CHARACTERIZATION AND UTILIZATION OF WATER HYACINTH FOR BIOGAS GENERATION

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ABSTRACT

Water hyacinth possesses specialized growth habits physiological characteristics and reproductive strategies that allow for rapid growth and expansion in freshwater environments and has spread rapidly throughout the tropics and subtropics. Eichnoriacrassipes (Water Hyacinth) forms large free floating, mono-specific mats that complete with other aquatic species for light nutrient and oxygen. Eichorniacrassipes is a cause a major problem of water pollution so this study helps to identify the possibilites of conservation of water hyacinth into useful renewable resources like biogasgeneration.Biogas, a clean and renewable form of energy could very well substitute for conventional sources of energy which are causing ecological and environmental problems and at the same time depleting at a faster rate. With increasing energy demand in the world and to keep environment friendly, biogas technology has attained a notable position for the future scope. This project tells about anaerobic digestion of water hyacinth in mesophilic condition to produce and enhance biogas.. Thus water hyacinth holds a strong promise in the production of clean renewableenergy.Eichhorniacrassipes remains the world's most problematic water weed despite wide spreads and various approaches for its control

Keywords:*Biomass, Digester ,EichhorniaCrassipes,pH, Colour.*

I. INTRODUCTION

One of the greatest problems that the world facing today is that of environmental pollution. Environmental Effects consists of five basic types of pollution air, water, soil, noise and light. Environmental pollution is the contamination of the physical and biological components of the earth to such an extent that normal environmental processes are adverselyaffected.Water hyacinth is justifiably called the world's worst aquatic weed due to its ability to rapidly cover whole waterways. When not controlled, water hyacinth will cover lakes and ponds entirely; this dramatically impacts water flow, blocks sunlight from reaching native aquatic plants, and starves the water of oxygen, often killingfish.To review the and to explore the benefits and ill effects of ofwater hyacinthplants.

To investigate the properties like pH,turbidity, COD and TDS, etc., of the hyacinth plants affected water inriverbasin.To test the properties of Hyacinth plant leaves and to experiment generation of bio mass through bio massdigester

1.1 GEOGRAPHICALDISTRIBUTION

Water hyacinth infestations increase most rapidly by the production of new weeded plants. During high water flows and flooding, infestations can break up and be moved to newlocations.

1.2 SITUATION INTAMILNADU

Most rivers in Tamil Nadu have been covered by the green carpet of Water Hyacinth because of the pollutants dumped by the industries on their banks. Many textile processing units in Tamilnadu use a number of unclassified chemicals that arelikelytobefromtheRedListGroupwhichissaidto beharmfuland unhealthy.The Public Works Department (Water Resources Organisation) launched a massive campaign in April 2016 along a stretch of 400 m near the mouth of Mannaraianicut to weed out water hyacinth along River Noyyal course as the plant is blocking free flow of water into the supply channels that feed irrigation tanks.The weed, which grows into a thick bed of waxy leaves and multiplies with astounding rapidity, has turned out to be a major problem for the farming community and the power generation barrages of Tamil Nadu Generationand Distribution Corporation (TANGEDCO).The leaves clog bridges in the rivers. When water is released from the reservoirs, the leaves also enter into the irrigation canals and clog the regulationstructures In the city of Chennai, Velachery Lake, the boundary of pallikarani drainage swamp, a portion of Adyar river, Buckingham canal and Otterinullah have turned eutrophic due to Eichhorniacrassipes. This is also the case with water bodies around Trichy, Madurai,Tirunelveli, Coimbatore, Salem and other districts. Eichhorniacrassipesis the first order among water weeds causing menace only second to Ipomoea aquatica. In Tamilnadu almost 80% of 39000 tanks are already infested with this weed. Even very big lakes like Chembarakkamlake, Dusi- Mamandur lake, Kavaripakkam lake, Veeranam lake, etc are affected byWater Hyacinth.

1.3 PROPOSEDSOLUTION

More clearing of the weed has always led to negative results due to the fast regrowth of the Water Hyacinth. Hence, the best way to solve this problem is to make the best out of and find apt ways to use Water Hyacinth for Social Wellbeing. Some ways in which this plant can be used have been given below. But the choice of the solution lies in the size of the water body, area of Water Hyacinth growth, lifestyle of people living around it, need foremployment, etc.

