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Useful Utilization of Agriculture Waste

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Abstract:-Indian economy is mainly based upon the agriculture sector. The agriculture sector also produce field waste i.e. crop remain. Commonly this waste is burn in an open atmosphere, thus contributing to the air pollution. A model is suggested to convert this crop waste into useful product, i.e. regenerative energy fuel source.

Keywords:
Agriculture waste, treatment to agriculture waste, pollution from agriculture waste, biofuel from waste.

I. INTRODUCTION

Biomass is the world's fourth largest energy source worldwide, following coal, oil and natural gas. Biomass conversion is most often associated with electrical power generation, many other energy and non-energy products can also be produced from biomass. Recent events in the world have placed in an increased awareness on the need to provide alternative sources of fuel and energy.[1, 2]

Though, the biomass resource is abundant in the world, the efficiency of utilization is very low, with energy crisis and fuel tension, it is more important to develop new technology in order to use biomass resource efficiently. In recent years, the research on bio-oil has been paid more attention due to the property of sustainable, carbon neutral, and easy to store and transport.

Plants use and store carbon dioxide (CO_2) when they grow. Carbon dioxide stored in the plants is released when plant materials is burned or decays. By replanting the crops, the new plants can use the CO_2 produced by burned plants. So using biomass and replanting helps use the carbon dioxide cycle. The use of biomass energy has the potential to greatly reduce green house emissions.[3 – 11]

II. AIM / OBJECTIVES

Crop remain or field waste is one of the major problem in India. A method is proposed to convert crop waste into useful product i.e. regenerative energy fuel source.

III.MATERIALS AND METHOD

A simple pyrolysis technique is adopted to convert crop waste into useful product. The steps involved are as follows:

1. Drying of crop waste
2. Pyrolysis of crop waste
3. Product collection
4. Fractionation of liquid product
5. Separation of aqueous phase from liquid product by centrifugal separation
6. Evaluation of fractions.
7. To obtain material balance.

IV.OBSERVATION

The thermal pyrolysis of wood dust able to give gaseous, liquid and solid product, but here only liquid product is considered for this research work.

The liquid product obtained is an emulsion of water and liquid fuel component. To separate aqueous phase with an oil phase, two techniques are adopted: (1) ASTM fractionation and (2) Centrifugal separation.

ASTM separation gives an oil with a fraction 70-80%, 80-90% and 90% to F.B.P. range product whereas centrifugal separation, gives bottom fuel oil and top aqueous phase. This indicates that oil is heavier than water.

The various fuel oil fractions i.e. 70-80%, 80-90% and 90% - F.B.P., similarly fuel oil fraction from centrifugal separation is subject to evaluation as per ASTM norm. The result obtained are shown in table 1.

Table 1: Properties of Cracked Liquid Product

S.N.	Properties	70 to 80% fraction	80 to 90% fraction	90 to 100%	Centrifuge
1	Specific gravity (16^{0}C/16^{0}C)	1.05	1.07	1.082	1.0786
2	API gravity, ^{0}API	3.2619	0.7423	-0.7236	-0.31142
3	Density, gm/ml	1.048	1.07	1.08	-1.042
4	Viscosity, cSt, at 40^{0}C	3.42966	13.0406	24.467	010.259
5	Flash Point, ^{0}C, min (COC)	110	112	114	112
6	Smoke point, mm, max.	Less observed	Less observed	Less observed	Less observed
7	Aniline Point, (^{0}C)	Not observe up to -20^{0}C	Not observe up to -20^{0}C	Not observe up to -20^{0}C	Not observe up to -20^{0}C
8	CCR, wt%	11.11	13.2	15.3	13.0287
9	Pour Point, ^{0}C	-15	-15	-15	-15
10	*Copper corrosion test (at 100^{0}C for product)	Note worse than No. 1	Note worse than No. 1	Note worse than No. 1	Note worse than No. 1
11	Acid value, mg of KOH / gm of sample	3.91	2.18	2.12	4.14
12	Refractive index, 20^{0}C	1.4697	1.5184	1.5239	1.4501
13	Calorific value (kJ/gm)	24.899	19.646	15.803446	20.2984
14	Water content by Karl Fischer auto titrator (%)	2.7569	1.9227	4.2050	1.8388
15	ASTM Distillation % recover ↓	Temperature (^{0}C)	Temperature (^{0}C)	Temperature (^{0}C)	Temperature (^{0}C)
16	IBP	115	115	116	117
	10	125	154	240	152
	20	156	218	264	212
	30	176	243	278	241
	40	200	254	294	251
	50	216	266	304	267
	60	232	276	318	281
	70	244	281	340	289
	80	267	310	---	308
	90	274	---	---	---
	F.B.P.	382	---	---	---

