AN EXPERIMENTAL STUDY ON SEWAGE TREATMENT USING PLANTS

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ABSTRACT

The dirty water that comes from homes and businesses as a result of laundry, using the bathroom, and all the soapy water that comes from washing dishes and the likes in the kitchen is what we call sewage or wastewater. Rainwater entering drains and industrial wastes also appear to fit under this category. The growing population, urbanization, economic and industrial development are not only putting pressure on the water resources in terms of quantity and always polluted the water. Mainly Domestic sewage, industrial effluents and agriculture and mining runoff cause severe water pollution. One of the most pressing problems in the cities is the lack of sanitation and inadequate treatment facilities, resulting in severe water pollution, posing health and environmental risks. The waste water is directly discharged without treatment into the water bodies are causing environmental problems also affecting the health of human beings. Therefore the necessity is arises to remove the nutrients and other water pollutant parameters. The Major finding or issues surveillance of STP's in Major Indian cities are around 95% of the systems are not fully functional, Interrupted operation due to frequent power failure, Hydraulic or organic overloading, Inadequate oxygenation due to power failure and mechanical breakdown of aerators, uneven sewage distribution, difficulties in sludge handling and financial difficulties. So, the difficulties we have to study on natural sewage treatment plant where the plants species are used to treat the sewage water. The load on effluent treatment and disposal is increasing due to industries are growing day by day. The new treatment and reuse techniques are needed to be Discovered as the condition is getting worst.he method of removal of toxic substances from soil and water was developed which is known as Phyto-remediation.

Key-word: Sewage water, Phyto-remediation, Environmental pollution, Anerobic decomposition

INTRODUCTION

GENERAL

Most water treatment plants (especially large plants) employ coagulation, sedimentation, and filtration processes for water purification. The major sources of wastes are the sedimentation basins and filter backwashes. Alum coagulation sludges, which are high in gelatinous metal hydroxides, comprise large quantities of small particles. These are among the most difficult sludges to handle because of their low settling rate, low permeability to water, and thixotropic characteristics.Generally, about 100% of the treated water is used for washing filters. Volume reduction of backwashes and recycling of wash water to the plant influent can reduce waste production and cut costs.

CONTAMINANTS

Contaminants that have been remediated in laboratory and/or field studies using natural sewage treatment plant or plant- assisted bioremediation include:

- Heavy metals (Cd, Cr(VI), Pb, Co, Cu, Pb, Ni, Se,Zn)
- Radionuclides (Cs, Sr,Ur)
- Chlorinated solvents (TCE,PCE)
- Petroleum hydrocarbons(BTEX)
- Polychlorinated biphenyls(PCBs)

PROCESS OF SEWAGE TREATMENT

Sewage treatment is based on certain natural processes carried out by plants including:

- Uptake of metals and certain organic compounds (i.e., moderately water soluble, log Kow=0.5 to 3, such as BTEX) from soil and water;
- Accumulation or processing of these chemicals via lignification, volatilization, metabolization, mineralization (transformation into $CO_2$and water);
- Use of enzymes to breakdown complex organic molecules into simpler molecules (ultimately CO_2 andwater);

TYPES OF NATURAL SEWAGE TREATMENT PLANT

- **Phytoremediation**
- **Rhizofiltration**
- **Phytoextractio**n
- **Phytotransformation**;
- **Phytostimulation**or

