POTENTIAL YIELD OF WATER HYACINTH A REVIEW

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Abstract - Fossil fuels currently provide the bulk of world's primary energy. Since fossil fuels are nonrenewable natural resources and rate of its utilization exceeds the natural rate of production, an end point exists. , the world has gone through the wood age, the coal era, and will likely be done with the petroleum and natural age. There is thus a need for the development of new energy sources that will be more economically competitive. New and more economic sources of energy are constantly being developed and eventually the best will probably take over from the current oil and natural gas era.

Keywords - Fossil Fuels, Water hyacinth, Biogas, Sugarcane bagasse, Anaerobic Digestion

I. INTRODUCTION

Fossil fuels currently provide the bulk of world's primary energy. Since fossil fuels are nonrenewable natural resources and rate of its utilization exceeds the natural rate of production, an end point exists. There is thus a need for the development of new energy sources that will be more economically competitive. For example, the world has gone through the wood age, the coal era, and will likely be done with the petroleum and natural age. Yet we still have wood and coal around but they are not economically competitive with oil and natural gas. The same will happen to oil and natural gas eventually when the rate of exploitation exceeds the rate at which it is generated underground. New and more economic sources of energy are constantly being developed and eventually the best will probably take over from the current oil and natural gas era. Biomass has been defined as the natural biological storage of energy and other materials in complex organic substances primarily by gross photosynthesis. [1]

Biogas is a flammable gas consisting of methane (54% –70%), carbon (IV) Oxide (27% - 45%), Nitrogen (0.5% - 3%), Carbon (II) Oxide (0.1%), Oxygen (0.1%) and traces of hydrogen sulphide and water vapour. It is generated by the anaerobic biodegradation of any organic waste such as grass, animal excrements, municipal sewage sludge, abattoir waste, paper waste, grain stalks. Renewable energy plays an important role in reducing the greenhouse gases; particularly energy from biomass could contribute significantly as it is a carbon neutral fuel. Anaerobic digestion (AD) is an environmental friendly biological process in which microorganisms work synergistically to convert organic wastes into biogas and a stable product (soil conditioner) for agricultural practices without any detrimental effects on the environment. [2]

Biogas production consists of three biochemical process comprising hydrolysis, acetogenesis and Methanogenesis.

$(C_6H_{10}O_5)n + nH_2O \rightarrow n(C_6H_{12}O_6)$ - Hydrolysis

$n(C_6H_{12}O_6) \rightarrow nCH_3COOH$ - Acetogenesis

$n(CH_3COOH) \rightarrow nCH_4 + CO_2$ - Methanogenesis

II. WATER HYACINTH

For many centuries water hyacinth has been applied as an ornamental crop due to its attractive appearance by humans. Water hyacinth was also introduced as the invasive and free-floating Aquatic macrophyte by many botanists. It is a member of the family Pontederiaceae which is indigenous to Brazil, the Amazon basin and Ecuador region. The growth of this plant on the surface of water can reduce the penetration of sunlight into the water. Sunlight is vital for many photosynthetic organisms, reducing sunlight means reducing the grow rate of photosynthetic organisms and at the same time disturbing the ecological balance. Water hyacinth (Eichhornia crassipes) is a noxious weed that has attracted worldwide attention due to its fast spread and congested growth, which lead to serious problems in navigation, irrigation, and power generation. On the other hand, when looked from a resource angle, it appears to be a valuable resource with several unique properties. [1, 3]

The leaves are 10-20 cm across, and float above the water surface. They have long, spongy and buibous stalks. The feathery, freely hanging roots are purple black. An erect stalk supports a single spike of 8-15 conspicuously attractive flowers, mostly lavender to pink in colour with six petals. One of the fastest growing plants known, water hyacinth reproduces primarily by way of runners or stolons which eventually form daughter plants. It also produces large quantities of seeds, and these are viable up to thirty years. The common water hyacinth (Eichhornia crassipes) is a vigorous grower known to double its population in two weeks. [4]

Water hyacinth reproduces sexually by seeds and vegetatively by budding and stolon production. Daughter plants sprout from the stolons and doubling times have been reported of 6-18 days. The seeds can germinate in a few days or remain dormant for 15-20 years.

They usually sink and remain dormant until periods of stress (droughts). Upon reflooding, the seeds often germinate and renew the growth cycle.

Fig.1: Different parts of water hyacinth (Eichhornia crassipes). a) Leaves b) Baby plant c) Rhizome d) Flower [4].