* Strip above the sample undergoes colour change

V.MATERIAL BALANCE

The material balance for drying, centrifuge step etc. is discussed with percentage recovery as follows:

For Decomposition Batch:

1. Weight of sample (crop waste) before drying : 500 gm
2. Weight of sample after drying and cooling (at 105 + 5^0C) : 445 g
3. Moisture loss after drying : 55 g (11%).
4. Weight of feed taken into the Reactor for decomposition : 400 g (100%)
5. Weight of product obtain:

a) Liquid product
   (i) In volume = 160 ml,
   (ii) In weight = 161.91 g (40.40%)

b) Weight of Carbaneous material : 45.5 g (11.37%)

c) Volume of fuel gases obtained : 70.5 litre (48.23%)

For centrifugation:

The sample i.e. liquid product obtained from crop waste decomposition process is subjected to centrifugation to separate the oil phase and aqueous phase.

1. Total liquid product subjected to centrifuge = 200 ml
2. Aqueous material obtained = 148.2 ml (74.1%)
3. Oil phase obtained = 42.6 ml (21.3%)
4. Middle layer = 6.2 ml (3.1%)
5. Oil phase obtained including middle layer = 48.8 ml (24.4%)

Liquid Material Subjected to Fractionation:

Quantity of liquid products taken for fractionation = 200 ml

Table 2: Frationation by ASTM Method

Cut Fraction	Volume collected (ml)	Temperature (^{0}C)
IBP – 10	20	93 – 99
10 – 20	40	99 – 100
20 – 30	60	100 – 100
30 – 40	80	100 – 101
40 – 50	100	101 – 104
50 – 60	120	104 – 111
60 – 70	140	111 – 118
70 – 80	160	118 – 128
80 – 90	180	128 – 200
90 – EP	192	200 – 260

* The product up to 60-70 cut is considered as an aqueous phase

Total distillate vol% = 96%

Total losses in % = 4%

VI.RESULT AND DISCUSSION

1. Biomass is the world's fourth largest energy source worldwide, following coal, oil and natural gas.
2. The thermal pyrolysis of wood dust able to give gaseous, liquid and solid product, the gaseous product is burning when ignite, indicating that, it is a fuel gas. Solid is charcoal which can be used as an adsorbent, as a fuel or can be blended/mix with cow dung to prepare a coal known as "Kandi Kolasa".
3. ASTM separation of liquid product gives oil with a fraction 70-80%, 80-90% and 90% to F.B.P. range product, whereas centrifugal separation, gives at bottom fuel oil and top aqueous phase. This indicates that oil is heavier than water.
4. The specific gravity of all ASTM fractions is always more than 1, indicating that fuel oil is heavier than the water.
5. Viscosity variation shows that the lighter fraction consists of low molecular weight of compounds, heavier fraction consist of high molecular weight component.
6. The flash point test shows that 70-80% fraction consist of more lighter component, and as fractionation increases flash point increases, indicating that heavier fraction consist of more heavier component.
7. Smoke point test shows that the bio oil is not able to provide sufficient capillary action and holding capacity hence fuel not able to give high illumination and high flame.
8. The sample is biological fuel, hence there is less chances of presence of aromatic hydrocarbon, still high miscibility of aniline with sample in aniline point test is might be due to the solubility tendency of oil, but for this further investigation of oil in terms of components composition has to be carried out by using most modern techniques like HPLC or IR techniques.

