RESTORATION OF TS CANAL

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***Abstract*— *The present study addresses the need of resurrecting navigation through one of the oldest and historically significant inland waterways of our nation, the TS canal. Even though restoration projects were being proposed by various government agencies in the past, significant milestones remain to be encountered in this field..The study is aimed at the engineering aspects of restoration of the Kollam-Eravipuram stretch of the TS canal along with a generalised public opinion about the same. It is also intended to deal with the harmful social and environmental effects being posed by the poor quality of water in nearby aquifers as a result of groundwater intrusion through the canal water body.The study is designed to pin point the major factors that have led to the pathetic condition of the canal as seen today. On the basis of this, a set of recommendations and proposals are enlisted for ensuring restoration of inland navigation in a safe and eco-friendly manner through the same. A suitable waste water treatment plant is also be suggested with its design criteria.*

Keywords—TS Canal; Canal Restortation;Water Quality; Water Treatment;.

1. INTRODUCTION

A canal known as the 'West Coast Canal' (WCC) serves as the main arterial waterway of the Kerala region. This canal connects Neeleswaram in the north and Kovalam in the south expanding to a stretch of about 590 km. The portion of this canal from Thiruvananthapuram to Ponnani and then along Bharathapuzha River up To Shoranur is known as the 'Thiruvananthapuram-Shoranur Canal' (TS Canal). The portion of TS canal that passes through the city of Kollam connecting the lakes at Eravipuram and Ashtamudi and spanning a length of about 7860 m is called 'Kollam Canal'. TS canal (also called 'Parvathy Puthanar') as history says, was used as a means of transport for people and cargo and as an avenue for leisure. It is even believed that the canal acted as the main source of domestic water for the local dwellers. The name 'Parvathy Puthanar' was considered synonymous with crystal clear water, as was the case with the canal during the reign of the king of Travancore. Fast forward to the present day world and the name would contradict itself. For a present day man, TS canal is synonymous with pollution.

A. NEED FOR THE STUDY

The canal is highly contaminated with solid waste and liquid waste; hence the need for managing, treating and disposing the sewage and solid waste is inevitable for the entire locality.

After independence, with the continuous development of other modes of transport, the canal traffic ceased. This resulted in subsequent negligence and consequently the pathetic condition of the canal as seen today.

. It is now considered a portal for dispersal of communicable diseases and an end point for the disposal of raw sewage and wastes. Its ecosystem has degraded into a weed house and provided habitats for rats, vibio-cholerae, E-coli and thy mates.

A view of Kollam canal as seen today

The quality of water has deteriorated to such an extent that the canal has begun to threaten the groundwater along with the lakes at Akkulam and Veli.

So, there seems a need for safe water for domestic as well as drinking purposes for the people depending on this canal.and also for the safer and healthier living standards of local dwellers the pathetic condition of the canal water should be improved by minimising the waste loads to it and make it suitable for their needs.

B.OBJECTIVES AND SCOPE OF THE WORK

In this work, it is planned to study the various reasons for canal deterioration by some methods of survey and analysis of the extent of pollution affected by water quality assurance and thus designing the Sewage treatment plant for TS canal.

The main objective is to provide a safer and healthier source of water to the people in the study area from the respective portion of the TS canal selected as a part of this work. The survey area comprised of the TS canal stretch between Kollam and Eravipuram, including Vadakkumbhagam, Pallithottam, and Mundakkal.

It includes:

- Socio-economic survey in the area: To analyze the impact of socio-economic and sanitary conditions on the quality of water utilized by the local dwellers for drinking and domestic purposes.

- Water quality analysis: To determine and analyze the quality of water in that particular extent.
- Treatment processes: The object of waste water treatment is to produce a disposable effluent without causing harm or trouble to the communities and prevent pollution.
- Treatment plant: Design a Sewage treatment plant to improve the quality of Waste water disposal to the canal.

The Socio-economic surveys provide a powerful means of understanding local resource management systems, resource use and relative importance of resources for households and villages.Then,To improve water quality standards as Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients.And also by providing proper treatment processes and installing a Sewage treatment plant at a suitable location, It helps in reducing the pollution of the water in the canal and will improve the living standards of the dependent population and there by enhancing our natural environment.

2. REVIEW OF LITERATURE

This section provides details on the latest developments and efforts in the topic of Restoration of water bodies.

