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RESEARCH ARTICLE

CHALLENGES AND MANAGEMENT OF INSTITUTIONAL WASTE.

Nabnit panigrahi.
Dean R&D, Department of Mechanical Engineering, Gandhi Institute For Technology, Bhubaneswar, Odisha-752054, India.

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Abstract

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. An 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. An NGO took the initiative for the collection of the obsolete and non-functional item. The wastewater and construction debris are reused. This initiative is a value-added education, by providing the possibilities for the employees and students to have the Knowledge on the best waste management practice and the impact of waste on the environment. We convert the waste into opportunities.

Introduction:-

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 effect of waste and poor disposal results in environmental effects and economic effect. Surface water contamination, soil contamination, pollution, leachate 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.

The 3R's of waste management i.e. Reduce, Reuse and Recycle help turn recyclable waste into useful substances. This is the effect of reducing, reusing and recycling. This not only decreases the need for manufacturing new materials, but also help 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 leachate 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.

Corresponding Author:- Nabnit panigrahi.
Address:- Dean R&D, Department of Mechanical Engineering, Gandhi Institute For Technology, Bhubaneswar, Odisha-752054, India.

In GIFT, the breakdown of the waste generated are solid waste, liquid waste, and e-waste. The sources of waste generation are kitchen, construction / demolition site, electronic source of 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. GIFT always explores the possibilities of resource or energy recovery from the waste material that can be used to meet ever growing demand.

Materials 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.

Sources of 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 unsegregated 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.

Waste management technology adopted by the institute:-

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 [Das A, 2017]. The plant is exposed to sunlight. Schematic representation experimental set up of GIFT bio-gas plant is shown in Fig.1. The digester unit of biogas plant is shown in Fig.2. The biogas storage balloon and the bio-gas burner is shown in Fig.3. and Fig-4. respectively.

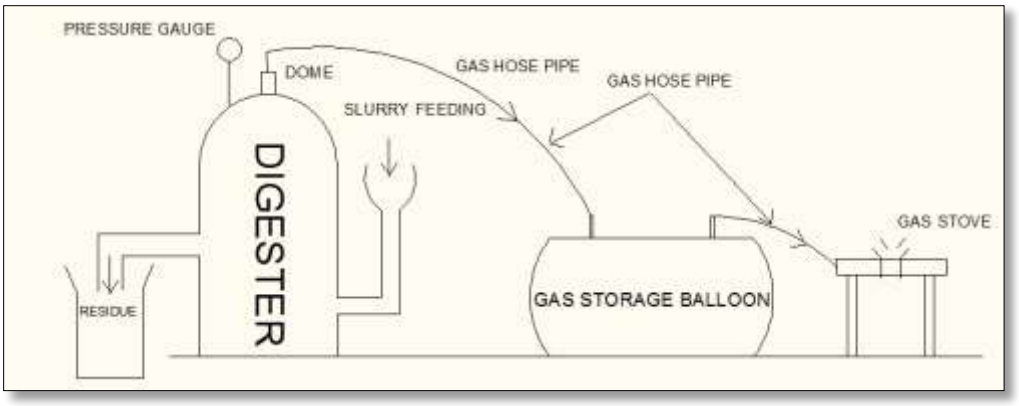

Figure 1:- Schematic representation experimental set up

Figure.2:- Digester unit

Figure 3:- Biogas storage Balloon

Figure 4:- Bio gas Stove

Plastic and rubber 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 [Panda AK 2014 : Sriningsih W et.al. 2014]. 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.

The main equipment used for this process are reactor, condenser and the receiver. All the equipment are designed and fabricated in machine shop lab under the supervision of Research and Development Cell in GIFT College. The schematic representation of the experimental set up is shown in Fig.5. The reactor and the experimental set up unit is shown in Fig. 6. Fuel from waste plastic is shown in Fig.7. TC- Thermocouple; T- Temperature gauge; P- Pressure gauge

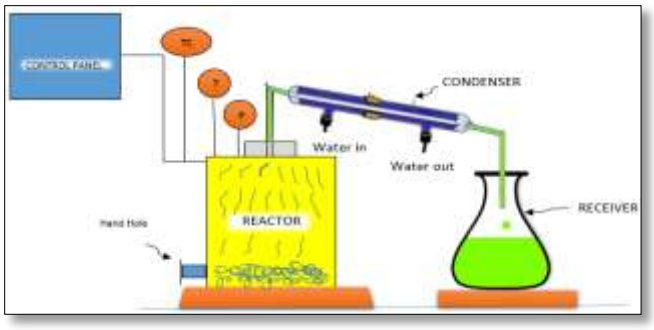

Figure 5:- Schematic representation of experimental set up

Figure 6:- The experimental set up unit of plastic fuel

Figure 7:- Fuel from waste plastic

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 GIFT is shown in Fig. 8.

