LEACHATE TREATMENT USING CASTOR SEED-BASED CONSTRUCTED WETLAND

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Abstract : Leachate forms a major environment problem in a developing country like India, compared to developed countries, became of improper waste disposal habits, non-segregation of waste and poorly designed landfill. Due to complex characteristics of leachate, its bio-chemical treatment becomes increasingly difficult unreliable. The purpose of the project into arrest leachate contamination by castor based constructed wetland and to generate value added products simultaneously.

***IndexTerms* – Leachate, Castor seed, Wet land, Landfill**

I. INTRODUCTION

Textile wastewater and industrial wastewater is considered a major threat due to toxicity & magnitude, especially in India. Chemical treatments leading to increasing cost & additional chemical toxicity. Wetland-based treatment is an eco-friendly, low-cost method and need less skill, with additional generation of resources. Castor-seed is resistance to high damped soil & can sustain high level of both organic & inorganic toxicity.

1.1 CASTOR SEEDS

Ricinus communis, the **castor bean** or **castor-oil-plant**, is a species of perennial flowering plant in the spurge family, Euphorbiaceous.

Castor seed is the source of castor oil, which has a wide variety of uses. The seeds contain between 40% and 60% oil that is rich in triglycerides, mainly ricinolein. The seed also contains resin, a water-soluble toxin, which is also present in lower concentrations throughout the plant properties. Like other crops, castor seed production will presume with land development. The land development part includes surveying and design; land clearing, leveling and irrigation system and access and farm roads construction. Usually land development is followed by land preparation activities such as disking and harrowing. After fine seed bed preparation, sowing with fertilizer application will be undertaken. In castor bean production, preharvest managements like cultivation for weed control and soil fertility improvement, irrigation water application, insect pest and disease control are the main activities to be carried out, timely.

1.2 WETLAND TREATMENT

Physical, chemical, and biological processes combine in wetlands to remove contaminants from wastewater. Theoretically, wastewater treatment within a constructed wetland occurs as it passes through the wetland medium and the plant rhizosphere. A thin film around each root hair is aerobic due to the leakage of oxygen from the rhizomes, roots, and rootlets. Microbial nitrification and subsequent denitrification releases nitrogen as gas to the atmosphere. Phosphorus is co precipitated with iron, aluminium, and calcium compounds located in the root-bed medium. Suspended solids filter out as they settle in the water column in surface flow wetlands or are physically filtered out by the medium within subsurface flow wetlands. Harmful bacteria and viruses are reduced by filtration and adsorption by bio films on the gravel or sand media in subsurface flow and vertical flow systems.

Using technologies that will have less footprint in our ecosystem can greatly reduce these consequences. The use of constructed wetlands in wastewater treatment may have answers in terms of footprint reduction and thus protecting the environment as opposed to convectional wastewater treatment systems. Apart from their environmental friendliness, constructed wetlands are also proposed as better alternatives in wastewater or industrial wastewater treatments for their significant advantages, including provision of high wastewater treatment levels. Contaminants in wastewater have been demonstrated to be reduced to acceptable levels using this technology. Wetland systems are inexpensive with little or no energy requirements and equipment needs are minimal, which adds to its low-construction cost.

II. METHODOLOGY

SAMPLING AND ANALYSIS:

The monitoring and analysis work had been classified into two categories namely collection of samples and analysis of data for modelling studies.