1.4ALTERNATE TECHNIQUES:

According to Mujingni,etal.,(2012) Some alternate techniques are

- Fertilizer
- Vermi composting
- Bio-Plastics

1.4.1 Fertilizer

Water hyacinth can be converted into compost and used on the land with proper management & technology. Water hyacinth is a well known cleaner of polluted water & different pollutants (like heavy metals) are deposited in its root. So roots are generally removed in case where water hyacinth is collected from polluted water. As a green manure it can be either ploughed into the ground or used asmulch**.**

1.4.2 Vermicomposting

Fresh water hyacinth is mixed thoroughly with cow dung (25%).After partial decomposing for 40 days, the earthworms are introduced and again composting is done for the next 40 days. The size of the heap: 5' X 5' X 5' (Approx.). A study was conducted in Tamil Nadu Agricultural University, Coimbatore to explore the possibility of conversion of water hyacinth into nutrient rich vermicompost. Among various treatments, vermicomposting withE

1.4.3 Bio- Plastics

Researchers at ManonmaniamSundaranar University in Tirunelveli, Tamil Nadu, have found that water hyacinth-derived sugar molecules like lignin, cellulose and hemicellulose can be converted into polyhydroxybutyrate (PHB), a polymer that is a raw material for making biodegradable plastic. Plastics developed using PHB are compostable. Also, making PHB from natural resources can reduce cost and harmful gasemissions.

1.5 BIO-GAS

There is world-wide interest in biogas production, and research is undertaken and equipment manufactured in very many tropical countries. Biogas is a combustible mixture of methane (50 - 70%) and carbon dioxide, with traces of hydrogen sulphide and water. This gaseous mixture is formed naturally. It is produced spontaneously in the rumens of cows, which each day produce about 200 litres of methane gas. It is also given off from the bottom of some marshes and lakes, and from rubbish dumps. It is formed by the process of anaerobic digestion, in which micro-organisms break down organic material in the absence ofoxygen.Thisprocesshasbeenusedtotreatsewagewasteforover100years.

1.5.1Advantage of Biogas

The gas can be used for cooking, lighting, heating and running refrigerators, incubators and engines. Small tractors have been run from biogas, though the gas cylinder must be transported by the tractor on a trailer. It is produced from waste materials, including waterhyacinth. The effluent from the process makes an excellent fertiliser. The nitrogen, potassium and phosphorus present in the feed are made into a form more easily absorbed by the plants, and the fibrous nature of the slurry provided by the water hyacinth makes it a good soilconditioner.

2.1 COLLECTION OF WATER HYACINTH WATER SAMPLE IN RIVER BASIN

The Water hyacinth water sample was collected from 4 location in a from a power plant barriage the collected water sample were brought to the laboratary and stored in deep freezer for 4^0c until analysis

Figure 1. Collection of Water Sample from barriage during Testing in Laboratory

2.2 **ANALYSIS OF RAW WATER HYACINTH WATERSAMPLE**

2.2.1 Determination of pH

The pH of the Water Hyacinth water sample was determined using portable pen type pH meter at room temperature. The pH meter was calibrated as per the standard procedure. The meter is switched on and the pH electrode about 2-3 cm was dipped into the pH standard buffer solution. pH calibration mode was activated by pressing CAL/MEAS key. The upper display shows the default (uncalibrated) pH measurement of pH electrode while the lower display indicates thepHstandardbuffersolutionwhichwasautomaticallyrecognizedbythematter.

2.2.2 Determination of Colour

The water sample colour parameter is determined by direct visibility and UV Spectrophotometer of wave length 430 nm. The colour of the water sample is Yellow incolour

2.2.3 Determination of Turbidity

Turbidity is the measure of the relative clarity of water. Turbidity water is caused by suspended and colloidal matter such as clay, silt, organic and inorganic matter, and microscopic organisms. Turbidity should not be confused with color, since darkly colored water can still be clear and not turbid. Switch on the power supply and check the battery of the turbidimeter, Press the 1 N.T.U button and coincide the scale with zero by using focusing template. Again press 1 N.T.U button and coincide the scale with zero using the focusing template. A Standard formazine solution of N.T.U is placed on turbidimeter in the path of rays and scale is brought 9 N.T.U. The Water sample is taken in a test and is placed in turbidimeter. Use A Cell rise if the turbidity is more than 100 N.T.U and get the turbidity dilutionfactor