Figure 8:- Certificate of Contribution Award to GIFT

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 [Tyagi N et. al., 2015 : Kumar R et. al., 2016].

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.

In our institute roof top rain water harvesting system is implemented. In this the roof becomes the catchments, and the rain water collected from the roof of the college building is diverted to artificial recharge system. It helps in augmenting the ground water level of the area. The system mainly contributes of catchment, down take water pipes, first flush, filter and sand gravel filter. The sand gravel filter is constructed by brick masonry and filtered by pebbles, gravel and sand. Each layer is separated by a mesh. The schematic diagram of septic tank is shown in Fig.9. The green campus is shown in Fig.10.

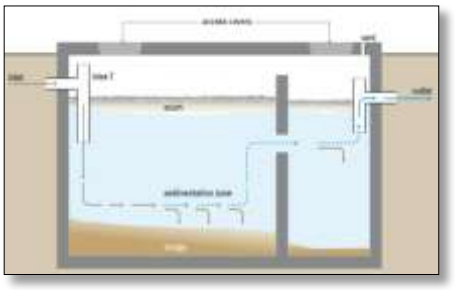

Figure 9:- Schematic diagram of septic tank **Figure 10:-** GIFT Green Campus

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.

Result and Discussion:-

The composition of biogas is shown in Table. 1.

Table 1:- 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 rate of biogas production is shown in Fig. 11. The sample wise chromatographs test report is shown in Fig. 12. Component of Oil from waste plastic is shown in Table. 2 and fuel properties of crude plastic oil is shown in Table. 3.

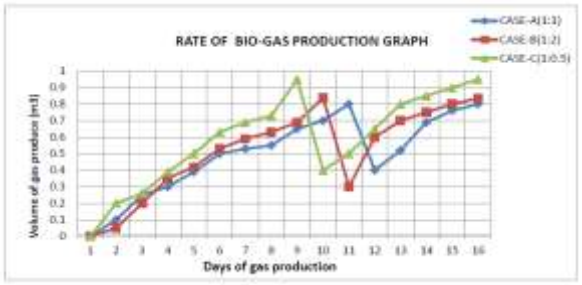

Figure 11:- Rate of biogas production

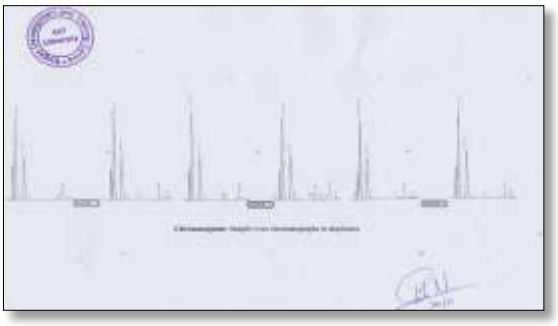

Figure 12:- . Sample wise chromatographs test report

Table 2:- Components obtained in the oil obtained from waste plastic

Retention time in minute	Name of the component
3.89	3-Decene
3.97	3-Dodecene
5.32	7-methyl -4-undecene
5.36	5-methyl1-4-decene
6.81	2,5-Dimethyl-2-undecene
6.92	CIS-2-Dodecene
7.00	2-Methyl-3-undecene
9.08	TRANS-2.2-Dimethyl1-3-decene
9.13	1-Pentyl-2-propylcyclopentane
9.26	3-Tetradecene
11.87	2-Methyldecan-1-ol
20.69	n-Heneisosane
21.49	n-Heneicosane
21.92	Hexadecene
22.26	n-Hexatriacontane

Table 3:- 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

Conclusions:-

The purpose of this paper is to find various waste related issues and strategies for effective waste management in an institution. With various training program and awareness events, provides a platform to educate the consumers and helps to handling procedure of waste. Use of innovative technology allows to provide low cost eco-friendly recycling plants to process and recover the resources. Also due to lack of funding the institute is unable to carry out certain project with modernization technique like recycle of waste. All institute should assess or evaluate the likely environmental impacts of their waste generated and developed or proposed project taking into account the inter-related socio-economic, cultural and human-health impacts, both beneficial and adverse.

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