank of dimension 4.5mx4.5mx3.7m,a collection pit of diameter 4m and depth 5m.

Keywords: Characterization, sewage, treatment plant.

## INTRODUCTION

Pollution in its broadest sense includes all changes that curtail natural utility and exert deleterious effect on life. The crisis triggered by the rapidly growing population and industrialization with the resultant degradation of the environment causes a grave threat to the quality of life. Degradation of water quality is the unfavorable alteration of the physical, chemical and biological properties of water that prevents domestic, commercial, industrial, agricultural, recreational and other beneficial uses of water. Sewage and sewage effluents are the major sources of water pollution. Sewage is mainly composed of human fecal material, domestic wastes including wash-water and industrial wastes.

Sewage Treatment Plant is a facility designed to receive the waste from domestic, commercial and industrial sources and to remove materials that damage water quality and compromise public health and safety when discharged into water receiving systems. It includes

physical, chemical, and biological processes to remove various contaminants depending on its constituents. Using advanced technology it is now possible to re-use sewage effluent for drinking water

The present study comprises the study on quality of domestic waste water that is discharged from the Anakapalle Municipality, through the kitchen outlets and bathroom effluents. The study includes characterization tests for pH value, acidity, alkalinity, chloride, residual chlorine, turbidity & DO.

**Objectives of the study**

The principal objective of waste water treatment is generally to allow human and industrial effluents to be disposed of without danger to human health or unacceptable damage to the natural environment. An environmentally-safe fluid waste stream is produced. No danger to human health or unacceptable damage to the natural environment is expected. Sewage includes household waste liquid from toilets, baths, showers, kitchens, sinks and so forth that is disposed of via sewers. Sewage also includes liquid waste from industry and commerce.

The objectives of the study are Physical and chemical characterization of the domestic waste water from residential of anakapalle.

- Comparison with the prescribed standard
- Design of the sewage treatment plant.

Observation of Study

Waste water samples from the kitchen effluent and the bathroom waste of Residential of Anakapalle.

The following physical characteristics were studied

- Odour
- Taste
- Colour
- Turbidity

The following chemical characteristics were studied:

- Alkalinity
- Acidity
- Chloride

- Sulphate
- $P^H$. of the sample
- Biochemical Oxygen Demand
- Dissolved Oxygen

Sampling Techniques:

Waste water samples have been collected in contamination free sampling bottles of 1000 ml from the kitchen effluent and the bathroom waste in anakapalle.

Test Results of Waste water:

| Sl. No. | Particulars | Kitchen waste | Bath Room waste |
|---|---|---|---|
| 1 | Color | Light Milky | Clear |
| 2 | pH | 7.4 | 6.8 |
| 3 | Suspended solids (mg/L) | 607 | 205 |
| 4 | $BOD_5$ at 20°C (mg/L) | 100 | 124 |
| 5 | COD mg/L) | 320 | 288.6 |
| 6 | Chlorides (mg/L) | 94 | 102 |
| 7 | Alkalinity (mg/L) | 24 | 80 |

**Design of Sewage Treatment Plant:**

**Plant capacity:**

Average water supply per day = 423000 lit = 0.423MLD

Average sewage generated per day = 85% of supplied water

= 0.85*0.423=0.36 MLD= 360 KLD

Average sewage generated per hour=360/24=15 cum/hr Peak factor = 3

Design flow capacity (maximum) = 13 x 3=45 cum/hr

MLD – million liters per day, KLD – Kilo Liter per day

**Sizing calculation for collection pit:**

Retention time required = 4 hr

Average design flow = 15 $m^3$/hr

Capacity of collection sump = 4 x 15=60 $m^3$

Assume liquid depth = 5 m

Area required for collection pits = 60/5 = 12 $m^2$

Let it is a circular tank

$$12 = \pi r^2$$

r = 1.93m

Volume of the pit provide = π/4 x 4 x 4 x5

= 62.8 $m^3$

Thus Area of the pit provided = 12.6 $m^2$

**Sizing calculation of bar screen:**

Peak discharge = 45 m3/h

Average discharge = 15 m3/h

Average velocity @ average flow isn't allowed to exceed 0.8 m/sec

Average spacing between bar 20 mm

The velocity = 0.3*60=18 m/h/ m2

Cross sectional area required = flow/velocity = 45/18 = 2.5 m2

Liquid depth required= 1 m

Velocity through screen at the peak flow = 1.6 m/sec Clear area = 2.5/1.6 = 1.3

No. of clear spacing = 1.3/0.02 = 65

Width of channel = (65 x 20) + (67 x 6) = 1702 mm Width of screen = 1700 mm

**Sizing calculation of aeration tank:**

BOD in the feed sewage = 100 ppm

No. of aeration tank = 2

Average flow = 360/2 = 180KLD

Total BOD load to the aeration tank = 15 x 24 x 100 = 36 kgs

Let mlss = 2000 mg/l, f/m=0.15

Volume of tank required = (Q x bod load) / (fm x mlss)

= (180 x 100)/0.15 x 2000=60 m3

Assume liquid depth = 3.5 m

Area = 60/3.5=17.143 m2

Tank size provided = 4.5 x 4.5 x 3.7

So, Volume of tank = 75 m3

**Check for aeration period/hydraulic retention time:**

Hydraulic retention time t = 75 x 24/180 = 10 h

So, the tank retention time is more than the required time.

**Sizing calculation for sludge drying beds:**

Maximum design flow rate = 45 m3/h, 360 kld

Total feed suspended solid = 250 ppm

Total outlet suspended solid = 50 ppm

Load to the clarifier = 250-50 = 200 ppm

Sludge generated per day = 360x 200/1000=72 kg/day

Solid content in the feed= 3% Specific gravity of the sludge= 1.015

Volume of sludge= ((72/0.03)/(1000x1.015))= 2.36 m3

For Anakapalle weather condition, the beds get dried out about 7 days No. of cycles per year = 365/7=52 cycles

Period of each cycles = 7 days Volume of sludge per cycle = 2.36 x 7=16.55 m3/cycle

Spreading a layer 1m per cycle, Area of bed required = 16.55/1=16.55 m2

So area of 16.55 m2 for 2 drying beds is provided for the above system Hence, Sludge Drying Bed has dimensions of 4.5 m x 4.5 m x 1 m of two numbers.

CONCLUSION

The average ranges of physical, chemical and biological characteristics of waste water quality are experimented and found out. The pH ranges from 7.8 to 8.01. The Turbidity ranged from 10 to 120 NTU.The value of Turbidity was found to be within the permissible limit.The Chloride and Alkalinity were in the range of 94 to 104 mg/l and 24 to 80 mg/l respectively.

The parameters studied resemble the waste water quality.

Total amount of waste water treated = 0.423MLD.

Dimension of the collection pit is calculated to be 4 m in diameter and 5 m depth of the cylindrical tank. A bar screen of width 1.7 m is provided. Dimension of the aeration tank is 4.5 x 4.5 x 3.7 m3. Dimensions of Sludge Drying Bed are 4.5 m x 4.5 m x 1 m of two numbers.

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