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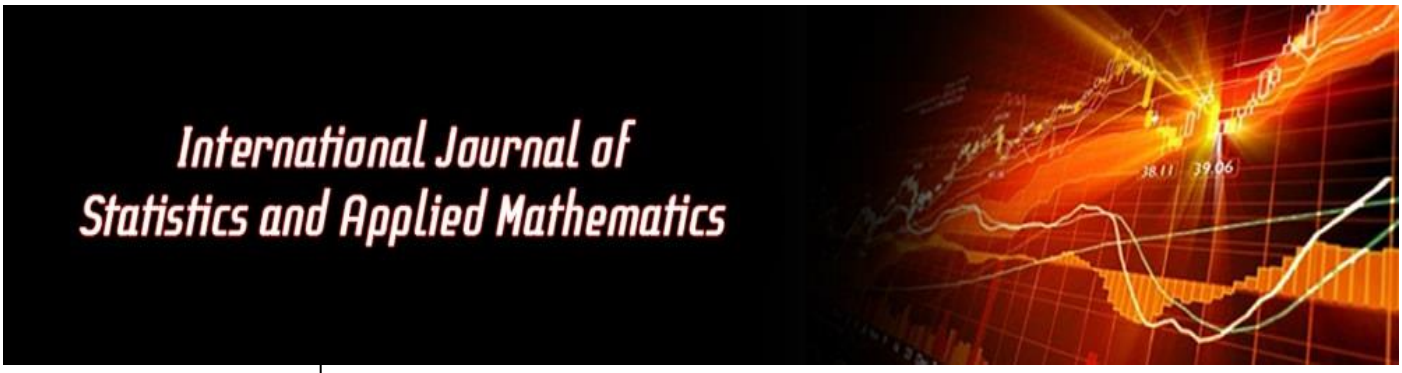

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A study on problems and solution of lake pollution (With special reference form Tirupattur, Vellore district)

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Abstract
Our world is emerging day to day. We can't live without food, air and pure water. So, we need to adopt the clean environment. In accordance with the health accepts, WHO (World Health Organization) over environment has to be keep cleanly. Our drinking water is more polluted in now-a-days. There are so many pollutants that affect the drinking water resources. So we have to keep in mind with the environment. The purification was done by the Tirupattur Lake and their purification includes the problematic laboratory test methods.

Keywords: Environment, water pollution, lake, rate of change and MATLAB

1. Introduction
According to Committee on Environmental Health Association of America, environment comprises "The surroundings in which man lives, works and plays. It encompasses the air he breathes, the water he drinks, the food he consumes and shelter he provides for his protection against the elements. It also includes the pollutants and other detrimental environmental factors which adversely affect his life and health". Environment means surroundings of an organism, including other organisms and physical features".
Environmental science is the application of knowledge from many disciplines for the study and management of the environment. It involves an understanding of scientific principles, economical influence and political action. The word 'Environment' is a general term that refers to the external conditions in which an organism lives. Environment refers to the sum total of conditions which surround man at a given point in space and time.
Environment is the sum of all social, economical, biological, physical and chemical factors which constitute the surroundings of man, who is both maker and moulder of his environment. The word 'Environment' comes from a French word 'Environ' or 'Environer' meaning 'around', 'round about', 'To surround', To encompass'. The environment is the base of all life and the source of all goods.

1.1 Pollution
Addition of any toxic materials effects into the environment which change the physical, chemical or biological characteristics of our resources like air, water and soil, hence, there will be damage to living organisms and other valuable properties is known as pollution. Pollution is generally defined as "The addition of the constituents to water, air or land which adversely alter the natural quality of the environment". The pollution caused by natural processes like by the volcanoes, earthquakes, dust stormed and etc. is called natural pollution". Pollution caused by the human activities are called artificial pollution".

1.2 Types of Pollution
1. Air Pollution
2. Water Pollution
3. Soil Pollution
4. Thermal Pollution

1.2.1 Air Pollution

The gaseous layer which surrounds the earth surface is called atmosphere". Without atmosphere there is no life in our planet earth. The atmosphere constitute mostly nitrogen (78%), oxygen (21%), water vapor, dry air and minor amount of aerosols (suspended particles) and other gases like CO2, methane, etc. Air Pollution is the presence of toxic (harmful) substances in the atmosphere. The high concentration of toxic materials in the atmosphere are injurious to living organisms, spoils the valuable properties (like monuments, etc.) and dangerous to the whole environment. Major pollutants found in the atmosphere are Carbon Oxide (CO), Sulphur Oxide (SO), Nitrogen Oxide (NO), Hydro Carbon (HC), metals, etc. The effects of Air pollutions are Global warming, Depletion of ozone, Smog, Acid rain etc. The control measures of Air pollution are Source correction, Treatment, Enforcing laws/ Policies, Utilization of alternate energy, New technology etc.,

