

Design of Water Treatment Plant as a Part of Township at Kadamakkudy

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Abstract

As it is quite obvious that there is day to day increase in population, the major challenge faced by the civil engineers is to provide a better space for living at cities and to deal with the burning issues of water scarcity. Where urban planning is used to promote environmental sustainability. With good planning, urban heritage is a key sustainable resource that need promoting as part of the existing territorial competitiveness in a scenario marked by an increase in rivalry between cities. This requires the development of a conceptual framework that on a global, holistic and integrative approach covers equality and social justice, environment and public health, among other aspect. Public health is an important aspect to be considered in any development process because a stable living environment can be created only with healthy habitant. Increasing pollution is a factor that polluting water and environment which effects human life. Available supply of potable, clean water within the city helps to stabilize this healthy environment to an extent. A functioning water treatment plant in a city can achieve this goal. The properties of water changes based on its surface sources. Average total water demand on the particular area was estimated as 5 MLD. Design of 5 MLD water treatment plant is proposed in this project accordance to 2050 population. Some proposals to lacking facilities at the site is also made in this project to conserve the energy and to promote optimum utilization of renewable resources such as solar street light, biogas plant and the necessity of a proper solid waste management system is also indicated in this report.

Keyword- Town Planning, Environmental Sustainability, Water Treatment Plant

I. INTRODUCTION

The Town planning and design for sustainable development is the process of shaping the physical setting for life to deal with the three-dimensional space in cities, towns and villages and its objective relies in accordance with the vision of the future that they represent. Town planning can be carried out in different manner in accordance to the current availability, present and future needs and the development is the rise in the level and quality of life of the population without damaging the resources of the environment. Thus, town planning is rather than brining a sudden change on a particular area, that development should create a growth progress which bring a positive change in physical, economic, environmental, social and demographic components. The purpose of town planning is to provide a better living space to the growing population without any clash in a healthy environment and to provide facilities lacking in that area in an economical, sustainable and healthy manner. Area we selected for this project is Kadamakuddy, Scope of development is very high in this area is very high by the establishment of the Pizhala – Valiya Kadamakuddy bridge which is a part of a cluster of three bridges being built to link Chathanad, part of Ezhikkara in North Paravur, and Kochi side on Container Road in Moolampilly-Pizhala bridge and the Valiya Kadamakuddy- Chathanad bridge, the construction of which are under way. The State government had allocated ₹40 crores for the Pizhala- Valiya Kadamakuddy bridge in the 2017-2018 budget.

A. Concept of Town Planning

Town planning is the process of managing land resources. It involves the control of existing and new developments, as well as strategy preparation to ensure manage future requirements. Town planning maintains the best of the past while encouraging creativity and innovation in the development of a sustainable future. The purpose of town planning is to protect and improve the commonwealth of a particular location. The objectives are to protect the environment, improve public health and safety, and increase the wealth of choices available to each and every citizen. The basic intention of town planning is to satisfy the needs of our future generations and to prevent the disorganized growth of the town or a city. The township planning demands active imagination and sharp common sense of the understanding of the various needs of the society occupying or likely to be occupy the township. A well-planned township carries out its activities in a normal way like a living organism.

B. Concept of Zoning

Zoning is the process of divide the land on the basis of the land use. The type of zone determines whether planning permission for a given development is granted. Zoning may specify a variety of outright and conditional uses of land. The primary purpose of zoning is to segregate uses that are thought to be compatible. Zoning is also used to prevent new development from interfering

with existing uses and to preserve the character of a community. In town planning the area should be divided into suitable zones such as commercial, industrial, residential etc. The suitable rules and regulations should be formed for the development of each zone.