9. In case of pour point, it is very low (i.e.-15 C), indicate the heavy saturated material present is in less quantity.
10. The copper corrosion test and acid value indicates that some acidic component are present in sample which get vaporizes during heating , leads to give brown- color to copper strip.
11. Calorific value of product sample varies from 24.899 to 25.80 KJ/gm. This is less as compare to petroleum fuel which has caloric values always more than 38 KJ/gm.
12. ASTM distillation test indicate that product is in fuel range and will able to run the engine.
13. The fuel oil obtained by thermal pyrolysis of crop waste able to pass ASTM/IP test prescribe for hydrocarbon fuel but for knowing the exact composition of product fuel oil, it must be subjected to evaluation by most modern technique like GLC, HPLC or FTIR.[10 – 22]

VII.CONCLUSION

From above study it is observed that the thermal pyrolysis of field waste, i.e. agriculture waste able to give gaseous fuel, solid fuel (carbon) in the form of charcoal and liquid product. The liquid is an emulsion of water and fuel oil. The fuel oil obtained by separation from water phase able to stand the ASTM/IP test but has certain limitations to used as diesel fuel.

REFERENCES

1. "Review of biomass fuels and technologies", Yakima county public works solid waste division, section 2 page no. 19 Biomass technologies (2003). www.yakimacounty.com
2. An important source of renewable energy, biomass www.biomass.net
3. Website://cdn.intecopen.com/l6645/Intech-Preperation_and characterization_of bio_oil_from_biomass
4. Leach, G., "Energy and Food Production", International Institute of Environment and Development, London, (1976).
5. Leandro S. Oliveiral and Adriana S. Franca, "From Solid Biowaste to Liquid Biofuels" ,Nova Science Publishers, Inc. Page no. 8, 9, 910, 15, 17. (2009) www.demee.ufmg.br
6. Website: www.wood_McBroom.com Chemical composition of wood
7. Kumar, A.; Wang, L.; Dzenis, Y.A.; Jones, D.D.; Hanna M.A., "Thermogravimetric characterization of corn stover as gasification and pyrolysis feedstock", Biomass Bioenergy, 32, 460-467. (2008).
8. J. Holmgren, R. Marinangeli, P. Nair, "upgrading pyrolysis oils in to renewable fuels.", Hydrocarbon Processing, volume 87 (2008). www.hydrocarbonprocessing.com
9. Mansaray, K.G.; A. E. "Physical and Thermochemical properties of rice husk" Energy Source Part A, 19, 989-1004 (1997). www.tandfonl ine. com
10. Website: www.corrim.org/presentations/video/2008/CORRIM.../14 Steele Biomass to Bio-oil- CORRIM
11. Website: www.che.ncsu.edu/'ILEET/.../biomass-biofuels/Pvrolysis-of-Wood.pdf. Pyrolysis of Wood /biomass for Bio-oil-Chemical & Biomolecular.
12. Website: www.foume polymertechnik.de/index.php?option Vacuum pyrolysis cleaning process
13. Website:www.link.spronger.com/article/10.1134%2FS10 7036321250350 Thermal Methods to obtain Liquid Fuels and Other Products from Wood
14. Biagini, E.; Barontini, Tognotti, L., "Devolatillaxation of biomass fuels and biomass components studied by TG/FTIR technique", Ind. Eng. Chem. Res, 45, 4486-4493 (2006). gasifier.bioenergylist.org
15. A. B. J. Oudhuis, H. Boerrrigter, J. P. A. Neeft, H. Zanting, "Staged thermal treatment combined with pyrometallurgical smelting producing energy and products from waste" Proceedings, 5th World Congress on Integrated Resource Management, Toronto, Canada.(June 5-9, 2000)
16. Coulson and Richardson son, "Chemical Engineering Volume-2 Practical Tech. and Separation Process," Published by - in Great Britten by the Bath Press, Bath, Fifth Edition. www.enviromental-expert.com
17. "Standard method for analysis and testing of petroleum and related product Vol. 1", Published by the 'Institute of petroleum', London, by John Willey and Sons (1993).
18. "Standard method for analysis and testing of petroleum and related product Vol. 2", Published by the 'Institute of petroleum', London, by John Willey and Sons, (1993).
19. Dr. B. K. Bhaskar Rao, "Modern petroleum refining process", 4th Edition, Published by Oxford of IBH publication, (2002).
20. Dr. Ramprasad Yadav, "Petroleum Re-refining technology", Published by Khanna Publication, New Delhi, 37-141, (2007).
21. "Operating Manual of Karl-Fischer Moisture Analyzer, by Veego Progressive Instrument", Published by Veego Instrument Corporation, Mumbai.
22. http://webapps.utsc.utoronto.ca/chemistryonJine / refractive-a.html