1.2.2 Water Pollution

Contamination of fresh water by the addition of unwanted toxic substances is known as 'ground water pollution' or simply 'water pollution'. Waste water re- leased from the domestic, commercial, municipal, hotels, hospitals, institutions, etc. are grouped as sewage. The discharges of waste water from the carious industries are termed as effluents, which is common in and around industrial complex. The untreated sewage and effluent waste are the main reasons for the water pollution".

When toxic substances enter lakes, streams, rivers, oceans, and other water bodies, they get dissolved or lie suspended in water or get deposited on the bed. This results in the pollution of water whereby the quality of the water deteriorates, affecting aquatic ecosystems. Pollution can also seep down and affect the ground- water deposits. Water pollution has many sources. The most polluting of them are the city sewage and industrial waste discharged into the rivers. The facilities to treat waste water are not adequate in any city in India. Presently, only about 10% of the waste water generated is treated; the rest is discharged as it is into our water bodies. Due to this, pollutants enter ground water, rivers, and other water bodies. Such water, which ultimately ends up in our households, is often highly contaminated and carries disease-causing microbes. Agriculture run-off, or the water from the fields that drains into rivers, is another major water pollutant as it contains fertilizers and pesticides. Domestic sewage refers to waste water that is discarded from households. Also referred to as sanitary sewage, such water contains a wide variety of dissolved and suspended impurities.

It amounts to a very small fraction of the sewage by weight. But it is large by volume and contains impurities such as organic materials and plant nutrients that tend to rot. The main organic materials are food and vegetable waste, plant nutrient come from chemical soaps, washing powders, etc. Domestic sewage is also very likely to contain disease-causing microbes. Thus, disposal of domestic waste water is a significant technical problem. Sewage generated from the urban areas in India has multiplied manifold since 1947. Today, many people dump their garbage into streams, lakes, rivers, and seas, thus making water bodies the final resting place of cans, bottles, plastics, and other household products. The various substances that we use for keeping our houses clean add to water pollution as they contain harmful chemicals. In the past, people mostly used soaps made from animal and vegetable fat for all types of washing. But most of today's cleaning products are synthetic detergents and come from the petrochemical industry. Most detergents and washing powders contain phosphates, which are used to soften the water among other things. These and other chemicals contained in washing powders affect the health of all forms of life in the water.

Aside from the very important issue of clean drinking water, why care about clean water? Clean water- and enough of it is essential to any and all life, animals, plants, and microbes. Fish are vulnerable to polluted water. Indeed, there are places in the world where the water is so polluted that fish have disappeared. In many other places fish or shellfish survive, but are not safe to eat because their flesh is contaminated. Humans enjoy being around water, but contamination with infectious organisms makes swimming unsafe; of if water has obnoxious odors or scum, being near it is not pleasant. Clean water is vital.

A point source is “Any single identifiable source. from which pollutants are discharged, e.g., a pipe, ship, or factory smokestack." Outlet pipes of industrial facilities or wastewater-treatment plants are examples of point sources. Developed countries such as the United States initially worked to control point sources of water pollution. Point sources originate in large easily identified facilities and thus are easy to race. Developed countries control most point sources well. A non- point-source" pollutant is one whose source is much harder to identify precisely, hence the term non-point".

Impact of Pollution on Water Bodies When thinking about the impact of a pollutant, be sure to consider the type of water body involved: a river, lake, stream, wetland, estuary or coastal water, ocean, or groundwater. Given quantities of pollutant running off are one time into a large fast running river may have minimum impact, but the same amount may damage a slow moving stream or small lake. Of course, if the pollutant continues to enter the large river, it too may be damaged. Or a river may carry continuing inputs of pollutants to locales where they do cause damage as happens with the dead zones described below. Metals are natural components of sea water, and a onetime small additional input may go unnoticed. But, adding the same amount to a fresh-water lake, where metal concentrations are normally low, may cause problems. Lakes also may have little exchange of water to dilute the metal. Of course sea water too, especially coastal water, may be badly polluted by continuing input. If you add an organic pollutant to surface water, microbes may break it down, assisted by oxygen, sunlight, and wave movement, or it may evaporate. Conversely, groundwater has fewer means to degrade these pollutants, and hence their impact is more severe.

