Journal of Fundamentals of Renewable Energy and Applications

Harshwardhan and Upadhyay, J Fundam Renewable Energy Appl 2017, 7:5
DOI: 10.4172/2090-4541.1000237

Mini Review Open Access

Effective Utilization of Agricultural Waste: Review

Kumar Harshwardhan* **and Kanjan Upadhyay**

Department of Chemical Engineering, Ujjain Engineering College, Ujjain, Madhya Pradesh, India

Abstract

Agricultural substances are those substances that are produce on earth with the change of seasons. Basically these substances are produce in the nature and are very important for survival of animals and human beings who are consumers. These substances are widely available on earth can be a good source of energy or can be converted into useful products. The wastes generated from crop have a good potential to convert in energy in related energy sector. The waste produce from animal waste or from crop residues called biomass which has an interdependent relationship with ecosystem from production to disposal and has physicochemical properties. The present paper deals with the research work carried out in the past related to conversion of biomass and agricultural waste. An attempt is carried out to increase the economic values of agricultural waste into useful product.

Keywords: Biomass; Anaerobic digestion

Introduction

Agricultural waste is the material obtained due to crop production or from plant growth. In the past this biomass and agricultural waste were either burnt or naturally converted into organic fertilizer under favorable condition. But now in these days biomass produced from agricultural waste are used to generate energy because it carries great potential to convert into energy. Since the biomass is available throughout the world in abundant quantity so it is necessary to use alternate energy resources to fulfill our needs of energy consumption. The effective utilization of agricultural waste is a good option to convert these wastes in energy. For this efforts have been made and many more are under way, it requires guidelines concerning the utilization of agricultural biomass for energy purposes and optimal production. Production of energy from biomass can provide farmers with new prospects and possibilities to diversify agricultural activities. Some of these crops may compete for land and other resources with traditional crops, while other crops may be grown on marginal lands or even ecologically degraded areas and thus have a positive effect on the environment. In view of the circumstances described above, there has been growing interest in studies that present future energy scenarios and conversion of biomass into useful products. The primary aim of this paper is to analysis in detail the various application and research carried in the fields of biomass and forecast of the production potential of agricultural biomass. The detailed study includes the following factors scope of the forecasted consumption of renewable energy in terms of energy types (electrical energy, heat, automotive biofuels), energy potential of agriculture (sources of agricultural biomass, utilization structure of agricultural biomass, the volume of production of solid biomass, biogas and biofuels, cultivation area of energy crops) and barriers to the utilization of biomass.

Biomass is one of the renewable resources that is found in nature in abundant quantity it may be used as one of the most energy resource and can be converted into more reformed resources. Utilization of agricultural waste is very important concern especially when the world scenario of energy demand gap is being reported. The resolution to mitigate this gap is use of biomass and its other utilization is being investigated so that it can be used as an alternative source of energy production as well as converting the biomass into some commercial products. Lot of work has been reported in the literature regarding utilization of biomass some of the works conducted in this area are as follows:

In the year 2016, studies shows that the feasibility of utilizing the coffee waste in the production of bricks. The parameter of the study was CW (coffee waste) ratio and temperature. The properties like shrinking density and compressive strength were considered. In this methodology, control brick and three different percentage of coffee waste brick (CWB) (1%, 3%, 5%) were manufactured and fired at 1050°C. Apart from main properties like physical, shrinkage, density and compressive strength were reported and discussed additionally leaching of heavy metals from manufactured clay brick was tested by using toxicity characteristics leaching procedure. It was noted that with the addition of CW. the shrinkage increased linearly but still comply with minimum standard below 8% and good quality of brick was manufactured. Hence coffee waste can be utilized in the production of fire clay bricks with the different proportion of cw. in addition it gives alternate solutions on disposing the coffee waste. The CW could also have a potential low cost waste additive for production of bricks [1].

In the year 2016, studies the utilization of waste sawdust for the removal of basic dye "methylene blue" that describes as methyl blue which has adverse impact on photosynthesis in aquatic environment and many other complications. sawdust is a low cost agro waste and have tremendous capacity to absorb the dye on the surface. The study involves the comparison of dye removal capacity of raw saw dust and NAOH plus enzymatically treated sawdust Various parameters like substrate concentration, contact time and dye adsorption which having initial concentration of 100 mg/L was known to increase for both treated and untreated sawdust at 30°C and 120 rpm [2].

