Waste Management in Institution

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Abstract

Institutional waste is waste produced from institutions such as schools, hospitals, or prisons. These include waste not typically found in households but also hazardous wastes in some circumstances. This paper discusses the generation, treatment, disposal and management of the growing volume of waste in Gandhi Institute for Technology, (GIFT) campus. In our institute, daily a large amount of kitchen waste, waste plastic, e-waste, liquid waste is obtained and being utilized for better purposes. An attempt has been made to produce bio gas from kitchen waste. Attempt has also been made to produce fuel oil from college plastic waste collected from cafeteria by sequential pyrolysis reforming process. About the e-waste, after segregation, the functional items are reused. The fuel obtained from waste plastic and simarouba seed is used as an alternative fuel in diesel engine.

Keywords: *E-waste, Kitchen waste, Pyrolysis, Waste plastic.*

I. INTRODUCTION

WASTE to wealth is a buzz word now days. Much research work is going on how to proper utilize the waste generated from various organisation. Any unwanted solid or liquid material thrown out by the households, institutes, business establishment is called waste. The waste can be categorised as solid, liquid, or gaseous waste. The waste and poor disposal will results in environmental and economic effect. Surface water contamination, soil contamination, pollution, leach ate are categorised under environmental effects. Municipal wellbeing, recycling revenue are the economic effect. The main advantage of waste disposal unit helps a lot to make the environment clean and fresh. Also it makes disease free. There are number of waste disposal units in every town. Junk removal companies take the waste material from residential and commercial areas and dispose into these big units. Dumping waste in landfills, impacts the environment significantly. By properly disposing the waste, least amounts of waste reaches the landfills. By conserving space in landfills, the production of harmful substances is reduced significantly.

Reduce, Reuse and Recycle are the 3R' of waste management which help turn recyclable waste into useful substances. This is the effect of reducing, reusing and recycling. It decreases the need for manufacturing new materials and also helps to conserve the natural resources that are used in the manufacturing process. This also helps in turning unwanted waste into useful substances, such as compost and waste energy and in reducing the amount of greenhouse emissions and leach ate production. We can conserve space in landfills. Also we can conserve natural resources such as water, minerals and timbers. Thus proper waste management plays a crucial role in resource conservation. Waste comes in many different forms and may be categorized in a variety of ways. Liquid and solid waste types can also be grouped into organic, re-usable and recyclable waste.

In our institute, the breakdown of the waste generated is solid waste, liquid waste, and e-waste. The sources of waste generation are kitchen, construction / demolition site, electronic source of waste, agricultural waste and waste water from toilet. Proper waste management is adopted to reduce its ill effects on ecological, environmental and human health. Proper waste management helps to keep up the aesthetic value of our institute. The proper waste management helps the institute to: (a) Prevent or reduce the institutional environmental pollution, (b) Keep the institution clean and aesthetic, (c) Protect human health from various waste related diseases, Bio-waste is converted to energy fuels like bio-gas. Non- degradable plastic waste is converted to energy fuels which bear a resemblance to diesel. Kitchen waste is converted to Compost and liquid waste water is used for garden. Our institute always explores the possibilities of resource or energy recovery from the waste material that can be used to meet ever growing demand.

II. MATERIAL AND METHODS

For the purpose of study these sources are defined as giving rise to five major categories of waste: kitchen waste, plastic waste, e-waste, construction waste and liquid waste.

A. Sources of Institutional waste

Kitchen waste: In our institute we have 5 hostels. The day scholars, staff members and hostellers take their food in the common mess in the college premises. A lot of food waste is generated every day.

Plastic waste: The kinds of plastic waste were generated from 3 nos. of cafeteria. The kinds of plastic wastes were mainly High Density Poly Ethylene (HDPE), low Density Poly Ethylene (LDPE), Polypropylene (PP), Polystyrene (PS), Poly Vinyl Chloride (PVC) etc.

E-Waste: E-Waste can be defined as obsolete, unused, broken electronic or electrical equipment that are no longer in use or have reached end of their life. Major sources of E-waste generation from our institute are computers, cell phones, electronic tools, DVD players, printers, batteries etc.

Construction waste: The primary sources of construction and demolition waste are construction, renovation and demolition. Solid waste resulting from the construction or demolition of buildings and other structures, including but not limited to wood, plaster, metals, asphaltic substances, bricks, block and un-segregated concrete.

Liquid waste: Unwanted or used water led out of the institution which is termed as liquid waste. Liquid waste can be classified into grey water, storm water and black water. The source of grey water is from the kitchen and bath room. Storm water source is the heavy rain leading to accumulation of runoff water. The source of black water is from the toilet.

Agriculture Waste: Our institute is surrounded by simarouba plants. We extract the oil from simarouba seeds and convert to biodiesel by esterification and transesterification method. B20 (20% biodiesel by volume with 80% diesel) blend is prepared and run the diesel engine which is used in the generator for different purpose.