1.2.2.1 Bio Chemical Oxygen Demand

The amount of organic material that can rot in the sewage is measured by the biochemical oxygen demand. BOD is the amount of oxygen required by micro- organisms to decompose the organic substances in sewage. Therefore, the more organic material there is in the sewage, the higher the BOD. It is among the most important parameters for the design and operation of sewage treatment plants. BOD levels of industrial sewage may be many times that of domestic sewage. Dissolved oxygen is an important factor that determines the quality of water in lakes and rivers. The better water quality is the higher concentration of dissolved oxygen. When sewage enters lade or stream, micro-organisms begin to decompose the organic materials. Oxygen is consumed as micro-organisms use it in their metabolism. This can quickly

deplete the available oxygen levels drop too low, many aquatic species perish. In fact, if become septic. When organic compounds decompose without oxygen, it gives rise to the undesirable odors usually associated with septic or putrid conditions.

1.2.2.2 Agricultural Run Off

The use of land for agriculture and the practices followed in cultivation greatly affect the quality of groundwater. Intensive cultivation of crops causes chemicals from fertilizers (e.g. nitrate) and pesticides to seep into the groundwater, a process commonly known as leaching. Routine applications of fertilizers and pesticides for agriculture and indiscriminate disposal of industrial and domestic wastes are increasingly being recognized as significant sources of water pollution. The high nitrate content in groundwater is mainly from irrigation runoff from agricultural fields where chemical fertilizers have been used indiscriminately. The effects of water pollutions are Water borne diseases, Industrial heavy metals etc., Control Measures of Water Pollution.

1. Pollution Prevention before Contamination
2. Treatment after Contamination is Direct reuse, In-situ Chemical treatment, Indirect reuse, Recycling etc.

1.2.3 Soil Pollution

Degradation of soil and land due to industrial, agricultural and by means of other human activities are called soil or land pollution.

1.2.4 Thermal Pollution

Industries like thermal power plant, nuclear power plant, etc. are utilizing more water for cooling purposes. After being used, the hot water is let off into nearby sea, stream and other water bodies. The hot effluent released from the above industries increased the temperature of the water body where it is discharged. The hot effluent reduces the dissolved oxygen and severely affects the aquatic organisms. Thermal pollution is the addition of excess of undesirable heat to water that makes it harmful to aquatic life and cause significant changes of normal activities of aquatic communities".

2. Tirupattur lake pollution

2.1 Tirupattur Lake

In Vellore District, agriculture depends mostly on irrigation by Lakes. Tirupattur Municipality has three lakes; on Salem Road, near Adiyur village and in front of the New Cinema Theater (near Bus stand). The lake near Bus Stand is the widest one with huge capacity which ensures rich ground water for at least three years once filled. But today the situation is pathetic. The entire sewage system is directed to the lake, thus contaminating the lake. Also the water inlet ways have been blocked for several years. The extent of the lake can be seen from the Google Earth map presented in this section. We are highly grateful to the Pollution Control Board for analyzing the sample of the Lake water. We provide the analysis of the sample in the form of tables which shows the pollution present in the water. By analyzing the sample it is revealed that there are no hazardous chemicals contaminations, yet the water is not potable because the algal formation is high this may be due to contamination like sulphates and nitrates which acts as micro nutrient for the algal growth and due to the human activities.

Fig 1: Tirupattur Lake

Table 1: Polluted water Results of samples

S. No	Parameter	Concentration
1	pH	7:7
2	Total Suspended Solids (Mg=L)	112
3	Total Dissolved Solids (Mg=L)	1636
4	Chlorides (As Chlorides) (Mg=L)	600
5	Sulphates (Mg=L)	80
6	Biological Oxygen Demand (Mg=L)	36
7	Chemical Oxygen Demand (Mg=L)	166
8	Oils and Greases (Mg=L)	LMDL
9	Sulphide (Mg=L)	LMDL
10	Total Hardness (Mg=L)	280
11	Calcium Hardness (Mg=L)	130
12	Magnesium Hardness (Mg=L)	150
13	Ammonical Nitrogen (Mg=L)	LMDL
14	Hexavalent Chromium (Mg=L)	LMDL
15	Total Chromium (Mg=L)	LMDL
16	Alkalinity (Mg=L)	LMDL
17	Fluorides Mg=L	LMDL

LMDL=Less than Minimum Detectable Limit.

2.2 Indian Standard Specifications for Drinking Water

The following table presents parameter. The following table presents parameter and the desirable limit provided by the Indian Standard Specifications for Drinking Water.

