

## Study of Pollution Prevention Strategies for Reclamation and Waster Management of Lake in Tourism Place

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### ABSTRACT

Udhagamandalam, the capital of Nigiris district in Tamil Nadu is a tourism important place. This hill station is also called as Queen of Hills and the people flow to his hill resort during the summer months and as in normal seasons is been increasing day by day. As a result of this, the pollution load on environmental components are creasing exponentially. The take, an artificial one formed by John Sullivan around 18<sup>th</sup> century is a boon to Ooty. Being the located at a low level, the entire rain water as well the sewage is flowing towards the lake and polluted year by year. In order to restore the quality of lake, several effective measures are taken by the Government including bioremediation by public works department. A study on the pollution effect to this lake been conducted as a project and the factors responsible for the pollution has been studied and present in the report. Necessary preventive measures and suggestion for the improvement of the solid and sewage management has been made.

**KEYWORDS:** Lake, Pollution Study, Prevention, Strategies, Waster management,

### 1. INTRODUCTION- GENERAL

“Nilgiris” is the name in Sanskrit means BLUE MOUNTAINS and in Tamil it means NEELAMALAI. The Nilgiris District is situated in the Western Ghat. It is surrounded by Coimbatore District, Kerala State and Karnataka State on the Eastern, Western and the Northern side respectively. The Nilgiris District is a celebrated summer resort for the tourist from all over India. Ootacamund or Udhagamandalam rightly described as “Queen of Hill Stations” is spread over an are of 36Sq.Km. it is the most popular of all the destinations of the Nilgiris. The special attraction of Ooty is its lushy vegetation, the blue screen of the mountain, blue coloured flowers and the mild climate. There are many places of tourist attraction in and around Ooty. Main attraction are the Botanical Garden, the Dhoddabetta Peak, the Udhagai Lake etc. The development of the Town started from the year 1821 and the town expands its limit year after year. Now it has 32 municipal wards and the expected population by the year 2011 is 1,50,000. The Udhagai lake was once a part of a west flowing stream. In 1824, the lower part of the stream was converted into a lake. There is a boat house where row boats and motor boats can be had on hired. The original area of the lake was 65 hectares in the year 1823 and it is shrunken to the present status of 23 hectares. The main reasons for the shrinkage of the lake is the encroachment and the silt deposition. The encroachment removal needs wide planning and the approval of the people to remove their

settlement. So, it needs political as well as social reconciliations. Hence we, in this study paper, leave a lean line covering the topic. On the other hand, the siltation and eutrophication needs deep in depth knowledge for their analysis and taking remedial measures. The siltation create the following problems.

- i. Increase the external loading into the lake
- ii. Reduces both the area and depth of the lake
- iii. Sediments becomes the Nutrients for the growth of algae.
- iv. Becomes the causes for the reduction of the spawning area of the fish.

Hence in the study paper, we give importance for the desiltation process.

The next main problem arising due to the pollutants is eutrophication. The lake is not losing materials to any other water body but they are gaining materials from the land. This may enter the stream either as organic matter such as leaf – fall or as nutrient salts from land drainage. Thus in aquatic ecosystems, the presence of inorganic and organic material and the micro organisms which are the decomposers is the result of gain of materials from the land. The most serious problems associated with eutrophication and likely to occur in sluggish water of lakes. In temperate climates with same nutrient levels, the problems are likely to be less severe. The removal of nutrients adds to the cost of treatment and sometimes leads to the withdrawal of the reservoir from service.

Although there is strong evidence to suggest that sewage effluents causes increase in growths of “Cladophora” sometimes to troublesome degrees, their effect on the growth of plants is less clear. So our aim in this study paper not only deals with the lake water but it includes the sewage system of Ooty also. The restricted sewage system is analysed by a quick review but elaborate analysis of the influent and effluent to the municipal treatment plant are attached at the end of this study paper. The remedial measures are taken as per experts’ views and we suggest some other remedial measures which are unique and if they are adopted, they may give good results. It is everyone’s duty to maintain the elegance and cleanliness of a town and tourist centre such as Ooty requires much more attention. This study paper reveals good opportunity for us to know about various aspects of pollutants and their effects. All those people who read this paper will also get the same experience what we have by this time.

## 2. OBJECTIVE

As discussed earlier, Ooty has too many places for its Tourist attraction. Among them, the Udhagai Lake is an important place of attraction because of its boating activities.

The main objective of this study paper is

- i. To Study about the pollution of the Lake
- ii. To Study about the sources and causes of pollution.
- iii. To Suggest the ways for the prevention and Restoration of the Lake.

The pollution of the Lake does not needs any special type of chemical testing. Instead, the growth of weeds, the greenish colour of the water, the floating impurities and like these simple things all enough for a common man to tell that the water is polluted. For an environmentalist, it is about extending that view in to numerical values of polluting parameters and presenting those values by comparing with the standard available values. The study paper consists of a part that contains the present characteristics of the Lake Water, the Characteristics of the Municipal waste entering to the treatment plant and the characteristics of the treated water let into Sandynallah Reservoir. Further to add the value, the comparison chart has been made for the lake water samples from the year 1985 to 2004. This will definitely show the degree of pollution the lake undergoes and the reclamation activities that is going on now.