GROUNDWATER REMEDIATION METHODS

1) Rhizofiltration
2) Phytotransformation
3) Plant-Assisted Bioremediation

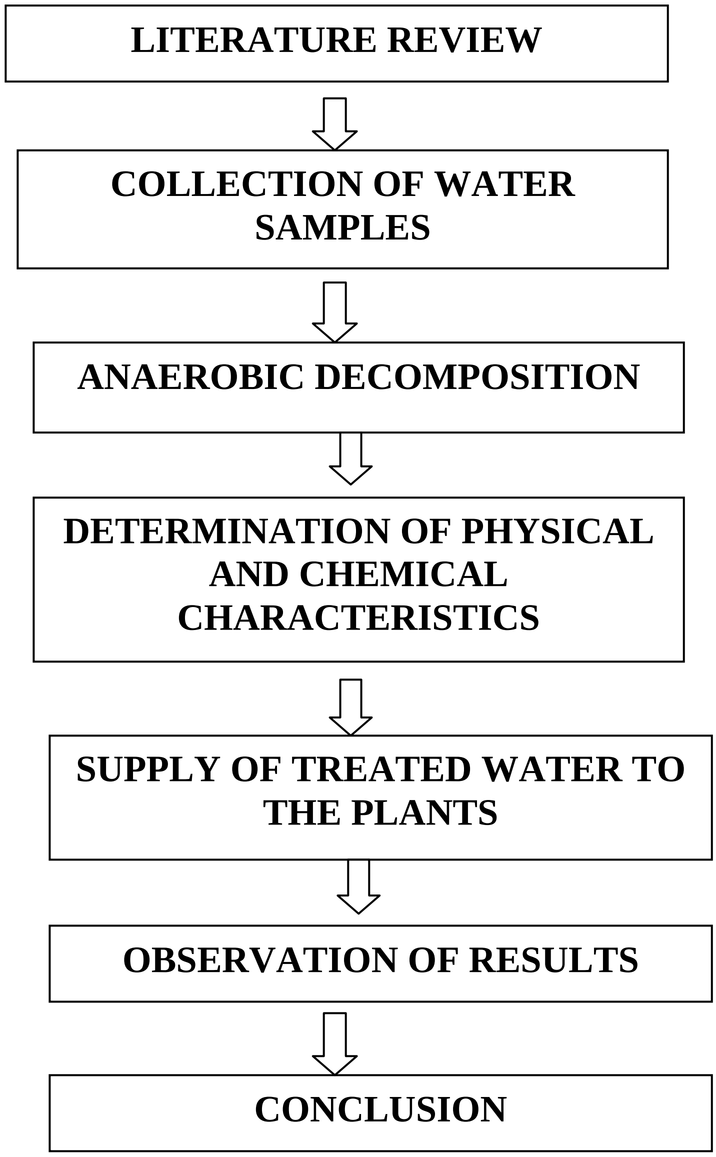
SOIL REMEDIATION METHODS

1) Phytoextraction
2) Phytostabilization

TYPES OF PLANTS USED FOR THE TREATMENT

1) Common arrow head
2) Vetiver
3) Cattails

METHODOLOGY



EXPERIMENTAL STUDIES

QUALITY OF SEWAGE WATER:

1) PHYSICAL QUALITY
2) CHEMICAL QUALITY
3) MICROBIOLOGICAL QUALITY

DETERMINATION OF TURBIDITY

Apparatus :

Turbidity meter

Chemicals :

Formazin polymer standards

Procedure :

1. For testing the given water sample first the reagents are to be prepared. Then the turbidity meter is required to be calibrated.

2. To the sample cells, add sample water up to the horizontal mark, wipe gently with soft tissue and place it in the turbidity meter. Cover the sample cell with the light

shield. 3. Check for the reading in the turbidity meter. Wait until you get a stable reading

DETERMINATION OF ACIDITY

Apparatus

PH meter

Reagents

Sodium hydroxide titrant (0.02N) ;
Phenolthalein Indicator;
Methyl orange Indicator.

Steps

1. Take 50 ml sample in a conical flask and add 2-3 drops of methyl orange indicator solution.

2. Fill the burette with 0.02 N NaOH solution and titrate till the colour of solution just changes to faint orange colour, indicating the end point. Record the volume of titrant consumed as V1 in ml.Calculate the methyl orange acidity.