II. METHODOLOGY

Kadamakkudy Islands is an island suburb of the city of Kochi in the Indian state of Kerala. It is situated around 8 km (6 mi) north of the city centre Kadamakkudy Islands is a cluster of fourteen islands: Valiya Kadamakkudy (the main island), Murikkal, Palyam Thuruth, Pizhala, Cheriya Kadamakkudy, Pulikkapuram, Moolampilly, Puthussery, Chariyam Thuruth, Chennur, Kothad, Korambadam, Kandanad and Karikkad Thuruthu. Its total area is about 12.29 Sq. km. Its population according to census 2012 is 16,457.

A. Geographical Details

Kadamakkudy is a panchayat in Edappally city in district Ernakulam in Kerala. It is mostly surrounded with water and mangrove forest. The main occupation of the people there was fishing and cultivation. The main transportation there which connects these cluster of islands is water transportation. This area is about 9m above sea level. Its location is North latitude 10° 3' 54.68" N and East longitude 76° 14' 42.5" E. Here average rainfall is about 3289 mm.

B. Zoning of Area in the Proposed Township

In this area we can't done a perfect zoning based on shape without affecting existing structures. So, we zone this place according to various purposes the total area of proposed town is 12.29 sq. km. residential area of Kadamakkudy is 3, 14,532 cents. It is about 1,390 no of plots. It consists of 1, 50,665 cents of wet land and 1, 63,867 cents of dry land. Here 80% of land where used up. Wet Land Consist of plenty of pokkali fields and famous for plenty of migratory birds.

| ZONE | PERCENTAGE | HECTARE |
|-----------------------------|------------|---------|
| Residential | 40% | 491.6 |
| Commercial | 8% | 98.32 |
| Transportation | 4% | 49.16 |
| Institutional | 10% | 122.9 |
| Agricultural | 30% | 368.7 |
| Green belt and water bodies | 50% | 614.5 |
| Organized open space | 20% | 245.8 |

Table 1: Zoning of Area According to Land Use

C. Problem Study

The selected area is an island and surrounded by saline water. And they are facing problems like lack of drinking water, proper waste disposal, transportation. There is no adequate piped water supply and the surrounding water contains salt content. The treatment of saline water is not that much economical. The wastes are not properly disposed and they deposit wastes on the open spaces. It makes foul smell and the land get polluted every day. The transportation facilities are very poor. There is no proper bus stop and bus route.

D. Design of Water Treatment Plant

By analyzing problems in Kadamakkudy, water treatment plant suggests as a practical solution for the scarcity of drinking water. The water supply as per urban demand is 200 lpcd. For a future population about 2050 we need 4 or 5 MLD capacity treatment plant. Here we plan to design 5 MLD plant. The rate of water supply is 5 MLD. The water from Periyar River is used for supply. In this plant water pumped from Edamula to Kadamakkudy. The distance from Edamula to Kadamakkudy is 15 km. The Diameter of carrying pipe is 0.9 m and the Pumping station is at Edamula.

1) Screening

Screening is done to carry out the remove of heavy suspended solid from the water. Screening is done for treating surface water using:

- Coarse Screen
- Fine Screen

Coarse screen: - Coarse Screen in the form of bar of size 10mm to 25mm

Fine screen: - Fine Screen in the form of wire of size 10mm

Screening involves removal of any coarse floating objects, weeds etc.

Design of Screen:

- Size of bar 9mmX50mm inclined 30° with horizontal
- Gross numerical area of the screen = 0.25m²
- Submerged vertical cross-sectional area of screen = 0.125m²
- Velocity of flow in screen = 0.48m/sec

- Size of channel = 1.2mX0.4m

2) Aeration

Aeration is the process in which water of brought intimate contact of air. It removes undesirable gases like Co₂, H₂S and undesirable organic matter. It promotes helpful bacteria growth and percipates nuisance metals like iron and manganese.