A. A review of the impact of waterway restoration

There are many economic, social and environmental impacts of waterway restoration projects carried out over the previous two decades. These projects carried out by restoration groups and their partners as well as by the Trust contribute to the quality of life and the social and environmental aspects of communities. and saw the wide range of benefits that recent restoration projects had brought to communities, local economies and to the wider waterway network as a whole and was keen to reiterate that it's not just a case of restoring for restoring sake or through a sense of romantic nostalgia. The research also aimed to provide an overview of the impact indicators that the Trust might utilise to evaluate future restoration programmes.

B. A study in all the fourteen districts of Kerala on the health status of rural households

It is reported that acute morbidity declines as the social and economic status of households rises due to fall in the incidence of infectious diseases. The study further pointed out that the incidence of diarrhoea cases was more among persons using public wells and public taps.

C. Buckhingam Canal

The canal was formerly used to convey goods up and down the Coromandel coast from Vijayawada to Madras (now Chennai). The cyclones of 1965-66 and 1976 damaged the structure intensively. As of today, the canal is subjected to a combination of improper use and poor maintenance. Within the limits of the city of Chennai, it has been observed that industrial effluents and sewage have resulted in the deterioration of canal water body. Silting up of the canal has left the canal water stagnant in many parts of the city thereby creating an attractive habitat for disease spreading mosquitoes. In addition to this, hot water and fly ash is being discharged into the canal water by the North Chennai Thermal Power Station (NCTP).

On January 1, 2001, the Government of India launched a project to prevent sewage outfalls into the Buckingham canal and other waterways located in Chennai. The project also aimed at the removal of accumulated sediments on the canal bed so as to improve the efficiency of water flow. Within Chennai, much of the canal alignment has been used as a route for the elevated Mass Rapid Transport System (MRTS). As a result, MRTS stations at Kotturpuram, Kasturba Nagar and Indira Nagar have encroached on to the structure and narrowed the width of the canal to less than 50 meters at certain locations. Buckingham canal is the most polluted of the three major waterways in Chennai with nearly 60 per cent of the estimated 55 million litres of untreated sewage being let into it on a daily basis by the Chennai Metropolitan Water Supply and Sewerage Board.

3. METHODOLOGY

A.Socio Economic Survey

The socio economic survey were carried out first on the following basis by questionnaire method of field suvey

- Economic background
- Duration for which the residences were being utilized
- Sources of water being utilized for drinking and domestic purposes
- Waste disposal techniques being practiced by the households
- Harmful consequences posed by the poor canal water quality
- Opinion on canal resurrection and
- Effectiveness of the efforts of government authorities

The results were analysed with the help of pie charts as following.

Many of the inhabitants along the canal banks reported to be major sufferers of the poor quality of water in the same. It was revealed that because of stagnation, the canal waters had become a major breeding ground for disease spreading mosquitoes. Foul odours and health concerns were the other sufferings enlisted by these local dwellers. On the task of giving an opinion on canal restoration, all of the interviewees stood by the same sentiment that the TS canal should be resurrected as soon as possible not just for the society but for the nation as a whole. A majority of these people were of the opinion that the government had made ineffective attempts in this regard until this point in time. On further enquiry they revealed that they had said so because certain government authorities were involved in canal dredging works in the past. Due to lack of proper supervision and leadership they got indulged in sand mining works that led to soil erosion along the canal banks and the subsequent formation of cracks in nearby buildings.

B.Water Quality Analysis

The present study was conducted by collecting water samples from open wells of 12 households situated along the stretch of the TS canal between Kollam and Eravipuram. The samples were extracted from 3 locations at approximately equal intervals along the stretch with 4 samples being withdrawn from each of these locations. Two of the four samples were withdrawn from one bank of the canal whereas the remaining two were withdrawn from the opposite bank. The samples were selected on the basis of such a criteria. since it was desired to have a clear understanding of the possible effects of canal water intrusion as a result of a ground water discharge normal to the Arabian Sea. The samples were withdrawn with the aid of a pulley-bucket combination and stored in sterilized bottles made of plastic. This was to ensure that the samples would be tested in the same form as they are being utilized by the dwellers.

Sampling Station Locations

Certain tests are conducted for analysing the water quality of samples and the results are obtained by laboratory observations and also graphical representaions are made for easy analysis and comparison.