Maximum adsorption observed at concentration of 2.5 g% was 97.47% and 70% for treated and untreated sawdust respectively for contact time of 6h and initial concentration of 100 mg/L. When adsorption property of sawdust was checked for different concentration

***Corresponding author:** Kumar Harshwardhan, Department of Chemical Engineering, Ujjain Engineering College, Ujjain, Madhya Pradesh, India, Tel: 0734 251 1912; E-mail: harshvikky@gmail.com

Received August 26, 2017; **Accepted** September 07, 2017; **Published** September 15, 2017

Citation: Harshwardhan K, Upadhyay K (2017) Effective Utilization of Agricultural Waste: Review. J Fundam Renewable Energy Appl 7: 237. doi:10.4172/20904541.1000237

of the dye concentration rate of adsorption was decreased. Maximum dye removal was noticed to be 99.16% and 85.54% for treated and untreated saw dust respectively for the dye concentration of 25 mg/L and substrate concentration of 2.5% at 30°C and 120 rpm [2].

In the year 2016, it was mentioned that the properties of agricultural waste as soil stabilizer and found that agricultural waste in India is not disposed properly. The aim of this research was to utilize it in pure form hence ashes of these waste materials separately at 3%, 6%, 9%, 12% and 15% were used. Tests such as CBR and standard proctor tests were conducted. The parameter of study was specific gravity (2.662), liquid limit(66), plastic limit(26.62), plasticity index(39.99), free well index(23.08), optimum moister content(26.11), maximum dry density(1.445). During milling of paddy about 78% of weight is received as rice broken rice and bran, rest 22% of the weight of paddy is received as husk .This husk is used as fuel in the rice mills to generate steam for the parboiling process. This husk contain about 75% organic volatile matter and the balance 25% of the weight of this husk is converted into ash during firing process, known as rice husk (RHA). This RHA in turn contains around 85% to 90% amorphous silica, hence there is a addition to these two agricultural waste serving the three benefits of safe disposal of wastes using as stabilizer and return of incomes on it [3].

In the year 2016, studies prove that the feasibility of utilizing Wheat bran agricultural waste to produce bio-alcohol. It was observed that the production of alcohol from pentose sugar which is a sole constituent of wheat bran. Physical treatment like Particle size reduction of wheat bran along with chemical and enzymatic treatments, were studied for the production of bio-alcohol. Wheat bran of reduced particle size was treated with moist heat at 800°C, coupled with acid treatment produced total sugar with fermentable range. The parameter of study was size of wheat bran, thermal pretreatment, acid pretreatment, Estimation of total sugar. On fermentation with *Candida tropicalis* MTCC230 a maximum of 1.21 g of bio-alcohol was produced, relatively higher than earlier study. Viscosity was subordinate for 1% acid treated wheat bran due to breakdown of polysaccharides into simple sugar which is accountable for viscosity. Limited fermentation is seen in sample of wheat bran extract treated with higher concentration of acid, when subjected to fermentation with *Candida tropicalis* MTCC230 resulting in low yield of bio-alcohol [4].

In the year 2015, it was demonstrated that the physical and chemical properties of coconut shell in asphalt mixture and its application in road construction. It was observed that it can also be used on x ray fluorescent scanning electron microscopy x-ray diffraction and besides that, coconut shell also categories as metal matrix composites with fly ash and rice husk which can rectify characteristics such as great precise strengths, precise modulus, good weather resistance and great dumping capacity contrast to unreinforced alloys. Coconut shell ash and rice husk also are the cheaper and low density reinforcement as solid waste by-product. Dried CS contains 33.61% cellulose, 36.51% lignin, 29.27% pentosans and 0.61% ash. CS has low ash content but high volatile matter, 65-75%. The water absorption of the CS is higher than usual aggregate, which is 24% compared to 0.5% Coconut shell ash can hold out working temperature of 1500°C besides CS is also more resistance against crushing, impact and abrasion compared to others conventional crushed granite aggregates. Coconut shell that can be found in the market and crushed coconut shell that is normally used in the test can be mixed with asphalt mixture directly for the experiment except water absorption test. CS has high water absorption ability because of its open structure containing many hydroxyl and acetyl group hence hemicelluloses can be partly soluble in water and hygroscopic. In order to reduce the water absorption ability of CS as the excessive content of water will weaken the structure of CS. Chemical treatment can optimize the interface of CS to reduce its hydrophilic properties. The most usual treatment for CS is by using Sodium Hydroxide (NaOH) as it can reduce the hydroxide compound in CS thus reduce absorption ability.