Table 2: Normal water Results of samples

S. No	Parameter	Requirement desirable Limit
1	color	5
2	Turbidity	10
3	pH	6:5 - 8:5
4	Total Hardness Copper as Cu 0:05 Iron 0:3	300
5	Calcium as Ca	75
6	Magnesium as Mg	30
7	Copper as Cu	0:05
8	Iron	0:3
9	Manganese	0:1
10	Chlorides	250
11	Sulphates	150
12	Nitrates	45
13	Fluoride	0:6 - 1:2
14	Phenols	0:001
15	Mercury	0:001
16	Cadmium	0:01
17	Selenium	0:01
18	Arsenic	0.05
19	Cynanide	0.05
20	Lead	0.1
21	Zinc	50.0
22	Anionic detergents (MBAS)	0.2
23	Chromium as Cr+6	0.05

2.3 Applications of Modeling with First Order Differential Equations

2.3.1 A Polluted Pond

A pond initially contains 500,000 gallons of unpolluted water has on outlet that releases 10,000 gallons of water per day. A stream flows into the pond at 12,000 gallons per day containing water with a concentration of 2grams per gallon of a pollutant. Let us find a differential equation that models this process and determine what the concentration of pollutant will be after 10 days.

We let x(t) be amount of pollutant in the pond after 't' days.

We use a fundamental property of rates:

Total Rate = Rate In - Rate Out

We shall we use to find the rate is,

$$\frac{\text{grams}}{\text{day}} = \frac{\text{gallons}}{\text{day}}\frac{\text{grams}}{\text{gallons}}$$

$$= \frac{12{,}000}{1}\frac{2}{1} = 24{,}000 \text{ grams per day.}$$

Finding the rate out we first notice that since there was initially 500,000 gallons of water in the lake and the water level is increasing at a rate of 2,000 gallons per day, the total number of gallons of water in the lake after 't' days is gallons = 500,000 + 2,000t.

We write

$$\frac{\text{grams}}{\text{day}} = \frac{\text{gallons}}{\text{day}}\frac{\text{grams}}{\text{gallons}} = \frac{10{,}000}{1}\frac{\text{x}}{500{,}000 + 2{,}000\text{t}} = \frac{10\text{x}}{500 + 2\text{t}}$$

grams per day

Putting this all together we get,

$$\frac{dx}{dt} = 24{,}000 - \frac{10x}{500 + 2t}$$

This is a first order linear differential equation with

$$p(t) = \frac{10}{500 + 2t}$$

We have,

$$\mu = e^{\int \frac{10}{500+2t} dt} = e^{5\ \ln(500+2t)}$$

Now use the initial condition to get $C = -3.125 \times 10^{19}$

Then x=218,072 grams

The solution is presented by using MATLAB.

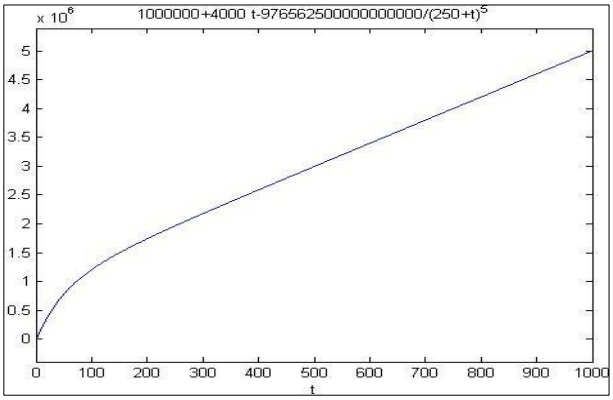

Fig 2: Polluted water Results of samples

Suppose that a new industry starts up river from a lake at t=0 days, and this industry starts dumping a toxic pollutant, P(t), into the river at a rate of 7 g/day, which flows directly into the lake. The flow of the river is $1000m^3/day$, which goes into the lake that maintains a constant volume of 400, $000m^3$. The lake is situated in a hot area and loses $50m^3/day$ of water to evaporation (pure water with no pollutant), while the remainder of the water exits at a rate of $950m^3/day$ through a river. We assume that all quantities are well-mixed and that there are no time delays for the pollutant reaching the lake from the river.

Remarks 1

Now consider a differential equation that describes the concentration, c(t), of the pollutant in the lake, using units of mg/m^3 (Note that 1000mg = 1g), then solve the differential equation. If a concentration of only $2mg/m^3$ is toxic to the fish population, then find how long until this level is reached If unchecked by regulations, then find what the eventual concentration of the pollutant is in the lake, assuming constant output by the new industry.