1) pH: pH is a measure of the relative acidity or alkalinity and it represents the negative logarithm of the concentration of free hydrogen ions in a solution. Scale of pH ranges from 0 to 14 with 7 as neutral; below and above this value, the solution can be respectively deemed acidic or alkaline. In this phase, the pH value of water was measured by the use of a pH indicator paper.

2) Hardness: Hardness of water is mainly due to the presence of calcium and magnesium ions in it. These ions may be in combination with carbonates and bicarbonates apart from sulphates, chlorides, and nitrates. In this phase, hardness of water was measured by EDTA titration method.

3) Chloride: Chloride was estimated by Mohr's titration method. In this method, chloride containing sample was titrated with silver nitrate in the presence of potassium chromate to form a slight soluble white precipitate of AgCl. A brick-red solution of silver chromate was formed at the end point owing to the reaction of slight excess of silver nitrate with potassium chromate.

4) Total Dissolved Solids: Total dissolved solids in water can be defined as the residues left after evaporation of a filtered sample. It was determined by the evaporation method of filtered sample followed by gravimetric analysis.

5) Iron: Phenonthroline method was used to determine the concentration of iron. Iron occurs in natural waters in oxidised (ferric) as well as reduced (ferrous) states. All of the iron was converted into the ferrous state through boiling with hydrochloric acid in the presence of hydroxylamine. The reduced iron chelated with 1, 10-phenonthroline at a pH range of 3.2 to 3.3 to form a complex having an orange-red colour. Intensity of the so formed colour was deemed proportional to the concentration of iron in the sample.

6) Nitrate: The sample under consideration was made to pass through a column containing copper coated cadmium. The nitrate content in the sample was determined by diazotizing it with sulfanilamide dihydrochloride. The resulting water soluble dye yielded a magenta color which was read at 520 nm.

7) Coliforms: Multiple tube fermentation technique was used to determine the concentration of coliforms (total and faecal) in the concerned samples. The technique involved inoculation of the sample in a suitable liquid medium. After the expiry of the incubation period, the tubes were examined for gas production by the coliform organisms. This presumptive test was followed by a confirmatory test for all those samples which yielded positive results.

The results of samples collected are analysed as following:

ANALYSIS OF LOCATION 1: All samples extracted from this location yielded the values of pH, hardness, chloride, and nitrate within the BIS specified permissible limits. Sample C exceeded the permissible limits specified for total dissolved solids and iron. All samples exhibited a high concentration of coli form content within them.

ANALYSIS OF LOCATION 2: All samples extracted from this location yielded the values of pH, hardness, and nitrate within the BIS specified permissible limits. Samples A1, B1, and C1 exhibited high concentration of total dissolved solids. Sample A1 exhibited a high chloride content whereas sample C1 exceeded the permissible limits specified for iron. All samples exhibited a high dosage of coli form content within them.

ANALYSIS OF LOCATION 3: All samples extracted from this location yielded the values of pH, hardness, chloride, and nitrate within the BIS specified permissible limits. Samples B2 and C2 exhibited a high concentration of total dissolved solids. Sample B2 exceeded the permissible limits specified for iron. All samples exhibited a high concentration of coli form content within them.

The results of the analysis conducted in this phase have clearly revealed that all of the water samples examined along the Kollam-Eravipuram stretch of the TS canal are highly contaminated and unsafe for drinking as per the specifications laid out by the Bureau of Indian Standards. The fact that all samples are contaminated with high concentrations of coli form bacteria is a clear indication of the intrusion of human excreta into the nearby located groundwater aquifers.

To avoid the problems of water scarcity in the surrounding area can be effectively eliminated by providing a Sewage treatment plant at a suitable location near the canal course.

C.Waste Water Treatment

1.Object of Treatment

The main object of treatment units is to reduce the waste water contents (solids) from the waste water and remove all the nuisance causing elements and change the character of the waste water in such a way that it can be safely discharged in natural water course applied on the land. In other words, the object of waste water treatment is to produce a disposable effluent without causing harm or trouble to the communities and prevent pollution.