The next topic "Sources and Causes of Pollution" is covered under the topic "Waste Management". The Waste management in Ooty find its own importance because, the Kodappamund Channel that runs in the heart of the city is converted into the dumping place of the different types of waters by small hotels, land encroachers, market, shop keepers etc., moreover it has been the outlet for the sewage of the unauthorized house owners and the rain water drains are utilized for this purpose. So we feel that the study is not enough if we confine the causes of pollution limit only to the lake. On the other hand, the entire waster management system both the existing and the proposal will keep checking the pollution of the lake and also improve the general appearance of the tourist town Ooty. The final one is about the suggestion. Though various experts suggest various types of treatment process to the polluted lake water and some of them are being implemented in different phases, it is on our part to suggest certain methods for both the improvement of quality and quantity to lake water.

Our suggestion recommends the usage of the treated water to improve the quantity of lake water once they meet the quality standards. For this purpose the standard quality chart is also enclosed at the latter part of the study paper. We feel that the fewer steps what we take towards the cleaner and attractive lake and even Ooty itself will definitely pay good results and serve the objectives what it intends to do.

## 3. MATERIALS AND METHODS

### 3.1 PRELIMINARY STUDY

The purpose of preliminary investigation is to find out the general trends in town development, the exposure of industries, the details about the tourist population, the waste generation and their disposal, various agricultural and recreational activities etc.

### 3.2 STUDY POPULATION GROWTH

Udhagamandalam, a selection grade Municipality is the Head quarter of "The Nilgiris District". The municipal area extends to 30.67sq.km. cover in 32 wards. Population of Udhagamandalam Municipality as per 1981 census in 78,277. The town has been provided with water supply scheme and the inlet water supply of the improvements scheme is also in operation. A partial sewerage scheme is also existing.

Udhagai Census 1981	:	78,277
Udhagai Census 1991	:	81,763
Udhagai Census 2001	:	1,26,904
Udhagai Census 2010	:	1,40,208

### 3.3 LOCATION

The Nilgiris District is situated on the Western end of Tamil Nadu state, and Udhagamandalam is the focal town of the District. Udhagamandalam Mncipal town is situated in western state at 11°24' Northern latitude and 76°44' Eastern Longitude. The town is surrounded with reserved forests. Tea Estates and vegetable producing fields. The main occupation of the people is agriculture. The town is situated at the earlier altitude and the elevation of the town varies between +2220m and m.

### 3.4 MATERIOLOGICAL STUDY

The present increase of global temperature slightly alters the materiological conditions of the district also. However the tourist visits to Ooty during the summer is to escape from the scorching sun in the plans. The climate in the district is so enthusiastic and enjoyable.

Average temperature during summer : 20°C

Average temperature during winter : 6°C

Average Annual Rainfall : 1920.80mm

### 3.5 TOURISM STUDY

Ooty's economy depends on the factors. The first one is the plantation and the next one is through tourism activities. The places of interest of tourists inside the Ooty municipal limit are:

- i. Botanical Garden
- ii. Boat House
- iii. Dhodabetta

During the year 2000 tourist population: 15,71,200.

During the season week day

tourist population: 4000 to 6000.

Week end tourist population: 9000 to 11000

### 3.6 TOURIST ACCOMMODATION STUDY

The tourist population is greatly undulating in nature. Naturally in summer, the flow of tourists to the city is more than that in the winter season. So the room rents are also fixed according to the season. All the Lodges are connected with the existing restricted sewage system and hence the wastes are treated. The very few hotel names are mentioned here for reference.

- i. Hotel Tamil Nadu
- ii. Hotel Fenhill Palace
- iii. Holiday Inn
- iv. Hotel Savoy
- v. Hotel Southern Star

The Total no's of notable hotels for providing good accommodation

Facilities in and around Ooty : 51.

### 3.7. INDUSTRIAL ACTIVITIES STUDY

The Nilgiris District is not to famous for the industrial population. Very few industries are situated in the district. Some of the major industries in the district are:

1. Aavin, Ooty – Milk Products.
2. Hindustan Photo Films, Ooty – Xray films, Cine Positive, Cine Negative.
3. Aruvangadu Cordiate – Defence Ammunition Preparation.
4. Rallies India Ltd. – Pharmaceutical plant.
5. P.P.I.Ltd. – Children's food.
6. Pasture institute, Coonoor – Rabies Medicine.
7. Human Biological institute.

The total no. of a Tea Factories – 223

### 3.8.AGRICULTURAL ACTIVITIES STUDY

The Nilgiris District is situated at a high of 6500 feet above MSL. The height and the climate favors the tea plantation. However some other crops are also grown here some of them are.

- i. Tea
- ii. Cardamom
- iii. Coffee
- iv. Hill Crops like Cabbage, Carrot etc.,

The total Percentage of area sown to

total geographical are : 20.90%

Agricultural workers in the district: 10.00%

### 3.9. STUDY OF INSTITUTIONS

The climate of the district favours the growth of institutions with hostel facilities. Such schools are generally referred with the name "Convents". Some of the famous institutions situated in and around Ooty are:

1. Good Sephered
2. Lawrence School
3. Breeks School
4. Gell Memorial Higher Secondary School
5. J.S.S. College of Pharmacy
6. Government Arts College
7. Government Polytechnic
8. C.S.I. Engineering College.