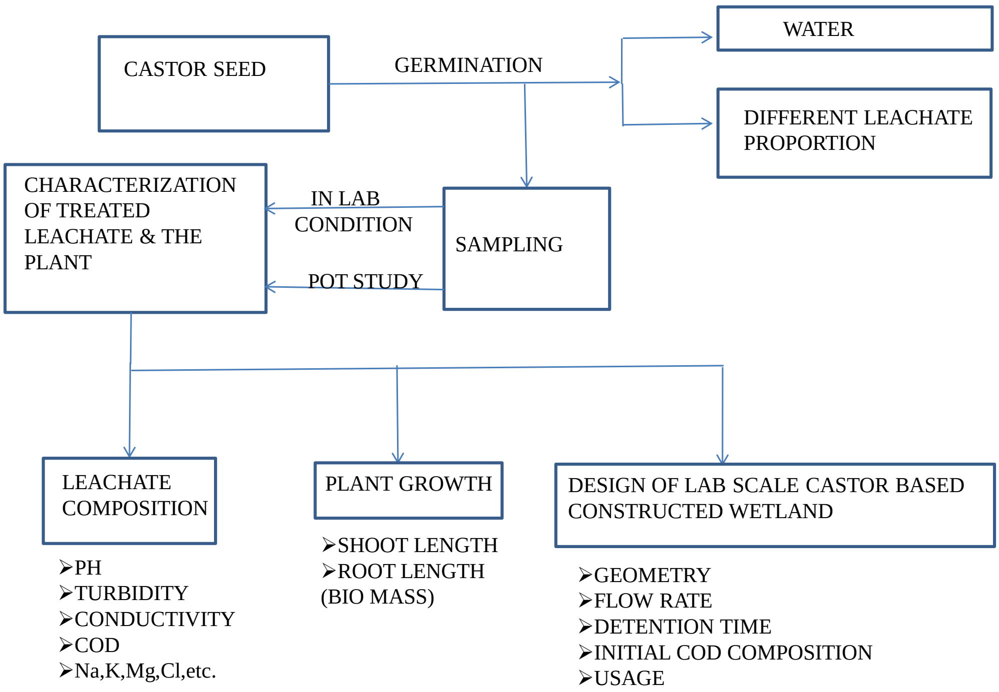

Figure 1 Methodology

2.1 COLLECTION OF SAMPLES:

The leachate sample was collected in a landfill at Thanjavur. The leachate has been diluted into differnet concentrations. Such as 20% of leachate, 40% of leachate, 60% of leachate and 100% of leachate.

2.2 GERMINATION STUDY:

The selected castor seeds are soaked into water for overnight. The next day, five seeds were placed into the moisture paper. Then it is wrapped and placed in the beaker containing leachate in various proportions. Every day, the growth of the seeds were scrutinized and measurement of their root length is recorded.

III. RESULTS AND DISCUSSION

The characterization of leachate in different concentration is measured. Such as salinity, conductivity and TDS with water analyser and pH is measured in ISE (Ion Selective Electrode) equipment. The ions present in leachate such as nitrate, bromide, fluoride, chloride also measured with ISE. The values are tabulated in Table 1.

Table.1 Characteristics of leachate with varying dilution

Varying dilution	Sal. (ppt)	Cond. (ppm)	TDS (mS)	pH	PCU	Na (mg/l)	K (mg/l)	Cl (mg/l)
20%	0.54	603	322	3.74	1176	25	62.5	356.8
40%	0.59	664	357	3.85	3240	25	137.5	305.1
100%	1.14	1.89	0.9	4.08	9250	262.5	4500	330.2

3.1 GERMINATION OF SEEDS IN TEXTILE WASTE WATER WITH MOISTURE PAPER

The selected seeds were immersed in water overnight (12 hours) before planting. Then textile wastewater samples of various dilutions in 20%, 40% and 60% were prepared and the germination test is conducted with the help of moisture paper. The seeds exhibiting the strong germination in low concentration of leachate and gradually decreases with higher concentration. These results were also compared with control in Table 2. The maximum and average growth of both root and shoot of the various dilutions are tabulated below in table 3.

Table 2 Measurement of root length in Control water

DAY	S1	S2	S3	S4	S5	Max. growth	Min. growth	Avg. growth
2	0.9	0.4	0	0	0	0.9	0	0.26
3	7.5	4.2	0	0	0	7.5	0	2.34
4	8.5	7.9	0	2.5	2.8	8.5	0	4.34
5	8.8	7.9	0	5	2.8	8.8	0	4.9
6	9	7.9	0	7	1.5	9	0	5.08
7	9.5	8	1.5	10	1.5	10	1.5	6.1
9	16	10.5	8.5	17	0	17	0	10.4
10	19	13.5	12.5	18.2	0	19	0	12.64
11	19.2	15.8	14.7	18.5	0	19.2	0	13.64
12	19.5	17.2	17.8	18.8	0	19.5	0	14.66
13	19.8	18.5	19.2	20.1	0	20.1	0	15.52
14	20	20.5	21.5	22	0	22	0	16.8
16	21.6	22	23.2	24.1	0	24.1	0	18.18