2.2.4 Determination Of Total Dissolved Solids

The amount of total dissolved solids, the sample was determined by filtering the solids from the liquid present in the sample. An evaporating dish of suitable size was taken and dried for 1 hour. The dish was stored in the desiccator until it became cool. The initial weight of the dried and cooled dish was noted. 25ml of the sample was filteredusing Whatmann filter paper. 10 ml of the filtrate collected was taken in the evaporating dish. The sample taken in the dish was placed in hot plate until all water particles were evaporated. Then the dish was cooled in the desiccator until it become cool and the weight of the cooled dish along with the solids was measured. The difference between the initial

weight and the final weight of the final weight of the dish along with dissolved solids was calculated to determine the Total Dissolved Solids in the sample as perequation.

2.2.5 Determination Of COD

The chemical oxygen demand of the sample was determined by closed reflux method. 2 ml of the sample was taken in COD digester bottles. 1ml of mercuric sulphate was added to avoid the interference of chlorine present in the sample and 3ml of COD acid was acid was also added to the sample. 1ml of potassium dichromate solution was added to the mixture and mixed well. The sampleintheCODcuvettesalongwiththeblanksolutionpreparedwithdistilled water was refluxed in the COD digester for 2 hours at 150^{o} C. The reflux was allowed to cool in the room temperature after the refluxing period. The blank and samples were titrated against Ferrous Ammonium Sulphate using Ferrion indicator. The volume of the titrate required for the samples and the blank to change colour from the bluish green to wine red wasnoted.

2.2.6 Physico-Chemical Analysis Of Biomass

Water hyacinth, salvinia and cow dung were analysed for total solids (TS), volatile solids (VS), ash content, pH, chemical oxygen demand (COD), carbohydrate, organic carbon and total nitrogen for determining various physico chemical properties of biomass according doubling time,which lead to serious problems in navigation and irrigation.

2.2.7 Anaerobic Digestion Of Aquatic Weed

The wet anaerobic digestion of water hyacinth and salvinia were carried out using 25 Litre Drinking Water Cane with cow dung as an inoculum. The inoculum to substrate ratio considered in the present study was at 2:1 on VS basis. The TS content of water hyacinth and cow dung mixture (WC) or salvinia and cow dung (SC)mixture was approximately 5 % (w/w), respectively. The water hyacinth or salvinia and cow dung were weighed at an inoculum to biomass ratio of 2:1 on VS basis and mixed them together. Digester was then sealed airtight and nitrogen gas was flushed for 5 min to create anaerobic condition inside the digester. The digesters were maintained in a temperature-controlled shaking water bath at 37C during anaerobicdigestion. A large quantity of Fresh Water hyacinth was obtained from the river basin. This sample was washed in fresh water and then boiled in hot water so that porosity increases and easily and complete digestion takes place in digester. The boiled sample was sun-dried to reduce its moisture content.The dried sample of water hyacinth was then cut into small pieces to allow for more surface area to be acted upon by the microorganisms that bring about the anaerobic bio digestion.

III. RESULTS AND SUGGESION

The investigate work on the Water Hyacinth Water Sample was planned to determine the characterization of colour, TDS, turbidity and COD.Then the same Water Hyacinth water sample was analyzed to determine the physico-chemical parameters present in it. The physico-chemical parameter determined are pH, colour, TDS, COD, turbidity are compared with the raweffluent.

3.1 PHYSICO-CHEMICAL PARAMETER BEFORE TREATMENT

a)Initial Characteristic Of Collected Water Sample

S.No	Observed Reading
Odour	Unpleasant
Colour (Hazen unit)	Yellow
TDS (mg/l)	2100
COD (mg/l)	750
Turbidity (NTU)	460

b)Water Sample pH optimization

S. No	pH	Alum (mg/l)	Contact time (min)	FeCl (mg/l)	Initial Abs	Final Abs	Removal Effencicy
1	12	40	120	20	1.327	0.671	49.4 %
				40	1.327	0.432	67.5 %
				60	1.327	0.397	70.1 %
2	12	45	120	20	1.327	0.663	50 %
				40	1.327	0.382	71.2 %
				60	1.327	0.358	73.02 %
3	12	50	120	20	1.327	0.690	48 %
				40	1.327	0.406	69.4%
				60	1.327	0.325	75.5 %

c) Optimization of time

S. No	pH	Alum (mg/l)	Contact Time(min)	FeCl (mg/l)	Initial Abs	Final Abs	Removal Efficiency
1	12	45	0	40	1.285	1.285	0 %
2	12	45	20	40	1.285	1.193	7.2 %
3	12	45	40	40	1.285	0.869	32.4 %
4	12	45	60	40	1.285	0.531	58.7 %
5	12	45	80	40	1.285	0.383	70.2 %
6	12	45	100	40	1.285	0.307	76.1 %
7	12	45	120	40	1.285	0.269	79.1 %

d)ComparisionOfPhysico – Chemical Parameters For Initial And Optimally Treated Effluent