$$CS\text{-}OH + NaOH = CS\text{-}O\text{-}Na^+ + H_2O$$

Besides that some researchers have burnt CS into charcoal form and used as a filler to resist freezing, crushing and absorption. Hence it can be concluded that by using coconut shell in asphalt mixture has better potential than others raw materials to contribute in construction field [5].

In the year 2015, studied the potential of organic farming and sustainable agricultural waste like banana peels which has becomes serious problem caused by its productions. It can be used in making organic fertilizer and also have a potential to develop to a commercial level. The organic waste from the banana peels is fermented by effective microorganism and molasses. This can be used as Fermented Organic Liquid. The municipality has utilized this liquid as a deodorizer and cleaning liquid. Furthermore this organic liquid can be used as fermented organic liquid fertilizer. It works through traditional practices of recycling farm-produced livestock manures, composting, and crop residue management [6].

In the year 2014, studies shows that the effective utilization of Neem as natural absorbent in the treatment of Dairy Waste Water. It was observed that the consumption of large volumes of water and generation of organic compounds as liquid effluents are major environmental problems in milk processing industry. A large number of chemicals are used for the production of potable water and in the treatment of wastewater effluents. The adsorption process is one of the effective techniques and various natural adsorbents are widely used for removal of emerging pollutants in dairy wastewater. The use of natural adsorbents has been widely investigated as a replacement for current costly methods of removing pollutants from dairy effluent. The aim of this study is to contribute in the search for less expensive adsorbents and their utilization possibilities of various agricultural waste by-products such as sugarcane bagasse, rice husk, oil palm shell, coconut shell, coconut husk for the elimination of pollutants from wastewater. The parameter of the study includes turbidity, pH, colour etc. It was noted that at initial level the pH of effluent was reported as 10.5, which indicated the water is highly alkaline .After 1 hr the pH reduced to 10, after 2 hrs it became 9.8, after 3 hrs it was 9.5, after 4 hrs the pH recorded was 9.0 and after 24 hrs the pH value was 8.2 which shows the effluent is quite lesser alkaline than initial level [7].

In the year 2014, studies demonstrated the utilization of agricultural waste in stabilizing of landfill soil. The main constituent of material was palm oil ash and rice husk ash as a sustainable substitute instead of using traditional Portland cement. Landfill soil on its own and combination with laterite clay soil were stabilized using POFA (Palm Oil Fuel Ash) or RHA either on its own or in combination with Lime or Portland Cement (PC). The traditional stabilizers of lime or Portland Cement (PC) were used as controls. It was observed that landfill soil combined with laterite clay (50:50) stabilized with 20% RHA:PC (50:50) and POFA:PC (50:50) recorded the highest values of compressive strength compared to the other compositions of stabilizers and soils. However, when the amount of POFA and RHA increased in the system the compressive strength values of the samples tends to increase. These results suggest technological, economic as well as environmental advantages of using POFA and RHA and similar industrial by-products to achieve sustainable infrastructure development with near zero industrial waste [8].

In the year 2014, it was shown that the effective way to remove iron from drinking ground water with help of agricultural waste used as a natural adsorbents and area of study was typically associated in Chennai where the concentration of iron was 0.3 mg/L. The removal of iron was calculated by using sugarcane bagasse and coconut coir selected as solid phase extra coir for removal total iron. It was noted that these products exhibits remarkable characteristics and ability to remove total iron. The parameters such as effect of pH, adsorbent dosage, contact time, initial concentration etc. were studied. The highest percentage removal of total iron was observed at coconut coir than sugarcane bagasse [9].