Methyl orange acidity (or Mineral Acidity) = (V1 x 1000)/(Sample volume)

When the 0.02 N NaOH solution, used in titration is not standardized, mineral acidity is calculated

Methyl orange acidity = (V1 x N x 50 x1000)/ (sample volume)

DETERMINATION OF ALKALINITY, CARBONATES AND BICARBONATES

APPARATUS:

1. Burette with burette stand and porcelain title
2. Pipettes with elongated tips
3. Conical flask
4. Beakers
5. Stirrer
6. Measuring cylinders

Chemical:

1. Standard 0.02N sulphuric acid
2. Phenolphthalein indicator
3. Methyl orange indicator

PROCEDURE:

1. Measure 50 ml or 100 ml of your sample into a 250ml beaker or erlenmyer flask. Place your sample onto a stir plate (make sure to put a bar magnet in the flask).

2. Measure initial PH of your sample. If the sample pH is below 8.3 (if above 8.3, do step 3 frist), add several drops of methyl orange indicator. If the colour of he solution turned yellow, your sample with 0.02 N H_2SO_4 (you may need to dilute the acid provide in the lab) until the colour change to slightly orange ting (pH 4.5). Record the total volume of acid used for the titration.

CALCULATION :

Phenolphthalein alkalinity (mg/l as $CaCo_3$)

= Multiplying factor (MF) x milliliter of 0.02N H_2SO_4 (added up to pH 8.3)

Total alkalinity (mg/l as CaCo3) = Multiplying factor (MF) x milliliter of 0.02N H2SO4 (added up to pH approx 4.5)

DETERMINATION OF TOTAL SOLIDS, DISSOLVED SOLIDS AND SUSPENDED SOLIDS IN WATER

APPARATUS :

1. Balance
2. Beaker
3. Measuring cylinder
4. Filter paper
5. Funnel
6. Dropper

PROCEDURE :

MEASUREMENT OF TOTAL SOLIDS(TS)

(1) Take a clear dry glass beaker (which was kept at 103o C in an oven for 1 hour) of 150ml. capacity and put appropriate mark on it. Weight the beaker and note the weight.

(2) Pour 100ml. of the thoroughly mixed sample, measured by the measuring cylinder, in the beaker.

(3) Place the beaker in an oven maintained at 1030 C for 24hours, cool the beaker and weight. Find out the weight of solids in the beaker by subtracting the weight of the beaker determined in step (1)

(4) Calculate total solids (TS) as follows

CALCULATION :

Total solids,TS (mg/l)= mg of solids in the beaker x 1000 /(volume of sample)

Total dissolved solids,TDS (mg/l) = mg of solids in the beaker x1000 /(volume of sample)

Total suspended solids,TSS (mg/l) = TS (mg/l) – TDS (mg/l)

DETERMINATION OF CHEMICAL OXYGEN DEMAND

Take three COD vials with stopper (two for the sample and one for the blank).

• Add 2.5 ml of the sample to each of the two COD vials and the remaining COD vials is for blank; to this COD vial add distilled water.

• Add 1.5 ml of potassium dichromate reagent – digestion solution to each of the three COD vials.

CACULATION

COD = (A-B) x Normality of FAS x 8000

Where

A = ml of FAS used for titration of blank

B = ml of FAS used for titration of sample

Determination of Biochemical oxygen demand

CALCULATION:

BOD = L (1- 10^kt)

Where, L = Ultimate BOD (L)

K = Deoxygeneration rate constant/s t=Time

DETERMINATION OF TOTAL HARDNESS

- Pipette 20 ml of water sample and transfer it to clean 250 ml conical flask.
- Add 2ml of ammonia buffer solution to the water sample so that the pH will be maintain between 9 and 10.
- Add few drops of EBT indicator to the conical flask and the sample turns to wine red in colour.
- Before starting the titration rinse the burette with few ml of EDTA.
- Fill the burette with 0.02 m EDTA solution and adjust to zero then fix it in burette stand.
- Note down the burette reading .
- The value of titration 29.8ml.
- Repeat the titration for concordant values.

DETERMINATION OF CHLORIDE

- Before starting the titration rinse the burette with silver nitrate solution. Fill the burette with silver nitrate solution of 0.0282 N. Adjust to zero and fix the burette in stand.
- Take 20 ml of the sample in a clean 250 ml conical flask.
- Add 1ml of potassium chromate indicator to get light yellow colour.
- Titrate the sample against the silver nitrate solution until the colour change from yellow to brick red i.e., the end point.
- Note the value of silver nitrate added (A)
- The value of titration is 3.3 ml.
- Repeat the procedure for concordant values.