Table 3 Measurement of root length in 20 % of leachate

DAY	S1	S2	S3	S4	S5	Max. Growth	Min. growth	Avg. Growth
2	0.7	0.3	0	0.5	0.5	0.7	0	0.4
3	2.5	2.2	1.7	3	0.7	3	0.7	2.02
4	3.2	4.3	2.2	4.6	3.8	4.6	2.2	3.62
5	5.5	7.7	3.2	6	3.8	7.7	3.2	5.24
6	6.5	9.5	3.2	6	3.8	9.5	3.2	5.8
7	6.5	9.5	3.2	6	3.8	9.5	3.2	5.8
9	13	13.8	13.5	12.5	13.8	13.8	12.5	13.32
10	14.5	15.2	15	14	14.8	15.2	14	14.7
11	16.3	17.8	15.7	14.3	15.2	17.8	14.3	15.86
12	17.2	18.4	16.2	14.8	16.2	18.4	14.8	16.56
13	18.2	18.6	17.2	14.9	17.8	18.6	14.9	17.34
14	19.5	18.8	20.3	15	19.5	20.3	15	18.62
15	22.7	21.3	24.2	18.7	24.2	24.2	18.7	22.22

Table 4 Measurement of root length in 40% of leachate

DAY	S1	S2	S3	S4	S5	Max. growth	Min. growth	Avg. growth
2	2.2	0	0	0	0	2.2	0	0.44
3	6	0	0	0	0	6	0	1.2
4	6.5	0	0	0	0	6.5	0	1.3
5	8.2	0	0	0	0	8.2	0	1.64
6	9.9	0	0	0.3	0.1	9.9	0	2.06
7	11.2	0	0	2.5	1.5	11.2	0	3.04
9	14.5	0.3	2.5	7.1	4.2	14.5	0.3	5.72
10	15.5	1.5	3.8	8.2	4.5	15.5	1.5	6.7
11	15.6	2.5	4.2	8.5	5.41	15.6	2.5	7.242
12	15.8	3.8	5.2	8.9	6.3	15.8	3.8	8
13	16	4.2	5.6	9.3	6.8	16	4.2	8.38
14	16.1	4.5	5.9	9.6	7.2	16.1	4.5	8.66
15	16.8	5.1	6.3	10.5	10.2	16.8	5.1	9.78

Table 5 Measurement of root length in 60% of leachate

DAY	S1	S2	S3	S4	S5	Max. growth	Min. Growth	Avg. growth
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0.5	0	0	0	0.5	0	0.14
9	0	2.1	0	0	0	2.1	0	0.6
10	0	2.4	0	0	0	2.4	0	0.68
11	0	2.5	0	0	0	2.5	0	0.71
12	0	2.8	0	0	0	2.8	0	0.8
13	0	2.8	0	0	0	2.8	0	0.8
14	0	2.8	0	0	0	2.8	0	0.8
15	0	2.8	0	0	0	2.8	0	0.8

The maximum and average root growth in different proportions of leachate shows that concentration of leachate plays a major role in growth of seeds. The lowest proportion i.e., 20% shows higher growth capacity when compared with the others. The higher concentration of leachate almost shows nil germination when compared with 20 and 40 % of leachate. The values were plotted in figure 2 and 3.