B. Waste management technology adopted

Kitchen waste: An attempt has been made to produce bio gas from kitchen waste generated from the canteen by a biogas plant. Anaerobic digestion process is applied where the bacteria degrade organic matters in the absence of oxygen. The biogas plant is made up of PVC fibre with 1 m3 capacity with a loading rate of 10 kg bio waste daily with a 1:1 proportion with water [1]. The plant is exposed to sunlight. The digester unit of biogas plant is shown in Fig.1.

Plastic waste: The plastic waste collected from campus was broken in to small sizes and the samples were subjected to pyrolysis process. Pyrolysis is a thermo chemical decomposition of organic material at elevated temperature without the participation of oxygen. It involves the simultaneous change of chemical composition and physical state [2][3]. The process involves of heating plastic waste without the participation of oxygen environment. The plastic will melt, but will not burn. After it has melted, it will start to boil and evaporate. The vapours are then passed through a cooling pipe and when cooled the vapour will condense to a liquid and some of the vapours with shorter hydrocarbon lengths will remain as a gas. The condensed liquids are collected. Vapours formed as a result of pyrolysis are condensed over water as plastic crude oil due to density difference. The upper oil was separated and weighed.

Fig. 1.Experimental set up of bio-gas plant

The main equipment used for this process are reactor, condenser and the receiver. All the equipments are designed and fabricated in machine shop lab under the supervision of Research and Development Cell in our College. The schematic representation of the experimental set up is shown in Fig.2. Thermocouple; Temperature gauge, Pressure gauge and other accessories are fitted to this equipment.

The experimental set up is shown in Fig. 2.

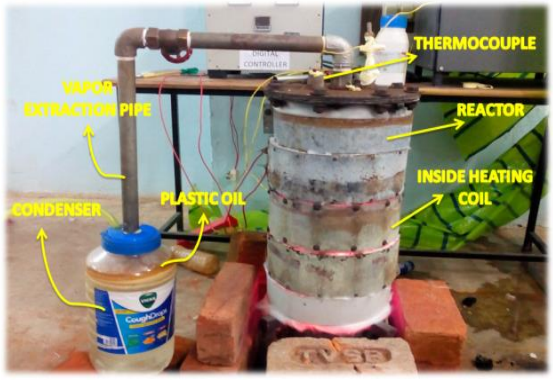

Fig.2. Experimental set up of the pyrolyisis method

E-Waste: The College dis-assembles the e-waste equipment. The sub parts are classified according to their label as obsolete, non-functional, functional, repairable and non-repairable parts. After repairing the items they are reused. The functional items are also reused. The functional items are used by the students for their project as and when needed. Also a State Pollution Control Board Authorized Collection unit named as Kalinga e-Resources Pvt. Ltd took this initiative for collection of the obsolete and non-functional items. Certificate of Contribution awarded to our institute is shown in Fig. 3.

The Ministry has collaborated with many international/national companies and NGO's like National Solid Waste Association of India (NSWAI), Toxic Link, Waste Electrical and Electronics Equipment (WEEE), Attero, Clean India, Indian Environmental Society and India Habitat Centre to handle the problem of e-waste [4][5].

Liquid Waste: The grey water and black water is segregated before the disposal. Grey water are diverted to the garden. Black water are send to the septic tank. The solid matters settle down at the bottom of the tank. Anaerobic bacteria convert the sewage into liquid and gases during the process of digestion. In this way there is a appreciable reduction in the volume of waste as it changes into semi solid condition. The over flow of the septic tank is used for gardening purposes. The septic tank is covered with concrete.

Fig. 3. Certificate of Contribution Award to the institution

Construction waste: The concerned civil department makes a plan for gainful use of construction debris. The low lying areas, which need to be filled up for the purpose of building activity, may be mapped and a contingency plan prepared so that whenever a demolition or construction activity takes place, its debris can be directed to such places in order of priority. However, such activity is planned and implemented strictly under the supervision and approval of the concerned authority.

Agriculture waste: The simarouba seed is collected from nearby village. The extraction of oil is carried out by extraction mill. The conversation of straight vegetable to biodiesel is carried out by esterification and transesterification methods. The flow chart of extraction oil to biodiesel is shown in fig 4.

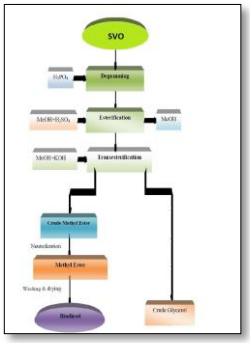

Fig. 4. Flow chart of extraction oil to biodiesel

Many researchers told that B20 blend is the best choice among the blend to be used in diesel engine regarding performance and emission. Thus SB20 blend is prepared by considering (20%volume of simarouba biodiesel and 80% volume of diesel. All the properties are compared with diesel. The simarouba oil and biodiesel is shown in Fig.5.