### 3.10. SANITARY STUDY

The success of the growth of a town depends on the sanitary conditions prevailing to that place. The sanitation includes the cleanliness of the town as well as providing treated water for consumption.

#### 3.10.1 Sewerage System

Udhagamandalam Municipality has at present a sewage scheme. Covering an area of 12.95 sq.km. area of the existing system is situated outside the rain catchment area. Total length of the existing sewer is 31.63km. of with 20sq.km. come with in the catchment area. The sewage coming into the sewer is allocated the sewer runs parallel to the kodappamund channel children's park, and then cross the children's park from the children's park end. The trunk sewer runs along periphery of the lake to a point about 150m upstream of the treatment plant. The effluent from the aeration tank is let in to a nearby sewer which goes to a farm having area of 14 acres, maintained by the Municipality and then let into the Sandynallah reservoir, which is the surplus from the Udhagai Lake.

#### 3.10.2. Drainage Date

1. Length of drainage main : 54.10kms
2. Extent of sewage system : 12.95sqkm.
3. Present status: The sewerage water collected through street sewers, is pumped to the treatment plant and the treated water is discharged in to Kamarajar Sagar Dam.
4. Total No. of Drainage Connections : 3960
5. No. of Connection given so for : 3901
6. Total Length of open drains : 12.33Kms
7. No. of Treatment plant : 1 no.

#### 3.10.3. Water Supply Data

1. Daily supply of water to the town : 8.09md.
2. Per capita supply : 69.7Lpcd.
3. Water treatment plant : 1
4. Pumping station : 2
5. No. of public function : 279
6. Hours of water supply : 3to6hrs.
7. Total no. of Domestic Connection : 7642
8. Total no. of Non-Domestic Connection :448
9. Length of Mains : 32.32kms
10. Total No. of Reservoirs:
  1. Persons Valley
  2. Tiger Hill
  3. Upper Doddabetta
  4. Lower Doddabetta
  5. Marlimund
  6. Upper Kodappamund
  7. Lower Kodappamund
  8. Old Ooty
  9. Glen rock
  10. Gorishola

### 3.11. TOWN PLANNING STUDY

The growth of a town should coincide with the growth of population and should have enough spaces for the accommodation of floating population. The people of the town should get proper facilities for their well being. That includes good interconnection of places with roads, proper illumination of the roads, both active and passive recreational facilities, good sanitation and water facilities, hospital facilities etc. the following are the investigated data of the town planning.

#### 3.11.1. Town Planning

- i. Parks and Gardens maintained by this municipality : 19.
- ii. Trees Standing and owned by the Municipality : 86867
- iii. Unauthorized Residential : 580
- iv. Commercial : 103

#### 3.11.2. Slums

- i. No. of notified slums : 16
- ii. No. of un notified slums : 20
- iii. Slum population : 24848
- iv. No. of Slum House Holds : 5481

#### 3.11.3. Roads

- B.T. Surface : 142.109kms.
- i. No. of Streets : 246
- ii. Length of Streets : 181.60kms.
- iii. Maintenance Charge : Rs.99.58lakhs.

#### 3.11.4 Street lights

- i. Sodium Vapour lamps : 859
- ii. Tube Lights : 2875
- iii. High mast lights : 13
- Total : 3747

### 3.12. HEALTH STUDY

The people of the town should live with good health and harmony. The healthier condition may be provided either by immunization programme or by giving enough treatment for attack of the diseases. Both these programme will be successful only if there are enough dispensaries and hospitals.

#### 3.12.1. I. Municipal Dispensaries:

- a. Medical officer : 2
- b. Pharmacist : 1
- c. Male Nursing Assistant : 2
- d. Female Nursing Assistant : 2
- II. Private Hospitals : 23
- III. Maternity and Child welfare : 3

### 3.13. SOLID WASTE STUDY

The generation of wastes, their collection and disposal are studied in Ooty Municipality. Though the word "Waste" includes all the wastes that are in the Solid and liquid in nature, it generally confines to the solid waste only.

### 3.13.1. Generation and collection of wastes

1. Average Quantity of waste per capita per day : 0.340kgs.
2. Average Quantity of waste generated each day : 30 mt
  - a. House holds shops and establishments : 22.00mt
  - b. From Market : 4.50mt
  - c. Meat, Fish, Slaughter House: 2.00mt
  - d. Others: 1.50mt
3. Hospital waste generated : 0.168mt
4. No. of Zones : 10
5. No. of Vehicles : 7
6. Staff Position:
  - a. Sanitary inspectors : 8
  - b. Sanitary Supervisors : 8
  - c. Sanitary works deployed for collection of waste : 253
  - d. Sanitary workers deployed for transporting waste : 41
7. Sweeper / Population ration in each ward: 1 sanitary worker for 324 persons.
8. Sweeper / Road length ratio in each ward: 0.72 per sanitary worker.
9. Total no. of Dust Bins : 238
10. Mild steel containers : 10
11. Masonry Bins : 72
12. Action plan for Removal of waste
  - a. Door to door collection of segregated wastes implemented in 21 wards.
  - b. Total no. of household covered in door collection: 7426
  - c. Pushcarts used for door to door collection: 24 nos.
  - d. Separate dust bins have been provided for disposing bio degradable and non degradable wastes: As per location & wards.
  - e. Awareness campaigns conducted regarding segregation of wastes:
  - f. Door to door and ward level awareness programme conducted:
  - g. Self Help Groups, Community Organizers, NGO's Ward councilors involved.