Solution

The change in amount of pollution= Amount entering - Amount leaving

We have the conservation of amount of pollutant given by the equation:

$$P'(t) = k - fc(t) = 7000 - 950c(t).$$

Thus $c'(t) = \frac{k}{V} - \frac{f}{K}c(t) = \frac{7}{400} - \frac{950}{400000}c(t)$

We make the change of variables, $z(t) = c(t) - \frac{k}{f}$, with $z(0) = c(0) - \frac{k}{f}$ which gives the differential equation

$$z'(t) = -\frac{f}{V}z(t) \text{with } z(0) = -\frac{k}{f}$$

Thus, we need to solve t = In (1.3726)/0.002375≈133.3 days

The limiting concentration has the exponential term go to zero. Thus, we have

$$\lim_{t\to\infty} c(t) = \frac{7000}{950} \approx 7.368 \text{ mg/m}^3$$

Remarks 2

Suppose that the lake is at this limiting level of pollutant and a new environmental law is passed that shuts down the industry at a new time $t = 0$ days. Write a new differential equation describing the situation following the shutdown of the industry and solve this equation. Calculate how long it takes for the lake to return to a level that allows fish to survive.

Solution

The new environmental law shuts down the industry at a new time t = 0days, so the equation above follows with k=0mg/day with $c(0)=7000/950\approx 7.368 mg/m^3$.

Thus, we need to solve

$$c'(t) = -\frac{f}{V}c(t) = -0.002375c(t) \text{ with } c(0) = \frac{7000}{950}$$

To find when the concentration is reduced to 2 = mg/m^3, we evaluate, t=In (3.684)/0.002375 ≈ 549 days

2.3.2 The Flows of Polluted Lake Water

A stable and highly soluble pollutant is dumped into a lake at the rate of 0.16 tons per day. The lake volume is $4\times10^7 m^3$ and the average water flow-through rate is $8x10^4 m^3$/day. Ignore evaporation from the lake surface and assume the pollutant is uniformly mixed in the lake. What eventual steady-state concentration will the pollutant reach.

Solution

The rate at which pollution is added to the lake is given, so to calculate the steady-state stock, the residence time is needed. Because the pollutant is uniformly mixed in the lake, the residence time of the pollutant will equal the residence time of the lake water, which can be derived from the lake date provided. Dividing the stock of water, M_ω, by the rate of water flow-through, F_ω, the residence time of water in the lake, T_ω, is obtained:

$$T_\omega = \frac{M_\omega}{F_\omega} = \frac{4 \times 10^7 m^3}{8 \times 10^4 m^3/day} = 500 \text{ days}$$

$$M_p = F_p T_p = 0.16 \frac{\text{tonnes}}{\text{day}} \times 500 \text{days} = 80 \text{ tonnes}$$

This is given by, $T_{\omega,outflow} = \frac{4\times10^7 m^3}{5.3\times10^4 m^3/day} = 750$ days

The rest of the calculation remains the same, and the steady-state concentration of pollutant will be 3/2 greater than before.

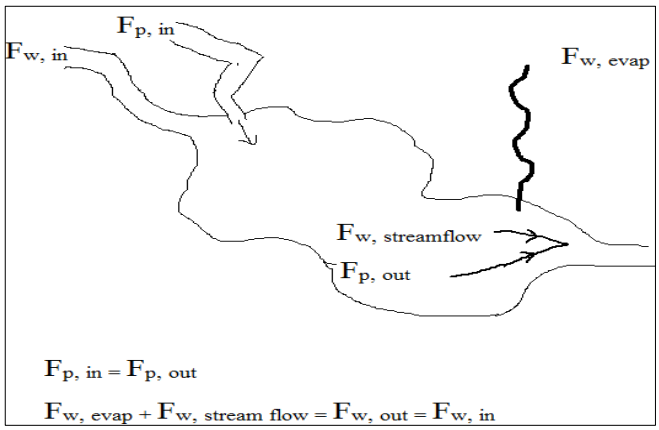

Fig 3: Direction of Lake View

3. Conclusion

There are so many pollution is affected the resources. Mainly the soil, water, airs some aspects and increasing population affects the resources. The lakes, pond, river are mostly affected by the pollution. Some of them in the world are getting pure drinking water. The level of water Purification to the laboratory and calculated them. Explains the highly polluted water was not much recommended. It has contained some amount of toxic chemicals after the cleaning process.

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