ISSN: APPLIED
2018, Volume – 1; Issue – 2;
Page 199

PHYSICAL AND CHEMICAL PROPERTIES OF BIOMASS FUELS FROM AGRICULTURAL RESIDUES

A.N.SEETHALASHMI

PG and Research Department of Physics,The M.D.T.Hindu College, Tirunelveli-627 010.

Email: dransmdt@gmail.com

Abstract

In rural areas biomass has been the traditional energy source. Considering the quantitative availability, the non-plantation resources are most potential. We developed a protocol in order to characterize the physical and chemical properties of agricultural residues to be used as feedstock for energy conversion process. Proximate, ultimate and elemental analyses showed that agricultural residues rice husk, rice straw maize stalk and sugar cane are appropriate to meet the requirement of thermochemical process. When compared to coal, agricultural residues biomass has a lower energy density and lower ash content. Nitrogen and Sulfur are very low, on the other hand, the content in ash-farming elements, especially in potassium is quite high and hence it is necessary to concentrate to prevent technical problems in operating thermochemical power plant using this type of biomass as feedstock. This sort of study could serve to create a database of biomass fuels which would support decision making in terms of energy conversion technology selection and operating condition setting.

Keywords: Biomass, Proximate analysis, Ultimate analysis, Elemental analysis, Agricultural residues.

Introduction

Nowadays biomass is playing an important role in mitigating global warming and securing fuel supply (1). Since biomass is readily available in many countries worldwide, especially those developing world, it came back on international stage and it is the most promising alternative to fossil fuels. A recent study conducted by the Joint Graduate School of Energy and Environment on Policy Research for Renewable Energy Promotion and Energy Efficiency Improvement indicated that agricultural residues are the most potential considering

their quantitative availability (2). A detailed knowledge of physical and chemical properties is required to use biomass efficiently for energy production is required. Average and variation in elemental compositions are essential for modeling and analysis of energy conversion process (3). In this study we developed a protocol to document the physical and chemical properties of agricultural residues rice husk, rice straw, maize stalk, and sugarcane.

Methodology

Agricultural samples were collected from their main production regions. One to two kilograms of each sample was collected from the plantation. They are over-dried at 70 °C during 24 h. Except rice husk are subjected to size 2cm length. All are ground and sieved to lesser than 100 microns.

The proximate analysis to measure moisture, volatile, fixed carbon and ash content was performed by AC 350 Bomb Calorimeter. By Elemental analysis carbon, nitrogen, sulfur and oxygen content were determined.

Results and discussion

Proximate analysis results

Table 1 shows the results from proximate analysis. For selection of energy conversion process technology moisture content is important. Low moisture content is required for thermal conversion technology whereas high moisture content is more appropriate for biological-based process such as fermentation of anaerobic digestion. It is noted from Table 1, that all samples are lesser than 10% moisture content and hence more suitable to serve as feedstock for thermal conversion technologies. For operation of a thermal conversion unit the chemical composition of the ash is a determinant parameter, since it gives rise to problems of slagging, fouling, sintering and corrosion. From the Table 1 rice husk and straw, possess ash contents ranging from 13-24%, the other types of agricultural residues ash contents are lesser than 10%. Regarding volatile matter, maize and sugarcane about 70% and rice range around 60%. Since maize and sugarcane materials have low ash content and high volatile content both materials seem to be the best

candidates for pyrolysis and gasification. Since rice husk and straw have high ash content they should be used with well-adjusted operational conditions in order to prevent problems. Our results showed that among all analyzed samples, sugarcane has the highest calorific value, followed by maize stalk, rice husk and rice straw.

Table 1 Proximate analysis of agricultural residues

Properties	**Rice husk**	**Rice straw**	**Maize stalk**	**Sugarcane**
Moisture (%)	6.25	6.50	8.32	7.84
Ash (%)	19.51	23.76	5.35	7.79
Volatile (%)	60.70	57.64	70.21	71.14
FixedCarbon (%)	13.54	12.09	16.13	13.24
Calorific Value (kJ/kg)	12,240	11,500	14,200	14,800

Ultimate analysis results

Organic elemental contents in the samples are listed in Table 2. Obtained results show that the agricultural residues contain higher proportion of hydrogen and oxygen, which leads to calorific value reduction. Indeed, carbon-oxygen and carbon-hydrogen bonds energy levels are lower than carbon-carbon bonds. For this reason, the obtained calorific values ranged from 12-14MJ/kg, while coal has energy content is of 34 MJ/kg(4). The agricultural residues contain very low level of nitrogen and sulfur.

Table 2 Ultimate analysis of agricultural residues

Element %	**Rice husk**	**Rice straw**	**Maize**	**Sugarcane**
N	0.32	0.7	1.1	0.6
C	37.00	37.42	43.4	43.8
H	5.78	6.25	5.7	5.8

S	0.06	0.30	<0.01	<.01
O	50.23	40.28	40.80	39.97

Conclusion

We developed a protocol to characterize the physical and chemical properties of agricultural residues to be used as feedstock for energy conversion process. Proximate, ultimate analyses showed that rice husk, rice straw, maize stock and sugarcane are of low moisture content and so they are appropriate to meet the requirements of thermochemical process. Compare with coal, agricultural residues has a lower energy density and lower ash content. Contents in nitrogen and sulfur are very low, so we can recommend the agricultural residues as a fuel for thermal power generation units. This sort of study could serve to establish a database of biomass fuels that would support decision making in terms of energy conversion technology selection and operating conditions.

References

1. McKendry, P. (2002). Energy production from biomass (pat1): Overview of biomass. Bioresource Technology, 83, 37-46.
2. Thailand Research Fund (2006), "Policy Research on Renewable Energy Promotion and Energy Efficiency Improvement in Thailand" Project-First Progress Report.
3. Nordin, A.(1994). Chemical elemental characteristics of biomass fuels. Biomass and Bioenergy, 6(5), 339-347.
4. Cuping, L., Changzhi, W., Yanongijie and Haitao, H. (2004). Chemical elemental characteristics of biomass fuels in China, Biomass and Bioenergy, 27, 119-130.