#### 3.13.2. Disposal

- a. Disposal site available : 1
- b. Location : Theetukal
- c. Area in Acres : 5 acres owned by forest.
- d. Distance from town to compost yard : 6 km
- e. Method of Disposal : Open dumping
- f. Cost of collection of waste per Mt per day : Rs.1531.00
- g. Cost of transport of waste per Mt per day : Rs.558.00
- h. Cost of disposal of waste per Mt per day : Rs.220.00



### 3.14. STUDY ON RESTRICTED SEWAGE SYSTEMS

Udhagamandalam is a selection grade Municipal town and it is the head quarters of the Nilgiris District, Tamil Nadu. It has a population of 2,60,828 as per the census 1991. It has 32 Municipal wards and the town extends to 30.67sq.km. There was one existing century old partial sewage system which has been blocked often and leaking in operation. As a result, the sewage from leaking sewers and from the un sewered area (unauthorized also) enters the Kodappamund channel, which runs in the heart of the city designed to carry the storm water from the rain catchment area of the lake, join the Udhagai lake ultimately causing comparative degree of pollution to the lake. The lake whose surplus water and the effluent of municipal waste reaches the Sandynallah reservoir which is under control of the Tamil Nadu Electricity Board (TNEB) from where the hydro electric power is generated. When the polluted effluent reaches the Sandynallah reservoir, it create lot of problems in power generation also.

As a result, a combined proposal by TNEB, the Municipality of Ooty, TWAD board requested the Tamil Nadu Government to provide the restricted sewage system to the Municipality of Ooty. Later, professional consultancy is sought for the success of the sewage system. Experts from Dutch, followed intervention by a central team of Union Commission and other Central Ministries Provided some useful methods of treatment. The following steps are to be adopted. The revised proposal contemplates the following:  
 To adopt conventional activated sludge treatment process as cleared by the Technical Committee.

- a. To adopt gravity main sewer with R.C.C. pipes (instead of CI) from Kodappamund to children's Park.
- b. To adopt a pumping system consisting of a sewage pumping station at Children's Park and sewage pumping main along North lake road with C.I. main in place of gravity sewer along the periphery of Udhagai lake as cleared by the technical committee in its meeting.
- c. To provide.
  - Street Sewers in Zone I  
(North of Kodappamund Channel)
  - Street Sewers in Zone II  
(South of Kodappamund Channel)

Provision of House service connections.

The project was sanctioned for Rs.761.00 lakhs and Execution started:

Stage – I

Provision for treatment works.

Stage – II

Gravity mains sewer with RCC Pipes pumping main along the lake road from proposed sewage pumping station at Children's Park to treatment work at Kandhal. Proposed pumping station and Machineries purchases are made.

Stage – III

Provision of Street Sewers in Zone I

(North of Kodappamund Channel)

Stage – IV

Provision of Street Sewers in Zone II

(South of Kodappamund Channel)

Stage – V

Provision of House Service Connection.

#### 3.14.1 Sewage Treatment Plant 5 Mld Capacity

Erected by :M/s. Enken Engineer Pvt., Limited,  
 824, Poonthamalli High road,  
 Keelpauk,  
 Chennai – 600 010

Date of Commencement : 01.06.1992  
 Date of Completion : 15.06.1995  
 Estimate Amount : Rs.90.00Lakhs

#### Major Units:

Screen Chamber	:	1 Unit
Deteritor	:	2 Units
Aeration Tank	:	2 Units
Secondary Clarifiers	:	2 Units
Sludge Recirculation Pumps	:	2 Units

### 3.15. STUDY OF LAKE WATER

#### 3.15.1. P<sup>H</sup> Value

The acidity or alkalinity of water is measured in terms of its PH value or Hydrogen – ion concentration. Pure water (H<sub>2</sub>O) consists of positively charges hydrogen or H – ions combined with negatively charged hydroxyl or OH – ions. But the process of dissociation taken polace in pure water and hence it contains some uncombined positively charged H – ions and some uncombined negatively charged OH – ions. The water becomes acidic when positively charged H – ions are in excess than negatively charged OH – ions and it becomes alkaline when reverse is the case. For neutral water, the concentrations of H – ions and OH – ions are equal. The P<sup>H</sup> value should be within a range of 6.5 to 8.5.

#### 3.15.2. Dissolved oxygen

The water contains various gases from its contact with the atmosphere and ground surfaces. The usual gases are nitrogen, methane, hydrogen sulphide, carbon dioxide and oxygen. The contents of these dissolved gases in a sample of water are suitable worked out. The oxygen in the dissolved state is obtained from atmosphere and pure natural surface water is usually saturated with it. The simple test to determine the amount of dissolved oxygen present in a sample of water is to expose water for 4 hours at a temperature of 27°C with 10% acid solution of potassium permanganate. The quantity of oxygen absorbed can then be calculated. This amount, for potable water, should be about 5 to 10 p.p.m.

