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Sewage Water Treatment Using Azolla Algae

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Abstract:
As many research works are going on in the field of wastewater treatment, a newly developed wastewater treatment by Azolla is gaining much importance. Various parameters like Biological oxygen demand (BOD), Chemical oxygen demand (COD), Ammonia Nitrogen and Phosphate were observed after the treatment. It is a cost effective method and the method is Eco friendly .The treated water can be used for irrigation purpose.

Keywords: *AzollaAlgae,sewage water,Nutrient removal, Aeration Tank.*

1. INTRODUCTION

The earth and its ecosystems have been changed dramatically after the entrance of the human species into the cycle. One of the major problems, which has been accelerated especially after the industrial revolution is environmental pollution, among them water pollution. Water as one of the major resources for the development of human societies, has being used and then polluted by human bodies. While there are limited water resources which are available and appropriate for different kinds of development, the increase in the population and decrease in the quality of available water has magnified the magnificent of the problem. In particular, significant concentrations of heavy and hazardous metals are released into water bodies' mostly through industrial wastewaters and these can cause numerous environmental problems. The adverse effects associated with metals can the alteration of the structure of crops and functions of organisms and their effects can be observed in food chains. High metal concentrations and water parameters can be toxic to some organisms and metal imbalance in plant tissues can be critical for different kinds of diseases. On the other hands, the increase in the concentration of nutrients such as nitrogen and phosphorus in water causes eutrophication of surface water resources the capability of some plant species to absorb and accumulate high level of metals and nutrients in organs can be used for the purification of polluted environment; is a process known as phytoremediation, Aquatic macrophytes exhibit a high potential for heavy metal phytoremediation and rapid growth and high biomass. The objectives of this study were to test the role of Azolla pinnate in wastewater treatment. The environment is currently facing a number of pollution problems. One of the major problems is the accumulation of large amount of wastes, especially waste waters, generated by intensive production. The accumulation of these wastes may pose disposal and pollution problems unless environmentally and economically sustainable management technologies are evolved. Therefore, the development of cost effective technologies for wastewater treatment should be studied.

1.1 OBJECTIVES:

- To purify the sewage water.
- To reduce the scarcity of water.
- To make maximum use of sewage water for irrigation purpose.
- To reduce the use of chemicals for water treatement.

2. LITERATURE REVIEW

Arya Krishna, Anand Lali Neera "Waste water treatment by azolla algae"(2013) PP:286-293

They studied about the Process of plants for waste water remeniation to find out the role of aquatic ferns for wastewater treatment. Water bodies are the main targets for disposing the pollutants directly or indirectly. This is a paper illustrating the role of plants to assist treatment of industrial or residential wastewater. The paper discusses the potential of different process and utilization of terrestrial and aquatic plants in purifying water and wastewater from different sources.

Noorjahan C.M and S, Jamuna "Biodegradation of sewage waste water using Azolla microphylla" (2015) PP: 75-80

This study focus on the bio monitoring capacity of azolla micro phylla for purification of sewage waste water. 100% untreated and treated sewage sample were prepared and azolla microphylla were introduced into tubs. After 96hrs sewage waste water sample were analysed and the result showed an active reduction in physio-chemical

parameters and heavy metals. Bio treated samples of organic matter nitrogen phosphorous removal from waste water and can be good for soil fertility

Ranai Jangwattana "Using Azolla pinnata for waste water treatment from poultry farm"(2009) PP:23-27
He studied Waste water from animal farm especially from poultry industry is one of the sources of non-point source water pollution in Thailand. Plants can be a practical tool for waste water treatment. Aquatic fern (Azolla pinnata) has been used to for organic matter, nitrogen and phosphorus removal from waste water and can be good for increase soil fertility. This study demonstrated that Azolla pinnata can be taken into consideration as tool for wastewater treatment from agriculture activities especially suitable wastewater treatment for small poultry farming.