2. Degree of Treatment

The degree of treatment will mostly be decided by regulatory agencies and the extent to which the final product of treatment are to be utilized. The regulatory might have laid down standard for the effluent or might specify the condition under which the effluent must be discharged in to the natural stream. The method of treatment adopted should not only meet the requirement of the regulatory bodies, but also result in the maximum use of the end product with economy.

3.Design Period

The treatment plant is normally designed to meet the requirement over a 20 year period after its completion. The time lag between the design and completion should not normally exceed 2 – 3 years. Care should be taken that the plant is not considerably under loaded in the initial stages, particularly the sedimentation tank.

4.Location of Treatment Plant

The treatment plant should be located near to the point of disposal as possible. If the waste water is to be disposed finally in to the river, the plant should be located near the river bank. Care should be taken while locating the site that it should be on the downstream side of the city and sufficiently away from water intake works. If finally the waste water is to be applied on land, the treatment plant should be located near the land at such a place where the treated sewage can directly flow under gravitational forces towards disposal point. The plant should not be much far away from the town to reduce the length of sewer line. On the other hand the site should not be close to the town, that it may cause difficulties in the expansion of town and may pollute the general atmosphere by smell and fly nuisance.

5.Components Of Treatment Plant

Receiving Chamber

Receiving chamber is the structure to receive the raw sewage collected through Under Ground Sewage System from the city. It is a rectangular shape tank constructed at the entrance of the sewage treatment plant. The main sewer pipe is directly connected with this tank.

Receiving chamber is designed for the size of

Length	=	2 m
Width	=	1 m
Depth	=	3.5m (Including FB=0.5m)

Provide 400mm dia pipe from bye-pass chamber upto final effluent channel to meet any exigencies of Sewage treatment plant.

Screen Chamber

Screening is the very first operation carried out at the sewage treatment plant and consists of passing the sewage through different types of screens so as to trap and remove the floating matter such as tree leaves, paper, gravel, timber pieces, rags, fibers, tampons, cans, and kitchen refuse etc. · To protect the pumps and other equipments from the possible damages due to floating matter. To remove the major floating matters from the raw sewage in a simple manner before it reaches into the complex high energy required process. The coarse screens essentially consist of steel bars or flat placed 30° to 60° inclination to the horizontal. The opening between bars are 50mm or above. These racks are placed in the screen chamber provided in the way of sewer line. The width of the rack channel should be sufficient so that self cleaning velocity should be available and a bypass channel should be provided to prevent the overtopping. The bypass channel is provided with vertical bar screen. A well drained trough is provided to store the impurities while cleaning the rack. These racks are cleaned mechanically. Fine screens are the structures built between the grit chambers and primary sedimentation tank in order to remove some amount of suspended solids from sewage. The fine screens often get clogged need frequent cleaning. The brass metal is used as it has higher resistant towards rust and corrosion.

A screen chamber is designed of
Length, L = 2.5m
Width, B =0.74m
Depth, D =1m (Including FB =0.3m)

Grit Chamber

Grit removal basins are the sedimentation basins placed in front of the fine screen to remove the inorganic particles having specific gravity of 2.65 such as sand, gravel, grit, egg shells and other non-putrescible materials that may clog channels or damage pumps due to abrasion and to prevent their accumulation in sludge digesters. The grit chamber is designed to scour the lighter organic particles while the heavier grit particles remain settled.

Rectangular grit chamber (2 nos) are designed of size

Length , L	=	18 m
Breadth , B	=	0.5 m
Depth , D	=	1.2 m (Including FB= 0.3m)

Skimming tank

Skimming tanks are the tanks removing oils and grease from the sewage constructed before the sedimentation tanks. Municipal raw sewage contains oils, fats, waxes, soaps, fatty acids etc. The greasy and oily matter may form unsightly and odorous scum on the surface of settling tanks or may interfere with the activated sludge process. In skimming tank air is blown along with chlorine gas by air diffuser placed at the bottom of the tank. The rising air tends to coagulate and solidify the grease and cause it to rise to the top of the tank whereas chlorine destroys the protective colloidal effect of protein, which holds the grease in emulsified form. The greasy materials are collected from the top of the tank and the collected are skimmed of specially designed mechanical equipments.

