

Eco-Bin: A Novel Technique for Waste Management and Energy Generation

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ABSTRACT: The key factor of an efficient waste management is to ensure proper segregation of waste. Current methods used for waste management are incineration, recycling, composting, ocean disposal etc. Some of these methods have many disadvantages such as air pollution, cost inefficiency, effects on ocean eco system, time consuming, health hazard etc. ECO-BIN is a three compartment waste bin for disposing wastes in an effective and efficient way. It consists of compartments for food waste, plastic waste and other waste. The biogas produced from the food waste is used for the incineration of other waste except plastic. The polluted air due to burning of wastes is filtered using an air purifier. The heat energy from the incineration of waste is used for the production of electricity. It helps us to reduce waste effectively and also we will get electricity as the end product.

KEYWORDS: Biogas Plant, Combustion Chamber, Electricity Generation, Air purification.

I. INTRODUCTION

ECO-BIN is a three compartment bin for disposing waste in an effective and efficient way. It consists of compartments for food waste, plastic waste and other waste. The biogas produced from the food waste is used for the incineration of other waste except plastic. The polluted air due to burning of wastes is filtered using an air purifier. The heat energy from the incineration of waste is used for the production of electricity. It helps us to reduce waste effectively and also we will get electricity as the end product. This bin can be used in public places. It is user friendly as anyone could deal with it; we can place this in residential areas or compounds. The bin will operate only when garbage enters. It is highly reliable and eco-friendly. There will not be any pollution to the environment due to the operation of the bin. It is efficient in terms of time consumption. It is totally energy conservative and sustainable. There will not be any loss in terms of energy. Most of the disadvantages or limitations in present techniques can be solved by using this bin. Finally, this bin will help us to solve the problem of garbage accumulation and will decrease the cost of garbage collection. Also it is safe to use so that anyone could deal with it.

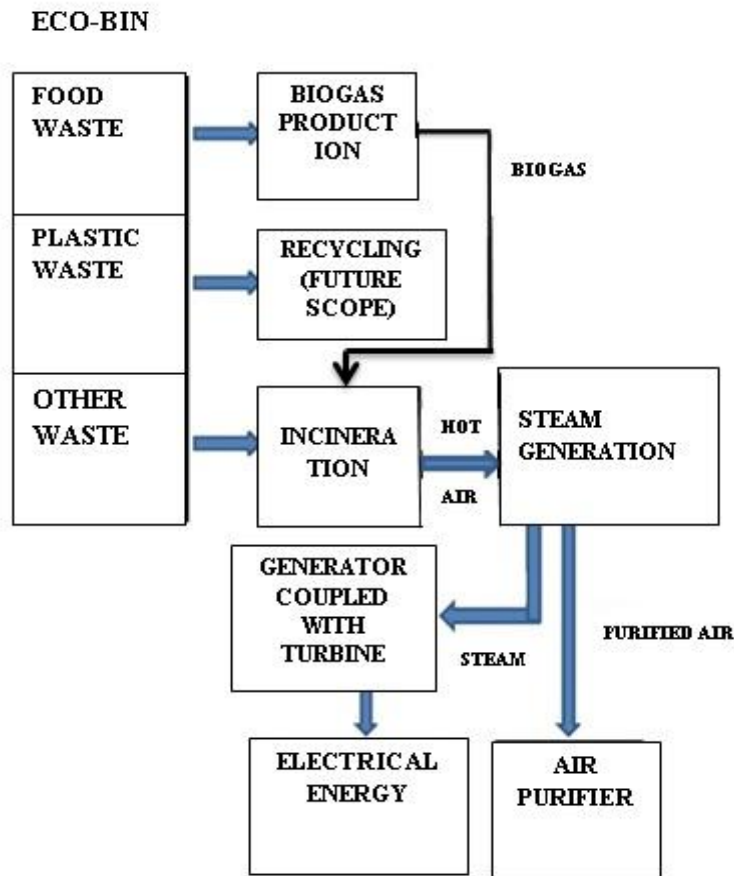
Paper is organized as follows. Section II describes the components used in ECO-BIN. The block diagram represents the working of ECO-BIN. Methodology is given in Section III. Section IV presents experimental results. Finally, Section V presents conclusion.