CALCULATION

Chloride ion (mg/l) = (A x N x35.45) X (1000/V)

Where,

A= Volume of titrant

N= Normality of silver nitrate 0.0141 N

V= Volume of sample

DETERMINATION OF DISSOLVED OXYGEN

Apparatus

- DO sample, for collection of undisturbed sample from surface water.
- BOD bottles, 300ml, narrow mouth, flared lip, with tapered and pointed ground glass stoppers.
- A siphon tube, for laboratory use.
- CALCULATION

$$Mg\ DO/l = \frac{\text{V X M}}{0.025}$$

Where: V = ml thiosulphate solution used

M = molarity of thiosulphate titrant

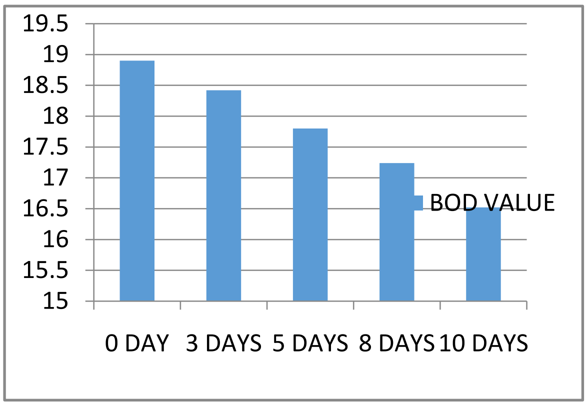
RESULTS AND DISCUSSIONS

BOD REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

S.NO.	PARAMETERS	VALUES	STANDARD PERMISSIBLE LIMITS
1	P^H at 25^0 C	7.10	6.5-8.5
2	Colour	Light Yellow	Clear
3	Odour	None	Odourless
4	COD(mg/l)	27.8	10 (WHO)
5	BOD (mg/l)	18.9	5 (WHO)
6	Alkalinity total	181.22	2.5 (WHO)
7	TDS (mg/l)	1566	500 (WHO)
8	Turbidity (NTU)	3.18	500 (WHO)
9	Cadmium (mg/l)	1.99	0.01 (WHO)
10	Zinc (mg/l)s	2.63	5 (IS:10500)
11	Copper (mg/l)	1.86	0.05 (IS:10500)
12	Mercury (mg/l)	0.004	0.001 (IS:10500)
13	Lead (mg/l)	0.67	0.1 (IS:10500)
14	Chromium (mg/l)	2.88	0.05 (IS:10500)

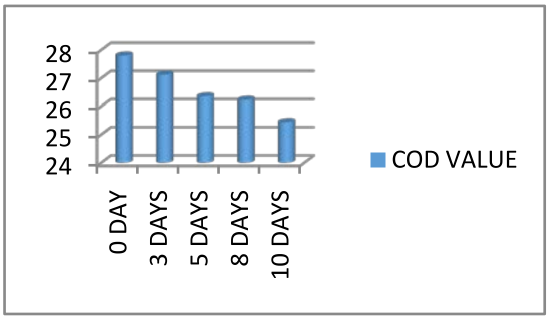
BOD REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	BOD ALUE
0 DAY	18.9
3 DAYS	18.42
5 DAYS	17.80
8 DAYS	17.24
10 DAYS	16.52



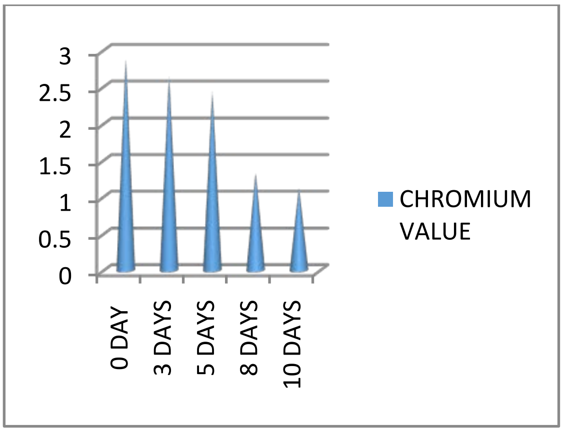
COD REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	COD VALUE
0 DAY	27.8
3 DAYS	27.12
5 DAYS	26.35
8 DAYS	26.23
10 DAYS	25.44