Parameters	Initial Observation	Final Observation	Efficiency
Odour	Unpleasant	----	----
Colour (Hazen unit)	Yellow	Pale Yellow	----
TDS (mg/l)	2100	960	54.3 %
COD (mg/l)	750	630	16 %
Turbidity (NTU)	460	68	85.2 %

e) Physico-Chemical Parameter Before Treatment in Collected Sample

S.No.	Reading Obtained
Odour	Unpleasant
Colour (Hazen unit)	Yellow
PH	9.5
TDS (mg/l)	750
COD (mg/l)	800
Turbidity (NTU)	350

f) Physico -Chemical Content Of Water Hyacinth,CowDung,Salvinia

Parameters	Water Hyacinth	Salvinia	Cow Dung
Total Solid	11.4	9.9	18.9
Volatile Solid	86.2	61.1	74.6
Carbon/Nitrogen Content	29.0	23.0	17.0
Carbohydrate Content	40.7	32.2	27.7

g) Yield of Biogas from Water-Hyacinth,Cow dung and Salvinia

Days	Volume of Biogas
0-7	56
8-14	85
15-21	120
22-28	135
29-35	165
36-42	178
42-49	110
50-55	150

3.3 DISCUSSION

Water-Hyacinth had a higher Carbohydrate content then salvania and hence a higher biogas potential..The present study indicated that water hyacinth had higher biogas yield than salvania.The current study yield 495 L biogas was obtained from water hyacinth 350 L from salvania during 55days.

.3.3.1 Bio Electricity Production

From energy equivalents, 1 kWh is equal to 3.6 MJ. The calorific value of 1 m^3 biogas is estimated to be 22 MJ. The electricity generation potential of 1 m^3 biogas is equal to 6.1kWh. However, considering an electrical conversion efficiency of 35 %, the estimated electricity generation potential from 1 m^3 biogas is estimated to be 2.14 kWh.Hence, from the current study, it is clear that approximately1.18 kWh and 0.47 kWh electricity could be produced from water hyacinth and salvinia (per kg VS), respectively, if the entire biogas is used for electricitygeneration.

3.3.2 Annual Consumption For 5 Person in a Family

The potential of water hyacinth and salvinia was estimated to be above 100 tonnes on an annual basis in the nearby villages of river basins . According to the present study biogas potential of water hyacinth and salvinia

were estimated to be approximately 495 m^3 and 350 m^3, respectively. A preliminary survey has been carried out to understand about the livelihood and energy consumption of rural villagers on an annual basis per household and it is clear that on an average, a family consisting of 5 people spends approximately Rs.47,000/- INR on a yearly basis to meet their daily energy demand and the corresponding CO_2emissionswere estimated to be 3,160 kg CO_2 per household on an annual basis. A main study has been carried out to meet these energy demands by the biogas produced from these aquatic weeds. The gas requirement per household is estimated to be 1.5 m3 biogas per day. It is clear that about 12 families may get benefited from the biogas produced using aquatic weeds which might be able to replace the conventional fuel sources such as firewood, kerosene and dung cake.

IV CONCLUSION

A study on water hyacinth for characteristics shows a good potential. The characteristic capacity depends on the type of location and the nature of water sample. The certain innovative steps government of india to control the growth .The Study Revealed that it is possible to produce biogas from the mixture of water hyacinth and cow dung and salvania. This study is able to attain the use of unwanted weeds as substance for methane production. Electricity generation Potential of water hyacinth is much higher than SalvaniaIn future agriculture is going to be a most important role in this world, In India it is a backbone of a country primary sector so Water Hyacinth can be used as a land manure it is good for Composting .Dried Water Hyacinth can be used as a biofuel .In future a Government should take a essential steps and Alternate ways for the non Renewable Resources and this above techniques is implement in a each remote rural areas. A future study is to be takes place for Bioelectricity and modern innovative technology is to be implementprocess.

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