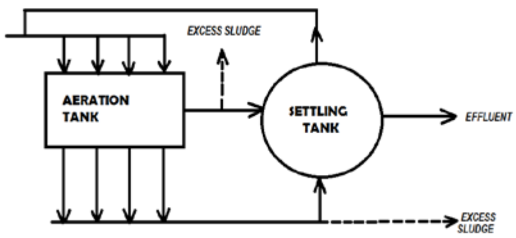
Skimming tank is designed for the size of
Length , L = 0.75m
Breadth , B= 0.5m
Depth , D = 3.3m (Including FB = 0.3m)

Activated Sludge Process

The activated sludge process is an aerobic, biological waste treatment system to treat the settled waste consist a variety of mechanisms and processes that use dissolved oxygen to promote the growth of biological floc that substantially removes organic material. The essential units of the process are an aeration tank, a secondary settling tank, a sludge return line from the secondary settling tank to the aeration tank and an excess sludge waste line.

Concept : Atmospheric air is bubbled through primary treated waste water combined with organisms to develop a biological floc which reduces the organic content of the waste water. The mixed liquor, the combination of raw waste water and biological mass is formed. In activated sludge plant, once the effluent from the primary clarifier get sufficient treatment, the excess mixed liquor is discharged in to settling tanks and the treated supernatant is runoff to undergo further treatment. Part of the settled sludge called return activated sludge (R.A.S) is returned to the head of the aeration system to re-seed the new waste water entering the tank. Excess sludge which eventually accumulates beyond R.A.S known waste activated sludge (W.A.S) is removed from the treatment process to keep the ratio of the biomass to supplied ratio (F/M). W. A.S is further treated by digestion under anaerobic conditions.

Method - Extended aeration process



Flow Chart of Extended aeration process

The flow schemes of an extended aeration process and its mixing regime are similar to that of the complete mix process. Primary sedimentation is frequently avoided in this process, but grit chamber or comminutor is often provided for screenings. As its name suggests, the aeration period is quite large and extended to about 12-24 hours, as compared to 4 to 6 hours in a conventional plant. The loading parameters for such a process are given in the table below. The process permits low organic loading, high MLSS concentration, and low F/M ratio. The BOD removal efficiency is also quite high, to say about 95-98% as compared to 85-92% of a conventional plant.

Aeration tank

Aeration tank is the mixing and diffusing structure in the activated sludge plant. These are rectangular in shape having the dimensions ranging 3 to 4.5 m deep, 4 to 6m wide and 20 to 200 m length. Air is introduced continuously to the tank. 31 Combined aeration type aerators having the diffused air aeration as well as mechanical aeration together in a single unit are used in the project. The dorocco model is designed as it gives higher efficiency and lesser detention period and lesser amount of compressed air.

Aeration tank is designed for the dimensions of

Length, L = 22 m

Width, B = 9 m

Depth, D = 4.5 m (Including a FB = 0.5m)

Secondary sedimentation tank

A sedimentation tank constructed next to the aeration tank is the secondary sedimentation. This tank will be as the primary sedimentation tank with certain modifications as no floating materials are here, provisions for the removal of scum, floatage are not needed. The surface area for the secondary sedimentation tank is designed for both overflow rate basis and solids loading rate basis. The larger value is adopted.

Secondary clarifier is designed for a size of

Diameter, ϕ = 11 m

Depth, D = 4.0 (Including a FB= 0.5m)

Hopper slope shall be 1 in 12.

4. CONCLUSION

Majority of inhabitants along the Kollam-Eravipuram stretch were found to belong to lower economic backgrounds. As such due to lack of proper sanitation facilities, they revealed they had no other alternative but to dispose off their wastes into the canal water. This enlightened another dimension in our quest towards understanding the causes of canal water deterioration.

Most of the inhabitants along the canal stretch reported being immensely affected by its poor water quality. Mosquito trouble, foul odour, and health hazards were revealed to be the commonest of concerns. They were unanimous in their appeal for an immediate resurrection of navigation through the waterway along with an overall improvement of canal water quality.

In this project, we put our sincere attempt to co-ordinate the various aspects for designing the Sewage treatment plant for TS canal. The canal is highly contaminated with solid waste and liquid waste, hence the need for managing, treating and disposing the sewage and solid waste is inevitable for the entire locality.

The main part of this project consists of Design of the complete components of a waste water treatment plant and Solid waste disposal scheme for TS canal. If the corporation takes the initiative, TS canal will become a zero waste canal in future.

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