Biological Attributes of water hyacinth for an efficient bioenergy crop attributes of an ideal biofuel crop are:

1. Naturally grown vegetation, preferably perennials.
2. High cellulose with low lignin content per unit volume of dry matter.
3. Easily degradable.
4. Should not compete with arable crop plants for space, light and nutrients.
5. Resists pests, insects and disease.

Water hyacinth is low in lignin content (10%) and contains high amounts of cellulose (20%) and hemicellulose (33%). A typical biomass from land plants can have 30-50% cellulose, 20-40% hemicellulose and 15-30% lignins. In plants, lignin (composed of phenylpropanoid groups) acts as a polymer around the hemicellulose microfibrils, binding the cellulose molecules together and protecting them against chemical degradation. Water hyacinth has low lignin, which means the cellulose and hemicellulose are more easily converted to fermentable sugar thus resulting in enormous amount of utilizable biomass for the biofuel industry. A new method of extracting ethanol by saccharification with diluted sulfuric acid, and hastening the process by using yeast was also developed. [5]

Because of the following characteristics of water hyacinth, it can be extensively used as a feed stock for generating biofuel:

- Ideal Attributes
- Wide availability
- Ease of cultivation
- Frequent harvest cycles
- No / low competition with food crops
- Easy to process
- Inexpensive
- Global invasive nuisance weed
- Aquatic plant
- Low-tech processing
- Millions of dollars spent each year to remove / dispose

III. LITERATURE REVIEW

Various studies were carried out by renowned experts from around the state on water hyacinth for its biogas generation potential.

In 2008, O. Momoh et al., carried out study on Effect of waste paper on biogas production from co-digestion of cow dung and water hyacinth in batch reactors. In this study the effect of waste paper on biogas production from the co-digestion of fixed amount of cow dung and water hyacinth was studied at room temperature in five batch reactor for over 60 days. Waste paper addition was varied for a fixed amount of cow dung and water hyacinth until maximum biogas production was achieved. According to their study, an optimum waste paper amount of 17.5g needs to combine with 5g of cow dung and 5g of water hyacinth in 250ml of water for maximum biogas production.

M. Eltawil and E. Belal **(**2009**)** have carried out study on Evaluation and scrubbing of biogas generation from agricultural wastes and water Hyacinth. In this study, the anaerobic batch biodegradation of five co-digested mixtures in terms of methane yield and energy production was done. The five different mixtures are: Mixture 1 (potato waste + sugar beet leaves), mixture 2 (cattle dung), mixture 3 (water hyacinth + cattle dung), mixture 4 (rice straw + cattle dung + poultry droppings) and mixture 5 (bagasse + cattle dung). Effects of stirring, dry oxidation and water scrubbing processes on the biogas quality were also examined. The peak values of gas generation reached up to 0.344 and 0.476 L/L/day for control and handle stirring in case of mixture 5.

M. Saravanan and. K. Manikandan (2012) has carried out Experimental study on biogas production in batch type digester with different feed stocks. In this work, two feed stocks, paddy chaff and water Hyacinth were attempted for biogas production using batch type digester. A closed type portable digester (batch type process) was used. Results of this study revealed that the maximum gas production was found in water hyacinth compared to paddy chaff. The gas produced from water hyacinth was ignited.

C. Vidya Sagar et al., (2013) carried out study on Sustainable biofuel production from water hyacinth (Eicchornia Crassipes). In this study, the potential of biofuel production of water hyacinth was tested and technical, socio-economic, and environmental benefits of small scale biofuels were discussed. They have conclude that significant amount of this material would biogenically result in methane emissions, its use as biofuels would simply be a better use for a common atmospheric emission of biogenic methane.

A. Fadairo et al., (2014) have done study on Biogas production from water hyacinth Blends. In this work the biogas generation potential of water hyacinth was studied. This was with a view to determining the effects of blending cow dung and poultry droppings with water hyacinth on the yield of biogas. The results of this study showed that the water hyacinth blend with proportions of water hyacinth, cow dung and poultry droppings in the ratio of 2: 2: 1 respectively, produced the largest volume of biogas of 3.073 Litres per 2.5kg of the feedstock. They have concluded that the biogas production from water hyacinth could be optimized by subjecting it to some pretreatments like blending with animal wastes.

IV. CONCLUSION

The renewable energy supply is continuously increasing. A large amount of investment has been made during recent years and advancement of technology has enabled countries to produce renewable energy more cost effectively. Water hyacinth holds good promise for bio-energy. It has been seen that Water hyacinth used in co-digestion with other types of inoculum such as cow dung, poultry waste, agricultural waste, etc gives better efficiency of biogas generation.

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