Durga Madhab Mahapatra, H.N Chanakya, T.V Ramachandra "Treatment efficacy of Azolla algae -based sewage treatment plants" (2012) PP:526-546
This study focuses on the treatment efficiency of Azolla algae based sewage treatment plant of 67.65million litre per day capacity considering the characteristics of domestic waste water and functioning of the treatment plant, while attempting to understand the role of algae in the treatment. Sewage treatment plant performance was assessed by diurnal as well as periodic investigation of key water quality parameters and algal biota.

Bruce Alen Hastie, B,S "The use of aquatic plants in waste treatment." (2011) PP: 135-162
In this, He reports that natural treatment came back into consideration mostly as an systems attempt to find a more cost effective means of achieving the mandated treatment levels that was available with the existing mechanical or chemical processes. Natural treatment systems are not disposal practices, nor are they random applications of waste and wastewater in various habitats.

3. METHODOLOGY

3.1 SITE SELECTION AND PREPARATIONS

The site for the project is selected in our college campus itself. The project must carry in four different pits. Each of pits must have the capacity to carry more than 50 litres. Pits are created in the soil with a dimension of 1mx1mx0.2m. The pits must be created in a place such that it should not have high temperature so the place for the project work is selected in a shadow place. The high temperature can causes damages to the Azolla algae. And also the high temperature can cause the easy vaporization of the sewage water. Azolla is a type of algae and it must have a permissible limit of temperature for its growing .It cannot tolerate high level of temperature. When high temperature acts on it its leaf will be dying and it will make the water more polluted so the selected place should not have high temperature.
The selected site is first cleaned for the preparation of the pit. After that three pits of having same dimensions are created. The water can't stay in soil because of the seepage of water though the soil pores. Because of this property there must be additional facilities must be provided to avoid the water seepage. Plastic poli ethylene covers are used to avoid this. This covers are used to place in the pits for preventing the flow of water though the soil. The pits that constructed in the soil must have other properties also. The site selected must be in higher level compared to the surrounding soil level Otherwise may the soil runoff can cause due to the surface water run due to any reasons like raining or pumping etc. By considering all these parameters we selected the place in our right back side of our hostel itself. The pits or water tanks can also provide. In our case we selected the pit by avoiding the tank. This is because of the cost analysis. Also we stated in the introduction that we are looking forward to a cost effective method. Hence we selected the pits by avoiding the other kind of tank preparations. We created three pits one adjacent to other for our test procedure As we considering the naturally growing plants for the test, it is necessary provide all the growing facilities. As we selected the azolla algae for the test procedure, it is necessary to find out its growing temperature and other needs.

3.2 COLLECTION OF MATERIALS.

Collection of materials includes the collection of waste water and the collection of Azolla algae. The waste water is collected from the Perambalur municipality and the Azolla algae are collected from the Roever Institute of Agriculture and rural development college. The water is collected in wide level because the test should carry in each three pits. One pit at least contains 50 litres. 25 gram of azolla is collected and it is placed in a pit having drinking water collected from the college. This is for the primary growth of azolla and touse in other pits. In the pure water we added some phosphorus and cow dung for the better growth of the azolla. Azolla have the ability to capture the water phosphorus for its growth and also the cow dung will help for its fast growing. It is a good nutrient for the azolla algae for its growth. As it having a deep root, it is able to catch all the nutrients from its surrounding water level.
T he material collection also includes the collection of a plastic cover for the prevention of water seepage to the soil, yellow colour plastic sheet is collected because it having a capacity to resist the heat from the sun light and hence the water in the pit will be cool for a long period. Laboratory tests were performed in order to examine the efficiency of using A. pinnate to treat the wastewater from poultry industry, Extensive monitoring of the treatment efficiency was performed by collecting weekly samples from the different treatment units. All physico- chemical analyses for pH, COD,

BOD, NPK, TSS, TDS, DO, Alkalinity, Acidity, Turbidity, Chloride, Hardness, Sulphate, Sodium, and Magnesium were performed to standard Methods. Each pond made of cement occupied 1 m² area and was 0.2 m deep. The experimental ponds were inoculated with A. pinnata, at60 g fresh aquatic fem per container. The plant growth rate and yield were monitored after the experiment in each pond.