#### 3.15.2. Alkalinity

The term alkalinity with reference to the water and waste water is defined as the capacity of substances contained in the water to take up hydroxium (H<sub>3</sub>O<sup>+</sup>) to reach a defined PH value (4.3 to 14). The alkalinity is due to the presence of bicarbonate (HCO<sub>3</sub><sup>-</sup>). Carbonate (CO<sub>3</sub><sup>-</sup>)

) or hydroxide ( $\text{OH}^-$ ). The water having alkalinity less than 250mg/lit is desirable for domestic consumption.

### 3.15.3. Acidity

The term acidity with reference to the water and waste is defined as the capacity of substances contained in the water to take up hydroxyl ions ( $\text{OH}^-$ ) to reach a defined  $\text{P}^{\text{H}}$  value (0 to 8.2).

The acidity is of the following two types:

- i. Carbon dioxide acidity
- ii. Mineral acidity

The water having acidity more than 50mg / Lit cannot be used.

### 3.15.4. Chlorides

The chloride contents, especially of sodium chloride or salt are worked out for a sample of water. The excess presence of sodium chloride in natural water indicates pollution of water due to sewage, minerals, edible oil mill operations, ice creams plant effluents, chemical industries, sea water intrusion in coastal regions, etc. the water as lower contents of salt than sewage due to the fact that salt consumed in food is excreted by body. For potable water, the highest desirable level of chloride content is 250mg/lit.

The maximum permissible level is 600mg/lit.

### 3.15.5 Nitrogen and its compounds

The nitrogen is present in water in the following four forms:

- Free ammonia
- Albuminoid ammonia
- Nitrites
- Nitrates

- **Free ammonia**

The amount of free ammonia in portable water should not exceed 0.15 p.p.m

- **Albuminoid ammonia**

The term albuminoid ammonia is used to represent the quantity of nitrogen present in water before the decomposition of organic matter has started. It should not exceed 0.3p.p.m.

- **Nitrites**

The presence of nitrites indicates that the organic matter present in water is not fully oxidized or in other words, it indicates an intermediate oxidation stage. The amount of nitrites in potable water should be nil.

- **Nitrates**

The presence of nitrates indicates that the organic matter present in water is fully oxidized and the water is no longer harmful. For portable water, the highest desirable level of nitrates is 45mg/lit.

### 3.15.6. Hardness

The term hardness is defined as the ability of the water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap. The

hardness or soap – destroying power of a water is of two types – temporary hardness and permanent hardness.

- **Temporary Hardness**

The temporary hardness is also known as the carbonate hardness and it is mainly due to the presence of bicarbonates of calcium and magnesium. It can be removed by boiling or by adding lime to the water.

- **Permanent Hardness**

The permanent hardness is also known as the non – carbonate hardness and it is due to the presence of sulphates, chlorides and nitrates of calcium and magnesium. It cannot be removed by simply boiling the water. It requires special treatment of water softening. The water, having hardness of about 5 degrees, is reasonably soft water and a very soft water is tasteless. Hence, for potable water, the hardness should preferably be more than 5 degree but less than 8 degrees or so.

### 3.15.7 Total Solids

The term solid with reference to the environmental, engineering is defined as the residue in water left after evaporation and drying in oven at 103°C to 105°C. The total solids consist of (i).Dissolved solids (ii).Suspended solids.

- **Dissolved solids**

In natural waters, the dissolved solids mainly consist of inorganic salts like carbonates, bicarbonates, chlorides, sulphates, etc. together with small amount of organic matter and dissolved gases. The permissible total dissolved solids for drinking water according to BIS is 500 mg/Lit with tolerable limit of 1500 mg/Lit.

- **Suspended Solids**

In surface water, the suspended solids consist of inorganic matter like silt or organic matter like algae. These materials are generally carried by erosive action of the flowing water over land. The ground water contains negligible quantity of suspended matter because of filtering action of soil strata through mechanical straining action. The amount of suspended solids in surface water increases with input of natural and man – made contamination. The term coefficient of fineness is sometime used to indicate the rates of weight of the suspended solids to the turbidity of water.

### 3.15.7 Biological Oxygen Demand

The amount of oxygen required for microbes to carry out the biological decomposition of dissolved solids or organic matter in sewage under aerobic conditions at standard temperature is known as the Biological Oxygen Demand. The organic matter in sewage can be classified in the following two groups.

- Carbonaceous matter
- Nitrogenous matter.

The test for B.O.D is very important in sewage analysis as it grants uniformity while comparing various results and tests. It is used as a measure for determining

the strength of sewage and it also helps in finding out the amount of clear water required for the successful disposal of sewage by dilution.