Design of aerator:

- Total area of central shaft = 0.636m²
- Total area of cascade aerator = 6.25m²
- Dia of central inlet pipe = 300mm
- Dia of aerator required = 3m
- Number of steps = 13 (rise per step 0.15m drop width 0.075m)
- Channel width = 0.3m
- Liquid depth in channel = 0.3m
- Velocity of flow = 0.6m/sec

3) Coagulation and Flocculation

Flocculation refers to water treatment process that combine or coagulate small particles into larger particles, which settle out of the water as sediment. Generally, use ALUM to promote coagulation. It causes clumping and sedimentation of solid particles. These solid particles are called floc or sludge.

Design of Lamella Clarifier

- Rise rate = 3m/hr.
125mm above the water level and 1.5m of space left below the plates at the bottom of the clarifier.
- Feed point -20% above the base of the plate to prevent disturbance
- Area of projected surface = $208.33/1.2$
 $= 173.61\text{m}^2$
- Length of weir = $208.333/10$
 $= 20.833\text{m}$

Lamella plate:

- Plate loading = 2.9m/hr.
- Plate angle = 55° from horizontal
- Plate spacing = 50mm apart
- 10 number of Plate of size = 2mX1m
- Projected area of plate = 151.34m²
- Neutral zone of height 0.45m and breadth 10m
- Hopper zone of height 2.1m and slope 1in 1.25 and height 2.1m
- Inlet velocity = 1m/sec

Flocculator Design:

- Size of tank = 8.8mX4.4mX2m
- Power required = 175.11W
- Rectangle paddles of 6.9mX0.22m around 3 rotating shaft of radius 0.623m
- Rotating velocity = 0.22m/sec

Mechanical Rapid Mix Unit Design:

- Size of tank = 1.3 dia and 2.25m depth
- Power required = 630.397 W
- Impeller radius = 0.26m
- Velocity at tip of impeller = 3.403 m/sec
- Rectangle blade of 0.09mX0.12m around impeller

4) Sedimentation Tank Design

Sedimentation is a physical water treatment process using gravity to remove suspended solids from water. Solid particles entrained by the turbulence of moving water may be removed naturally by sedimentation in the still water of lakes and oceans. Settling basins are ponds constructed for the purpose of removing entrained solids by sedimentation.

Clarifiers are tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. Sedimentation is the act of depositing sediment.

Design of Sedimentation Tank:

- Size of tank with bottom slope of 1% = 32mX8mX5.5m
- Hopper tank of height 1m and slope 2:1 provided
- Inlet pipe of dia = 0.22m

- Inlet channel (width) 0.75mX0.6m (depth)
- Velocity of flow in channel = 0.2m/s
- Provide 4 submerged orifice 0.2mX0.2m
- Baffle of 1m depth at distance of 0.8m from orifice

Effluent Structure:

- Weir length = 17m
- Number of notches = 100
- Trough = 17mx0.3mx0.5m
- Depth of channel = 0.4m

5) Filtration

Filtration is carried out for the removal of fin suspended particles. Filtration also remove organic matter. Water flows through a filter designed to remove particles in the water. The filters are made of layers of sand and gravel. Filtration collects the suspended impurities in water. The filters are routinely cleaned by backwashing.

Design of Rapid Sand Filter:

- Filter unit
- Size of filter unit = 7.55mx5.8mx3.4m

Under Drainage System:

laterals 7.2cm diameter with spacing 15 cm center to center of length 2.4 m. central manifold pipe of diameter 100.2cm 21 perforation of diameter 9mm per lateral at spacing of 11.4 cm.

- Velocity of flow of wash water in lateral = 1.08m/sec
- Velocity of flow in central manifold pipe = 0.56m/sec

Wash Water trough:

3 wash water trough of width 0.5m and depth 0.4m

Design of Granular Activated Carbon Filter:

- Using FILTRSORB 400
- Contact time = 20min
- L3.5m is used.
- Weight of carbon = 29513.275kg
- Total pressure drops in column = 41.75mbar/m
- Linear velocity = 10m/hr.
- Carbon column of diameter 5.2m and height

6) Disinfection

Disinfection is the process of removing harmful bacteria. The substances or materials which are to be used for disinfection are called the disinfectants. Mainly use chlorine as the disinfectant. It removes pathogenic bacteria, organic matter. It destroys algae that would otherwise grow and clog the water filters. Ozone is an expensive disinfectant used.