3.3 TESTING OF SAMPLE PARAMETERS.

After the collection of sewage water, it is necessary to find out the sewage water parameters. It is very essential and important to test the water before used for drinking, domestic, agricultural or industrial purpose, Water must be tested with different physio-chemical parameters. Selection of parameters for testing of water is solely depends upon for what we going to use that purpose water and what extent we need its quality and purity. Water does content different types of floating, dissolved, suspended and microbiological as well as impurities. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated analytical instruments and well trained manpower. The appearance, taste, odour and feel' of water determine what people experience when they drink or use water and how they rate its quality; other physical characteristics can suggest whether corrosion and encrustation arc likely to be significant problems in pipes or fittings. A number of chemicals, both organic and inorganic, including some pesticides, are of concern in drinking water from the health perspective because they are toxic to humans or are suspected of causing cancer, some can also affect the aesthetic quality of water The test procedure is mainly looking forward to the reduction of different parameters like turbidity, pH, acidity, and other chemical parameters like BOD, COD, Nitrogen, Phosphorous, ammonia etc.

Nature of test	**Test method**	**Instrument**	**Sample size**
Taste	Visual	Transparent glass	500
Colour	Visual comparison	Nesslers tube	200
Odour	At60˚C	Wide mounthed jar	500
Turbidity	Nephelometric	Turbidity meter	200
pH value	Electrometric	pHmeter	500
Conductivity	Lab method	Conductivity	500
Total solids (TS)	Gravimetric	Hot air oven	400
Total dissolved solid	Gravimetric 180˚c	Hot air oven	400
Suspended with/without	(TS-TDS=TSS)	Hot air oven	400
Acidity	Tirimetric	pHmeter	200
Alkalinity	Tirimetric	pHmeter	200
Ammonical nitrogen	Tirimetric	Distillation assembly	200
Biocarbonates	Tirimetric	pHmeter	200
Carbon dioxide	Tirimetric	Titrator	200
Carbonates	Tirimetric	pHmeter	200
Dissolved oxygen	Winkler titrimetric	Titrator	1000
Total hardness	EDTA Titrimetric	Titrator	400
Nitrate nitrogen	Colorimetric	UV-visible	200
Phosphate	Colorimetric	UV-visible	200
Silica	Colorimetric	UV-visible	200
Sulfate	turbidimetric	UV-visible	200
Chloride	Argentometric	titrator	200

Table 1 Different test methods and instruments are used for water parameter

3.4 METHOD OF TESTING AND CONTINUES OBSERVATION.

The selected site is first cleaned for the preparation of the pit. After that3 pits of having same dimensions are created. The water can't stay in soil because of the seepage of water though the soil pores. Because of this property there must be additional facilities must be provided to avoid the water seepage. Plastic poli ethylene covers are used to avoid this. This covers are used to place in the pits for preventing the flow of water though the soil. The pits that constructed in the soil must have other properties also. The site selected must be in higher level compared to the surrounding soil level. Otherwise may the soil runoff can cause due to the surface water run due to any reasons like raining or pumping etc .By considering all this parameters we selected the place in our right back side of our hostel itself The pits or water tanks can also provide. In our case we selected the pit by avoiding the tank. This is because of the cost analysis. Also we stated in the introduction that we are looking forward to a cost effective method. Hence we selected the pits by avoiding the other kind of tank preparations. We created four pits one adjacent to other for our test procedure.

At first stage, the azolla algae are allowed to grow in the first pit having pure water. Some of the ingredients are added to this pond such as the phosphorous and the cow dung, these are very help full in the growth of these algae. 25 gram of azolla algae are first floated on the pond for their growth. The growth of the azolla algae is observed in all the day and studied. The rate of growth of the algae in the first 10 days is faster than the other 10 days. The continuous observation and the weight measurement of the azolla algae are noted.