The B.O.D in p.p.m is then worked out by the following equation.

$$5 - \text{days B.O.D} = \text{loss of oxygen in p.p.m} \times \text{dilution ratio.}$$

### 3.15.8 Chemical Oxygen Demand

To measure the content of organic matter of sewage and natural waters, the chemical oxygen demand (C.O.D) test is sometimes carried out. The C.O.D can be defined as the amount of oxygen required to oxidize the organic matter by strong oxidizing agent under acid conditions. The C.O.D test can be carried out to measure organic matter present in industrial wastes having toxic compounds likely to interfere with the biological life. For many types of wastes, it is possible to establish a relation between the C.O.D and B.O.D. hence, once the correlation between the C.O.D and B.O.D has been established, it becomes easy and simple to rely on the C.O.D. test because the C.O.D can be determined in 3 hours as against 5 days for the B.O.D. For typical domestic wastes, the ratio C.O.D / B.O.D. is found to vary from 1.2 to 1.5. if it is greater than 3, the sewage is considered difficult to biodegrade and for non-biodegradable sewage, it exceeds 10.

### 3.15.9 Sulphates

Sulphate is naturally occurring anion ( $\text{SO}_4$ ) found in all kinds of natural waters. It is found in high concentrations in some regions. Discharge of industrial waste and domestic sewage in water tends to increase sulphates consumed in drinking water, it may give offensive odour, objectionable taste and laxative effects. Sulphates also, lead to crown corrosion in sewers.

## 4. WASTE MANAGEMENT

As Ooty being the Head Quarter of district that consists of natural forests, picturesque tea gardens. Gardens and parks, it attracts the tourists. Hence it may be said that the whole economy of the Nilgiris depends on the arrival of the tourists and the result of the good harvesting of tea, coffee and cardamom at good prices. To keep the places clean and to maintain the street, channels, parks, garden, steps are to be taken, implementation should be made with the help of both the citizen and tourists. The following topics cover the different types of waste management. Actual these are very small ideas that are conceived at a very small level but it may fetch good results if these are implemented.

The Waste Management may be classified as follows for easier approach:

1. Solid Waste Management
2. Industrial Waste Management
3. Hospital Waste Management and
4. Plastic Waste Management

## 4.1 Solid Waste Management

As with other civic matters, the collection and disposal of refuse in a public utility is the primary consideration of sanitary problems in the city. For this a thorough idea of the solid wastes, their origin, their mode of transportation to the yard, the disposal into various forms, every single item plays this role here. While Ooty is the town taken for the solid waste management consideration, the following type of solid waste are created. Figure.1 shows that unauthorised sewage entering .



FIGURE1.UNAUTHORISED SEWAGE ENTERING

### 4.1.1 Garbage

Waste Materials mainly consists of decayed vegetables, meat diet, feather etc., Main origin of this kind of waste is Ooty market. Nearly 20 lorries of garbage are collected from the Ooty Market alone. Approximately this may go up to 10 ton /day, when this waste is not given treatment, this will be the main cause for polluting the environment. Figure.2. shows the garbage deposited in the spillway.



FIGURE.2 GARBAGE DEPOSITED BENEATH THE SPILLWAY

### 4.1.2 Ashes

This is a peculiar kind of waste, but its quantity is not known. However, its quantity will be more in winter while other type of wastes are reduced. So at this point of time, the present treatment (or) collection and dumping process is enough.

### 4.1.3 Rubbish

This is the most dangerous part of the pollutant. It contains paper, rags, packing materials, wood, crockery and metals. Plastic materials can also be included in this



type. But they are dealt in the separate topic “Plastic Management”.

#### 4.1.4 Street Sweepings

These are made up of dust which has been worn from the road surfaces, materials, that have fallen from vehicle, sweepings from stores etc., this type of waste will give a better contribution on the waste accumulation.

The Solid Waste Management requires both skilled and unskilled labour forces, the former for the effective disposal and the later for the effective collection. However, it is the part of the general public and the visiting tourists to keep the city clean and beautiful. The collection of the garbage are done routinely and other type of solid wastes are done periodically. All the solid wastes are dumped in a place called Theettukal that is hardly 8kms away from the tourist town. Till this time, it has been dumped as it is and no recovery has been made from the dumpage. However, the following steps can be adopted for the recovery and the reusage of materials.

1. Crushing of materials.
2. By this method, the wasted electrical items, some kind of plastics can be separated.
3. ii. Selection for magnetic, non magnetic, specific gravity borne materials will be separated.
4. Thermal decomposition technique may be adopted for recovering organic substances in the form of Gas and Oil.
5. Food sources from organic wastes to meet the need for Livestock feed.
6. Composting.
7. Methane fermentation plus residual sludge may be obtained.
8. Composting.
9. Methane fermentation plus residual sludge may be obtained.
10. Some kind of solid fuel may be got.
11. Use of inceneration heat may be useful in many ways.

By using one or more ways, the dumpage load will be minimized and some kind of wealth may be obtained form this thrown away waste.

#### 4.2. Industrial Waste Management

The picturesque Nilgiris, is the junction of eastern and western ghats is at an elevation of 6500 feet above the mean sea level. Being at a higher elevation, the district provides a good environment for the growth of tea plantation. Some extent of coffee and some extent of cardamom also cultivated here. Because of its natural altitude and the type of raw material it has, the district in general is good for agriculture and industrial population is of moderate level. The major industry that may be quoted here is the Aruvangadu Cordite Factory. The defence utilization set up produces the ammunicions like dynamite for army uses. Another industry which is sick now is Hindustan Photo Firms. They are producing Xray film, audio and video tape etc., cine positive and negative films are also manufactured under the brand name INDU. Since

only 20% of the unit is functioning how, the effluent discharge is very low.