In the year 2014, studies shows that the feasibility of utilizing fly ash and rice husk in stabilization of soil. Black cotton soil was mixed with fly ash at (5%, 10%, 15%, 20% and 25%) while Rice husk ash was treated with (10%, 15%, 20%, 25% and 30%) and examined after 28 days of curing. It was observed that Liquid limit was reduced to 55% for (20% fly ash and 25% RHA mixed with soil sample. Plasticity index was reduced to 86% for 20% Fly ash and 25% RHA mixed with soil, differential free swell reduced to 75% for 15% fly ash and 20% RHA mixed with soil, specific gravity reduced significantly as well [10].

In the year 2013, studies shows that the use of lignocelluloses rich agricultural waste. Cellulases are capable of the extensive solubilisation of highly ordered form of cellulose and are reported to be produced from well-known microbial sources such as aerobic and anaerobic fungi and anaerobic fungus. The cost of enzyme production can be significantly reduced if low value biological substrates like fruit processing waste are used [11].

In the year 2013, studies proved that the agro waste as an innovative material in Indian context by using agro waste characteristics with clay or calcium bicarbonate. Groundnut husk, jute fibre, rice husk, rice staw, rice bale, saw dust, and coconut fibre and other fibrous material have been identified as most economically important wastes for building industry. It is estimated that in India nearly 700 million tonnes of organic waste is generated annually which is either burned or land filled. The large amount of the agro waste generated from the market area has created major environmental problems. Earthworms have ability to convert organic waste into valuable resources containing plant nutrients and organic matter, which are essential for maintaining soil productivity. The parameter of study includes density, average particle size, specific surface area, minerology, non-crystalline shape and texture irregularity [12].

In the year 2013, studies conducted on growth medium for lactobacillus species by fermentation. The commercial probiotics lactobacillus which is a friendly bacterium with the help of fermentation addition to the ability of probiotics strains to grow in pineapple waste was investigated. The parameters which affect the reaction rate of microorganism activity are temperature, pH, and culture media. It was noted that pineapple wastes from these processing industries can be utilized to produce culture medium for cultivation of probiotics bacteria as compared to MRS (De Man, Rogosa and Sharpe agar) medium which is an expensive medium for cultivating probiotics [13].

Conclusion

As seen from the research literature related to the utilization of biomass and agricultural waste, newer development in technology in process development and in product development is necessary to increase the economic values of products. As seen from the literature, number of uses of biomass is being observed in the manufacture of brick making, as filler in asphalt mixing, as an adsorbent in biogas production etc. More conversion of this waste requires more research and renovation in the existing technologies.

References

1. Loeppert RH, Suarez DL (1996) Carbonate and gypsum. American Society of Agronomy.
2. Kalra YP, Maynard DG (1991) Methods for forest soil and plant analysis. Information report NOR-X-319. Northern Forestry Centre.
3. Maiz I, Esnaola MV, Millan E (1997) Evaluation of heavy metal availability in contaminated soils by a short sequential extraction procedure. The Science of the Total Environment 206: 107-115.
4. Lindsay WL, Norvell WA (1978) Development of a DTPA soil test for zinc, iron, manganese, and copper. Soil Science Society of America Journal 42: 421-428.
5. Black CA, Evans DD, White JL, Ensminger LE, Clark FE (1965) Methods of soil analysis: Part 2, Chemical and microbiological properties (2nd edn.). American Society of Agronomy. Medison, Wisconsin, USA.
6. International Forestry Resources and Institutions (2002) Field manual: Workshop in political theory and policy analysis. Indiana University, Bloomington, USA.
7. Hooker JD (1904) The flora of British India. Oxford Press, London, UK.
8. Ugemuge NR (1978) Flora of Nagpur district. Kalyani publications, New Delhi, India.
9. Misra R (1968) Ecology Workbook. Oxford and IBH Publ. Co., Ecology.
10. Shannon CE, Wiener W (1963) The mathematical theory of communication. Univ Illinois Press, Urbana, USA.
11. Simpson EH (1949) Measurement of diversity. Nature 163: 688.
12. Kumar PG, Hate S, Chaturvedi A (2009) Community based forest management and its impact on vegetation: A case study. iForest 2: 93-98.
13. MacDicken KG (1997) A guide to monitoring carbon storage in forestry and agroforestry projects. Winrock International Institute for Agricultural Development, Arlington, USA.