Fig. 5. Simarouba oil and biodiesel

The 5.9 kW capacity diesel engine is fuelled with SB20 for 1 hour at various load. The brake thermal efficiency and fuel consumption is calculated and compared with diesel. The engine set up is shown in Fig.6.

Fig.6. Diesel engine setup

III. RESULTS AND DISCUSSIONS

The composition of biogas is shown in Table. I.

TABLE I: Composition of biogas

Component	**Concentration in %**
Methane	55-60
Carbon dioxide	35-40
Hydrogen Sulphide	2
Water	2-7
Ammonia	0-0.005
Nitrogen	0-2
Oxygen	0-2
Hydrogen	0-1

The above table indicates that the higher concentration of methane of the biogas can be used for cooking purpose. Also by purification this gas can be used as IC engine.

The fuel properties of crude plastic oil are shown in Table. II.

TABLE II

Fuel properties of crude plastic oil compared with gasoline and diesel

Properties	Plastic oil	Gasoline	Diesel
Density @ 150C, Kg/m3	770	720	820 to 860
Kinematic Viscosity at 400C, mm2/s	1.89	1.076	2.0 to 4.5
Flash point, 0C	-23	38	60 to 80
Fire point, 0C	-20	-	-
Cloud point, 0C	4	-	-15to5
Pour point, 0C	-4	-	-35 to -15
Calorific Value, Mj/kg	42.41	46.9	43.7
Cetene index	75	40	46

Table II indicates that the plastic oil properties resembles with the properties of diesel and gasoline, which can be used as an alternative fuel for IC engine.

The fuel property of SB20 and diesel is shown in TABLE III.

TABLE III: Fuel properties of simarouba blends oil

Properties	Calorific value (Mj/kg)	Specific gravity	Kinematic viscosity (cSt)	Flash point (^{0}C)	Fire point (^{0}C)	Cloud point(^{0}C)
SB20	43.89	0.83	3.39	130	146	17
Diesel	45.33	0.82	2.85	60	65	6.5

TABLE III indicates that the fuel properties of SB20 shows similar trend with diesel.

The brake thermal efficiency of the tested fuel is shown in Fig.7

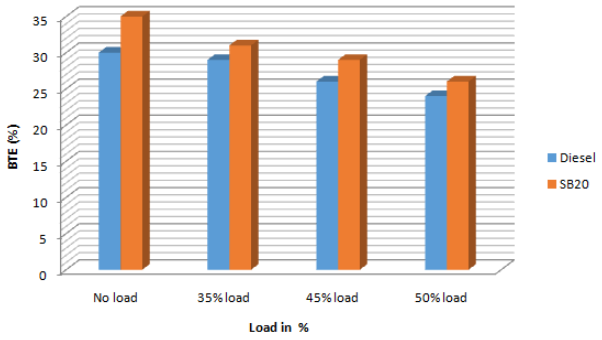

Fig.7. Brake Thermal efficiency of the tested fuels

Fig. 7. indicates that the brake thermal efficiency of SB20 is more than the diesel up to 50% load.

The brake specific fuel consumption (BSFC) of the tested fuels is shown in Fig.8.

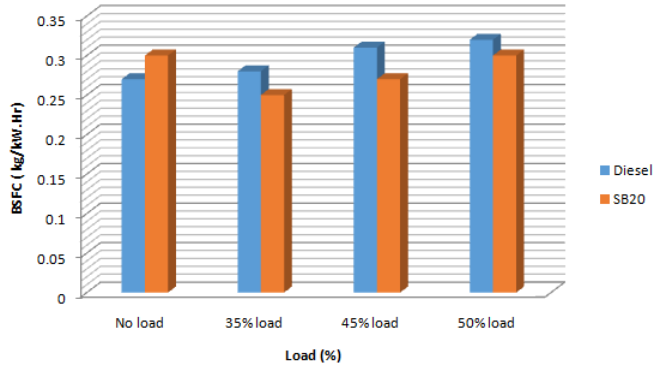

Fig. 8. Brake Specific fuel consumption of the tested fuels

The above graphs shows that the brake specific fuel consumption of simarouba biodiesel blend is less than diesel

IV. CONCLUSIONS

The above results concluded that the waste generated from the institution is properly utilized

The kitchen waste is used for bio-fuel generation and fertilizer.

The plastic waste can be used as an alternative fuel in the diesel engine.

E-waste is disposed to various agencies for reuse.

The liquid waste is used for gardening purpose and also a STP can be built up.

Construction waste is used for low lying areas.

The agriculture waste i.e.simarouba seed is used for biodiesel production and blending with diesel is fuelled to a diesel engine for generator purpose.

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