7) Computer Model

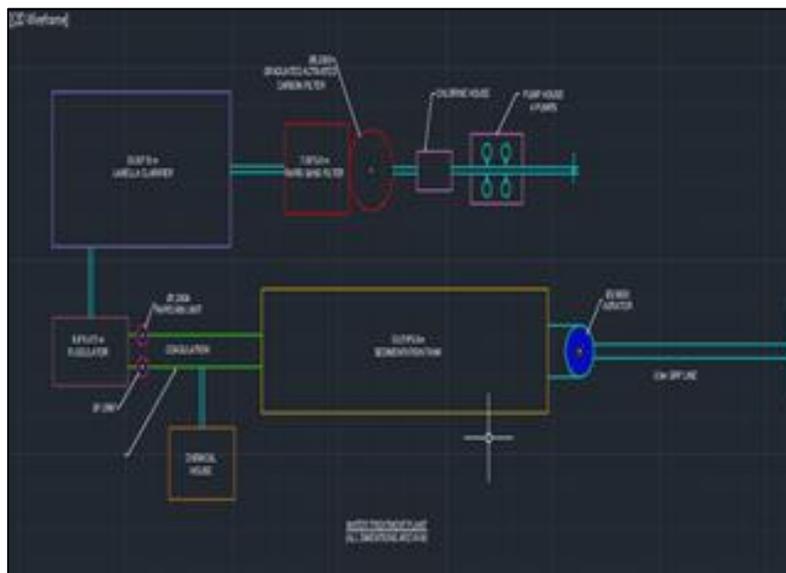


Fig. 1: 2D Plan of Water Treatment Plant in Auto CAD

E. Environmental Proposal

Some of the proposals which have been studied and necessary to implement in any new township project are as follows-

1) Solar Street Lights

Solar street lights are raised light sources which are powered by solar panels generally mounted on the lighting structure. It is cost effective, practical, ecofriendly and the safest way to save energy. It solves the two problems that we facing today, saving of energy and also disposal of incandescent lamps very efficiently. By solar street lights we can save more electrical energy. It reduces energy cost, maintenance cost and also reduce the greenhouse gas emission.

2) Biogas Plant

Biogas refers to a mixture of different gases produced by the breakdown of organic matter in the absence of oxygen. By providing biogas plants we can control water pollution by decomposing sewage, animal dung and human excreta. It produces a clean fuel and helps in controlling air pollution. Its construction is easy and requires only locally available materials.

3) Solid Waste Management

The major problem we noticed during our visit to Kadamakkudy is the poor handling of wastes deposited from various sources. Waste management are the activities and actions required to manage waste from its final disposal. It includes collection, transportation, segregation, recycling, and disposal. Collection and storage of solid waste is an important factor. Waste management deals with all types of wastes including industrial, biological and household. It is intended to reduce adverse effects of waste on human health, the environment or aesthetics.

III. CONCLUSION

The various aspects of planning a township and zoning the selected area according to its land use without effecting its existing structure are carried out. We can plan Kadamakkudy area by satisfying components of township. We have been studied and some of the conclusions are stated.

- 1) Population of the country increases tremendously, so there is increasing basic demands like pure water availability, increasing waste, Increasing pollution etc.
- 2) So we design water treatment plant with all its components and prepare layout.
- 3) There is a problem of disposal of solid waste it can be solved by proposal of solid waste management system.
- 4) Electricity is an integral part of life of the human beings. Increasing population result in more consumption. We solved this problem by introducing solar street lights.
- 5) By proper town planning we can alter any undeveloped area in to township. It can add to the country's economic progress.

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