II. MATERIALS AND METHODS

Fig. (a) is the block diagram of ECO-BIN. The basic structure of eco-bin consists of three compartments, namely the food waste compartment, plastic waste compartment and the compartment for collection of wastes other than plastics and food. The food waste collected is used for biogas production which in turn is used for incineration of the waste other than plastic waste. The heat energy obtained while incinerating the waste is used for producing steam which is further used for rotating the steam turbine. The steam turbine coupled to a generator to produce electricity. The exhaust gas is then filtered and released into the atmosphere. The plastic waste is stored for further recycling.

The work in this paper can be divided into two stages. 1) Biogas production 2) Electricity generation. Biogas is produced from the food waste in food waste compartment. The main components in biogas production are 30L container for collecting food waste which can hold up to 0.3m² waste, 3 inch lever ball valves, 3 inch female threaded adapter and 3 inch male threaded adapter acts as the joints, 45cm hose pipe is used as the gas outlet of the biogas container, 20cm long pipe and a 45 degree elbow is used for carrying the food wastes from the food compartment into the biogas container and sieves. Electricity is generated by the incineration of other compartment waste using the biogas produced. The main components in electricity generation are an incineration chamber made up of mild steel of size 585mm X 435mm X 720mm, boiler tank of 4L which can develop a pressure up to 4 kg/cm²,

50mm centrifugal impeller turbine rated 500W and 1700rpm, 12V 1500 rpm DC dynamo motor and activated carbon filter.



(a)Block diagram of ECO-BIN

III. METHODOLOGY

The waste in food waste compartment is used for the biogas production. For developing a mini biogas plant, a container of 30 liter in place of digester. The food wastes are collected to this container via food waste compartment. These wastes are stored in the container for 1-2 weeks. The biogas is collected and stored in another container. This gas is used for the incineration of other wastes like paper. Fig. (b) shows the biogas production unit.

The waste other than plastic and food waste are deposited into a separate compartment. Here the waste is incinerated and the thermal energy from this is utilized to produce electrical energy. The material in which the incineration process is carrying out has high temperature withstanding capability. The waste is filled into the bin through the automatically operated lid of the bin. The bin is operated by a motor through a relay which in turn is actuated by an ultrasonic sensor. Once the waste is filled, the bio-gas produced from the food waste compartment is used for incinerating the waste in the compartment. The ignition is initiated using a lighter which provides enough spark to ignite the bio-gas. The heat energy produced by combustion is supplied to the boiler of 4 liter capacity. Inside the boiler, when water boils, a pressure of about 0.5 – 1 kg/cm² is developed. This high pressure steam is directed to a turbine through a nozzle which itself has a very narrow cross sectional area. The turbine rotates, thus causing a dynamo attached to it through a belt to rotate. This rotation of the dynamo cause is production of electricity. Fig. (c) shows the incineration and energy generation system.



(b) Biogas generation unit



(c) Incineration and generation unit

IV. EXPERIMENTAL RESULTS

Considering the amount of waste in other waste compartment is about 10 kg.

The biogas produced from the food waste is given to the incineration chamber.

The heat produced is supplied to the boiler of 4L capacity and boils the water at 100°C.

The steam pressure is about 1 kg/cm² and it is monitored by using steam valve and pressure gauge. It is then given to the turbine through the nozzle and turbine runs at 150 rpm speed. The dynamo attached to the turbine generates electricity about 1 kWh.

For the generation of 1 unit power, 10 kg of other waste except plastic and food needed.



V. CONCLUSION

ECO-BIN is a three compartment waste bin which is user friendly as well as eco- friendly. There will be biogas production from the food waste and electricity from the heat energy obtained via the incineration of wastes like paper. It is totally energy efficient. This will eliminate many of the problems or disadvantages of conventional waste management methods. Due to the simple structure and user-friendly nature, this can be used in residential areas and will eliminate the garbage accumulation. It ultimately helps to keep cleanliness in the society. There is only a small emission of greenhouse gases form the incineration chamber compared to the conventional incineration technique, thus making it a more preferable waste management method.

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