It absorbs the nutrients from the water in a high rate and grown. After certain limit its growth rate began to reduce. That we observed from the weight calculation. The reason for this type of reduction in growth is the insufficient nutrients in the water medium. Azolla completely absorbed all the nutrients that are added to the water such as the phosphorus and the cow dung. Also the water medium is pure, hence the availability of the nutrients in the medium for the growth of azolla is comparatively less. This study helps us to find out the availability of nutrients for the growth of Azolla algae, the azolla is grown in a high range and the grown azolla can be used for the test that should be conducted in the other three pits with sewage water

After the sewage water is collected it is filled in the remaining three pits. One pit contains the sewage water as It is the second one contains sewage water with cow dung and phosphorus and the last pit contains the diluted sewage water. In which the 25 litres of sewage water is diluted with 25 litres of pure water. Then the Azolla algae having 25 gm weight is filled in each pit. As shown in the image fig.3. Daily observation is carried to test the growth of azolla and for the test out of water. The water is collected from the pits for testing the parameters in an interval of 15 Growth of azolla algae and the water parameters a tested days. periodically and identified the changes in the sewage water, Continues observation is made and the water in each pit is mixed thoroughly by using a stick in all days It is for the well capture of the impurities by the azolla algae. It is noted that the azolla algae in each pit is growing fastly day by day. The azolla present in the pit contains sewage water, cow dung and the phosphorus under gone for a fast growing. The amount of azolla present in that pit gets doubled in 2 days. It is because of the presents of the additional impurities added to the water. The pit contains the sewage water plus the pure water is observed and it is noted that the growth of azolla algae is in a slow rate.

4. RESULT AND DISCUSSION

The water in the pits is periodically taken for water testing to identify the reduction in the water parameters. The test is conducted with an equal interval of 15 days. One test is taken after 15 days and another on in 30 days. The full growth of the azolla algae is completed in 10 days.

Parameters	Standard value	Sample 1	Sample 2	Sample 3
Ph	6.5-8.5	9.2	9.5	8.8
Turbidity	10	50	58	45
TDS	500	840	980	675
TSS	500	753	832	685
Acidity	200	375	466	632
Alkalinity	200	427	559	263
Hardness	300	738	832	541
Chloride	250	433	459	380
DO	5	0.4	0.6	1
BOD	30	160	154	103
COD	30	185	199	117
Nitrogen	0.5	14	23	11
Phosphate	0.1	32	58	19
Sulphate	200	494	621	347
Sodium	180	224	356	217
Potassium	0.1	4.9	6.2	4.0
Magnesium	30	74	81	52

Table2 Sample water test result for 0 days

These are the parameters that measured in the sewage water. The pits the sewage water with the cow dung and phosphorus having a lot of impurities. It may because of the presents of the cow dung with small amount of soil and the phosphorus. The result shows that the sewage water contains a high rate of biochemical oxygen demand and the chemical oxygen demand

Parameter	**Sample 1**		**Sample 2**		**Sample 3**	
	15 days	30 days	15 days	30 days	15 days	30 days
Ph	9.0	8.6	9.1	8.3	8.5	8.1
Turbidity	32	18	46	27	23	14
TDS	731	612	774	689	627	605
TSS	719	638	741	645	602	565
Acidity	314	226	392	311	210	174
Alkalinity	384	249	428	312	217	185
Hardness	531	422	685	491	410	337
Chloride	354	288	313	264	287	216
DO	2.6	4.1	3.1	5.8	304	7
BOD	102	61	95	43	51	37
COD	115	64	128	54	71	48
Nitrogen	9	3	10	5	6	1.5
Phosphate	18	9	26	1	8	2
Sulphate	338	269	517	382	226	117
Sodium	216	208	305	210	192	187
Potassium	4.0	3.2	4.5	3.3	1.8	0.7
Magnesium	61	49	68	57	40	29

Table 3 Sample water test result in 15 and 30 days

The result obtained from all the water test results and the graphs shows that the water can be purified by using the azolla algae. The main objective of our study is to identify the reduction in BOD, COD, nitrogen, phosphorus and potassium