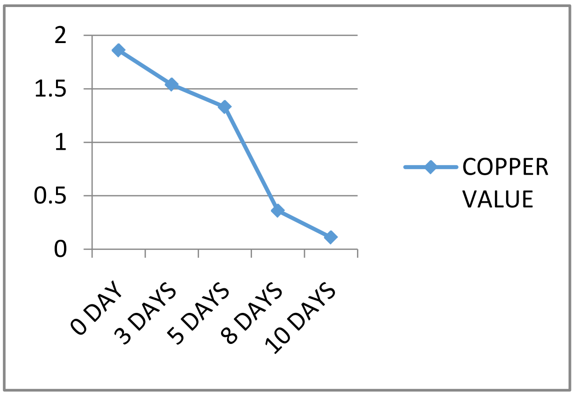
CHROMIUM REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	CHROMIUM VALUE
0 DAY	2.88
3 DAYS	2.64
5 DAYS	2.43
8 DAYS	1.32
10 DAYS	1.11



COPPER REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	COPPER VALUE
0 DAY	1.86
3 DAYS	1.54
5 DAYS	1.33
8 DAYS	0.36
10 DAYS	0.11



CADMIUM REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF. DAYS	CADMIUM VALUE
0 DAY	1.99
3 DAYS	0.85
5 DAYS	0.78
8 DAYS	0.66
10 DAYS	0.14

LEAD REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	LEAD VALUE
0 DAY	0.67
3 DAYS	0.53
5 DAYS	0.47
8 DAYS	0.44
10 DAYS	0.38

MERCURY REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	MERCURY VALUE
0 DAY	0.004
3 DAYS	0.003
5 DAYS	0.002
8 DAYS	0.002
10 DAYS	0.002

TDS REMOVAL IN NATURAL SEWAGE TREATMENT PLANT

NO.OF.DAYS	TDS VALUE
0 DAY	1566
3 DAYS	1445
5 DAYS	1419
8 DAYS	1378
10 DAYS	1320

TECHNOLOGY ADVANTAGES AND LIMITATTIONS

ADVANTAGES

- Can be performed with minimal environmental disturbance
- Applicable to broad range of contaminants, including many metals with limited alternative options
- Possibly less secondary air and/or water wastes generated than traditional methods
- Organic pollutants may be degraded to CO_2 and H_2O, removing, as opposed to X X transferring, environmental toxicity
- Cost-effective for large volumes of water having low concentrations of contaminants X to low (stringent) standards
- Topsoil is left in a usable condition and may X be reclaimed for agricultural use

LIMITATIONS

Possible disadvantages associated with all plant-assisted remediation techniques include:

- Long length of time required for remediation (usually more than one growing season);
- Treatment is generally limited to soils at less than 3 feet from the surface and groundwater within 10 feet of the surface;
- Climatic or hydrologic conditions (e.g., flooding, drought) may restrict the rate of growth of types of plants that can be utilized;

CONCLUSION

Based on the experimental and analytical investigation, following conclusion were made:

- It is concluded that the water samples were collected and the experimental studies of physical and chemical characteristics of water quality are experiment and to be found out.
- The results obtained from the present laboratory test reveals that the natural sewage water treatment plant technology by using Common arrow head, Cattails, Vetiver and Elephant grass can gradually reduce the polluted contaminants.

This system is useful for treatment of waste water in following:

- Domestic wastewater (including decentralized Municipal waste watertreatment)
- Colonies, Airports, Commercial complexes, Hotels
- Open drainage
- Agricultural wastewater
- Dairy waste
- Slaughter House Waste
- Pre treated industrial wastewater, Sugar Industries
- Lake restoration

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