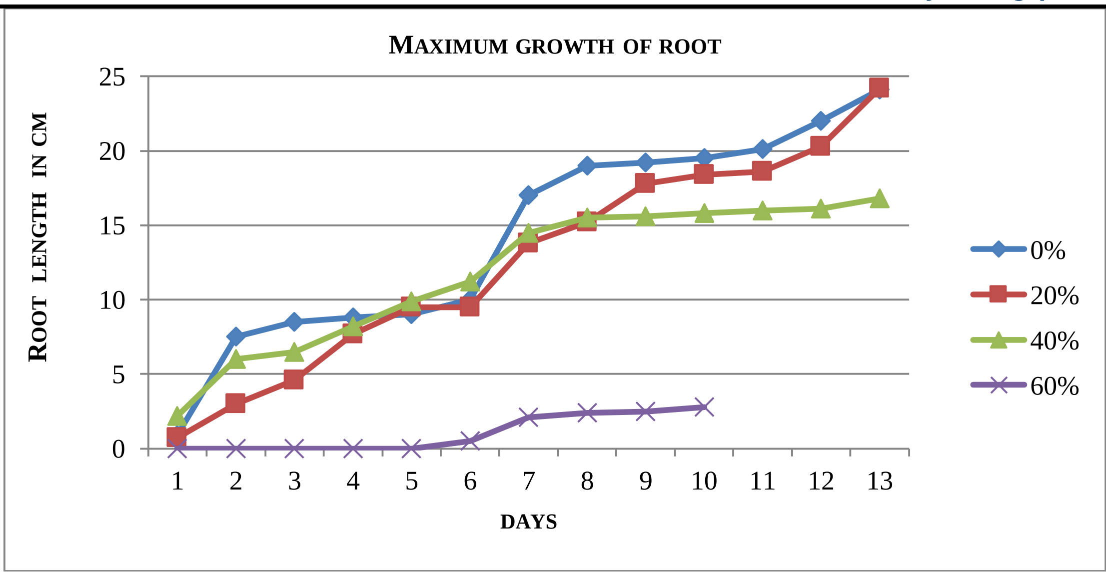

Figure 1 Maximum Root Growth with Different Dilution

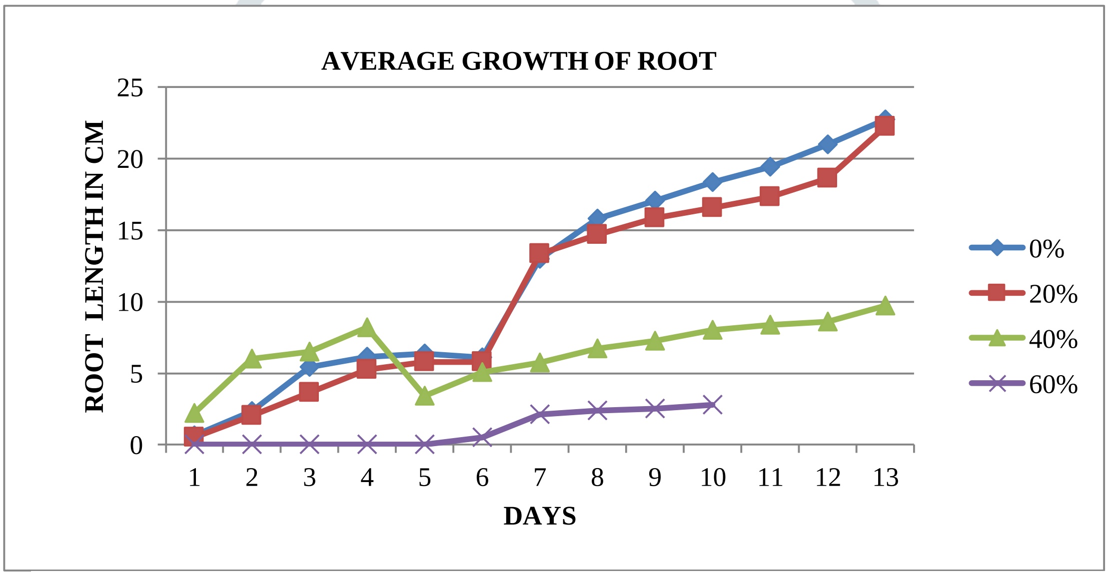

Figure 2 Average Root Growth with Different Dilution

IV. CONCLUSION

Thus, the above evaluations of the plants growth in leachate reveals that the treatment of leachate takes place by utilizing the nutrients available. The 20% of leachate proportion gives the maximum growth. Hence, if the leachate is diluted to 20% before passing through the constructed wetland; the germination of the castor seeds seems good. Therefore, leachate treatment could be possible and also economically useful in constructed wetland with the help of castor plants though it may have some limitations, which leads to further study with pot and field.

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