There are some 223 tea industries that are functioning in the Nilgiris. The waste water produced by these industries are very less in quantity and they are utilized by themselves for street side plantation. Another interesting development in this sector in the hotel industry. Nearly 51 large and medium scale hotels are here and their waste have been already in connection with the municipal drainage scheme. However small scale hotels that are left either by negligence or by the lack of money for connections may be serious points of threat if their wastes are disposed in the natural drain. So it is better to announce certain schemes to regularize these kind of hotel for the sake of the town. The hospital segment is another segment whose need the careful collection and disposal and this has been discussed separately. Figure 3.shows the screening process at lake entry point



FIGURE.3 SCREENING AT ENTRY POINT

#### 4.3. Hospital Waste Management

As discussed earlier, the hospitals are the known places for the health care products. These health care products produce the wastes of cotton, disposable syringes, bottles, bandages, gauge cloth with or without blood staining, medicines etc., unlike the municipal sewage; this type of waste requires a special care for their disposal. Hence the following steps may be adopted. There are some 23 hospitals have been identified for the waste management programme. The waste are to be carefully with a polyethene cover they have to be transported with utmost care, the waste should not spread in the streets at the time of transit. They have to be brought to the treatment place when the disinfection of the bacteria is done and deep burial should be done. The alternate for this method is to incenstrate the hospital wastes. For incenstration purpose, the combustibile solid wastes can be used. Hence it requires very less or almost negligible fuel cost.

#### 4.4 Plastic Management

The unique feature of the nilgiris is its greenery and wildlife. The wild life includes elephant, tiger, deer, wild boar etc. The eradication of forests and the occupation of the forest land makes the life of the animals worse day by day. It is very often that we read from the newspaper



about the eminence of animals in manual habitats. All these things have happened due to the continued intrusion of man in to animal habitats. These may be in two forms one is the occupation of forest lands permanently and the other form is by tourist. The plastic management nowadays finds its own importance because, the ill effects are being identified day by day. They are not bio degradable hence they remain as they are for years. Thus may block the minute pores of the soil and affect the bacteriological growth that gives nitrate to the land. Thus the land becomes infertile in nature. The animals, if they consume the plastic accidentally, even die because it cannot be digested inside the stomach. So the plastics are to be avoided. The Nilgiris Administration had started a massive campaign for the abolition of plastics. It produced good results in the earlier days. But it seems nowadays the usage of plastic are increasing. The following measures should be compulsorily taken by the authorities.

1. A Clear Co-ordination between all the responsible authorities like HADP, Ooty Municipality, PCB, NGO's should be made. The responsibility and the information should be shared by all of them.
2. The usage of plastics should be completely avoided in the district. This could be made not only through the citizens of the district but also the tourist population also.
3. Nearly 15,71,210 people have visited the city in the year 2000 and its nos. will increase in this year. The main problem of the tourists is water. They want water is possession while they are moving around the tourists centers. For this purpose they are using plastic bottle contained with water. After the use, bottles have been thrown as and whenever and wherever they are. This could be avoided if proper assurance is made by providing safe drinking water at tourists places. This can be achieved either by the municipal authorities or by getting sponsorship programme.
4. Plastic check centers can be made at the peak tourism period to check the entry of plastic materials through tourists. Plastic containers, carry bags should be prevented into the district at the every entry point. Thus the plastic problem can be avoided.
5. Plastic crushers can be used to crush be plastic bottles efficiently.
6. A massive plastic cleaning programme may be organized by the authorities, NGO's and with the help of students, we may achieve our goal easily.
7. Introduction of new inventions – like I.B.M's Biodegradable plastics obtained from plants.

Any type of solid waste management can be successful only if the general public is participating in it. Hence the first step towards the waste management is to create the awareness among the people and the necessity of keeping the city clean not only for them but also for their successors. After all, the health is the only thing this generation can leave for the forthcoming generation. And yes, "health is wealth".

## 5. SUGGESTIONS

### 5.1 Suggestion for the reclamation of Ooty lake

The picturesque Ooty Lake can be restored for the preservation of its elegance. For this purpose the following suggestion are made under the following four main categories.

1. Restoration of water lake by increasing the water level
  - a. By removing encroachments
  - b. By providing check dams
  - c. By providing communal rain water harvesting system.
2. Restoration of the lake by improving quality of water.
3. Restoration by artificial aeration & Aquaculture.
4. By re usage of Treated Municipal waste Water.

### 5.2 Reclamation in increasing the quantity of water

The main source of water of Ooty Lake is the Kodappamund channel. As that channel has its origin at upper Thottabetta, a peak that has its name as the highest peak of the Nilgiris. The water flow from the channel is not perennial hence it is the first choice to store the water in lake.

There are four ways to achieve the above goal.

Clean the encroachments along the banks of the channel that are the primary source of pollution by their unauthorized entry of sewage into the channel.

- To study the feasibility of building of check dam at the upper portion of Kodappamund channel and to divert the water to the lake when there is fall in the inlet of water in lake. This may be done either by gravity or by means of pumping.