The figure shows that the reduction of important parameters such as turbidity, biochemical and chemical oxygen demand, nitrogen, phosphorus and potassium in pit 2. The values are measured gives a good reduction in there quantities. Sometimes it reaches to standard values specified in the Indian standards. As we are important reduction rate in pit-2 because of the good growth of algae that pit, it is due to the presence of cow dung and phosphorus that are the important parameters for the growth of azolla algae

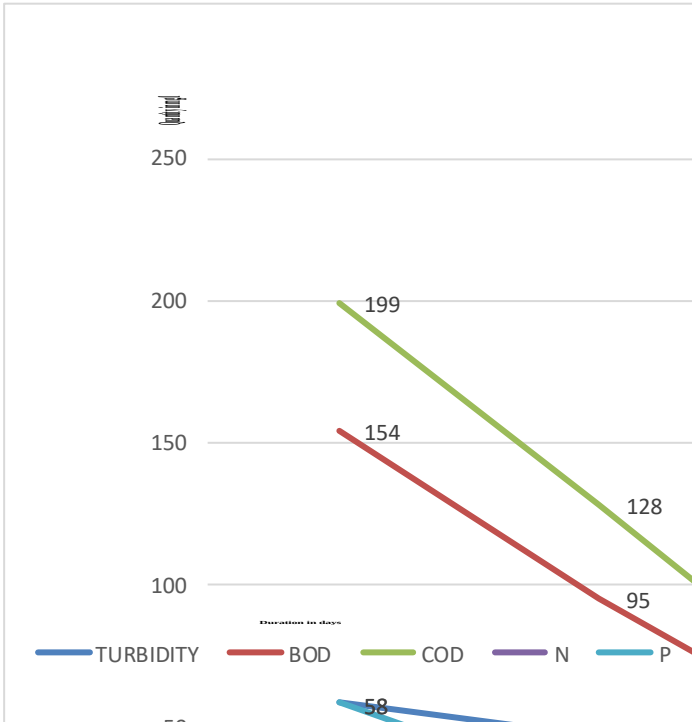

Fig 1 Reduction of important parameters

5. CONCLUSION

After the experimental studies, it is identified that the naturally growing aquatic fern azolla algae is a good method for waste water treatment. It can mainly reduce the amount of biochemical oxygen demand and chemical oxygen demand. The other parameters such as nitrogen, phosphorus and potassium can also reduce by using this method. An Azolla alga has the ability to reduce all the impurities in the water by consuming it for their growth. Each result is given as an average of two or three measurements taken from the same sample. The control proved that wastewater properties such as smell are due to the initial high BOD level and other water quality indicators persist in the absence of the plants. A drastic change in these indicators occurs when the plants are introduced For example, turbidity and BOD levels in the presence of plants were reduced after 2 to 3 days to the nearest standard level. In the absence of the plants, this level was not achieved during these durations

Three experimental setups were used and operated in the field. The growth process was monitored by measurements of turbidity and pH. Nephelometric turbidity unit [INTU] before starts the experiment of the plant growth in wastewater is measured. After day 2, the turbidity level remained nearly unchanged the after day 3, it started to reduce in a good manner. This produced a jump in the turbidity levels, which then gradually decreased (after a few days) to the standard level. The growth rates of the azolla were tested in the different pits having different waste water mixes. The growing algae consumed the wastewater so that water turbidity decreased with time and, in specific cases even to the levels found in drinking water. This provided initial evidence that the tested algae can be effective in cleaning the water from organic wastewater contents. It was used to examine the performance of the floating algae in the presence of mixture of wastewater and pure water. There is an excellent change the water parameters are noted in our experiment. All the important water parameters such as turbidity, BOD, COD, DO, nitrogen, phosphorus, potassium and also other parameters such as sulphate, dissolved carbon dioxide also can be reduced.
The azolla algae can be effectively used in the aeration tank and sedimentation tank as it hold the water for a long period when purification process take place. As a result it is identified that naturally growing aquatic plants like azolla algae are a good method for waste water purification and it is a cost effective method. It can be easily carried out and the water can be purified at a good rate.

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