### 5.3. Communal Rain Harvesting System

Nowadays it finds importance to save the rain water and to harvest them whenever necessary. But the awareness among the general public is poor. It is an additional expenditure incurred by the authorities. So in order to avoid bag opinion and to get the above system works properly and efficiently, communal Rain Water harvesting systems may be utilized.

Communal Rain water harvesting system means creating a singly rain harvesting system by and for the entire community occupying the particular area.

1. Each individual has the responsibility of joining their Rain water harvesting drains to a common well situated at the end of the street. Each end are interconnected and they are brought to a same or different pumping house from where the Rain Water alone is pumped to the lake and there it is shared.
2. The usual problem of getting insect by digging of the pit for Rain water harvesting is avoided by providing at street ends.
3. Since top of the under drain is perforated, no problem of clogging is encountered here. More over by the connection made from one well to another make the uplift movement of the silt particles and

hence the cleaning work of the filter media is done continuously.

4. No mixing of sewage with the Rain water. Hence the BOD of the lake will remain under control.
5. For this purpose the middle portion of the kodappamund channel may be used.

#### 5.4 Re Usage Of Treated Water

This way of increasing the water level is the lake in to be considered at the last moment day. Before letting it into the lake, care should be taken that all the pollutant parameter should be within control.

#### 5.5 Reclamation Of The Lake By Improving The Quality Of Water

Improving the quality of the lake water by periodical de silting method. The solid matters try to settle to the bottom of the lake, decompose, causing odour increasing increasing the BOD load on the lake. Hence desilting process can help in reducing the BOD and helps a lot in the restoration process.

Increase the Light intensity by Vertical Circular Motion: When the depth of water is more than 1.20 m its is very difficult for the light to penetrate and hence there are chances for the anaerobic degradation. So increasing the light intensity by giving vertical circulation of the surface water up to sufficient depth, the algae would be cycled out of the euphotic zone in the dark where their basic respiratory demands would exceed the photosynthetic production, there by reducing the algal biomass.

#### 5.6 Induce The Artificial Turbulence

For this purpose circulating rotators can be used. Two rotators are to be fixed facing each other or they may be fixed in alternative means to give powerful turbulence. The jubillance will give the movement of water particles affecting the growth of algae and reduce the BOD load.

#### 5.7 Usage Of Chemicals

Chemicals can be used in the control of the growth of algae. Though this is an alternate method, this will seriously affect the diversity and stability of more natural aquatic ecosystems the lake. Copper sulphate is the common chemical used for this purpose.

#### 5.8 Usage Of More Aerators

Aeration brings more oxygen for the disintegration of the BOD load. Hence aerators may be introduced at appropriate places.

#### 5.9 Reclamation By Miscellaneous Methods

- **Increase the fishery activities**

To consider this suggestion, desilting is to be done to make the bottom of the lake clean. Then the BOD content should be reduced. For this purpose any other previously described points may be adopted. Then fish can be let into the lake for biological treatment as well as aquatic life growth. Though this may be a non profitable

one in commercial terms, but it will help to keep the lake clean.

- **Increase the recreation activities**

Already boating is the recreational activity doing its best at the Ooty Lake. Along with boating, having some kind of water fountains which will act as Aerators will enhance the tourists' joy and the Ooty Lake will increase its fame to attract more people year after year.

**TABLE.1 TOLERANCE LIMITS FOR DISCHARGE OF TRADE EFFLUENT INTO INLAND SURFACE WATERS**

Sl.No	Characteristics	Tolerance limits
1	P <sup>H</sup> Value	5.50 to 9.00
2	Suspended Solids	100mg/lit
3	Dissolved solids (inorganic)	2,100 mg/lit
4	Oil and Grease	10 mg/lit
5	Bio Chemical Oxygen demand (3 days @ 27°c)	30 mg/lit
6	Chemical Oxygen demand	250 mg/lit
7	Sulphates (as SO <sub>4</sub> )	1000 mg/lit
8	Dissolved PHosphatees (as P)	5.00 mg/lit
9	Chloride (as Cl)	1000 mg/lit
10	Pesticides	Absent
11	Ammoniacal Nitrogen (as N)	50 mg/lit
12	Fee Ammonia (as NH)	5.00g/lit

## 6. CONCLUSION

The hill station in India are a legacy of the British Rule. We have not added to the list of hill stations after independence. But the worst part is that we have allowed the existing hill stations to deteriorate. Ooty is no exception to this. The environment in this hill station repels the tourist instead of attracting them. The present condition of the lake is a mute testimony to the deterioration of the quality of the environment in this hill station.

As explained in the various chapters the Ooty channel which feeds the lake is responsible for the pollution of the lake. A stable effort should be made to keep the channel and its environs clean. A committee for the protection of the Environment with members representing the Ooty Municipality, PWD, Tourist Department etc., and prominent citizens drawn from diverse walks of life should be formed and entrusted with the responsibility of keeping the town clean with special attention being paid to the lake.

The quality of the lake water should be monitored by measuring at fortnightly intervals important parameters should be checked for the limiting values. The remedial measures consists of very common ideas and if they are implemented, they will definitely fetch good results in future. It is our duty to keep Ooty and the Nilgiris intact. Environmentalist find their increasing importance nowadays and we are proud young Engineers to take part in the preservation of the environment of the tourist town, Ooty.

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