International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 11 | Nov -2017 www.irjet.net p-ISSN: 2395-0072

Ridding of Pollution from Plastic by turning it into Valuable fuel using wireless sensor technology

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Abstract – *As the population, Technology increased the waste generated by the people is also increased. We are consuming plastic for its versatility, durability, easy to carry and easy to produce. Even though it has lots of advantages it creates lots of nuisance to the environment and degrades in a big way. The second problem is associated with the petroleum problem. India like developing country has to import petroleum from other countries for transport and other purpose. So converting the waste plastic into liquid fuel is helpful to solve the problem of pollution and also reduce the fuel demand. This paper will solve the above mention problem by means of implementing sensor technology*

Key Words: Technology, versatility, nuisance, environment, degrade, implementing, waste plastic.

1. INTRODUCTION

Day to Day life the way of our life and the development of technology is increased, but it leads to the least consideration of the surroundings which we live in. Thus we polluted the environment and thereby reducing the quality of the place we live [1].So it is necessary to adopt the better waste management system to save our environment from the pollution.

2. WASTE MANAGEMENT

It is the action required to manage waste from inception to the final disposal methods. It includes collection, Transportation, Treatment (Separation, Cleaning) and finally disposing waste together with monitoring.

2.1 WASTE DISPOSAL METHODS

The following methods are commonly used in the process of disposing wastes that include,

(i)Disposal in Ocean / Sea-Disposing waste in water source
(ii)Landfilling-Dumping in land sites
(iii)Incineration-Degrading by means of burning
(iv)Composting-Degrade organic waste into rich soil
(v)Recycling-waste into new product.

2.2 PROBLEMS OF CONVENTIONAL METHODS

(i) Disposal in ocean / Sea – Water pollution, Killing of planktons, Destruction of food sources.
(ii)Landfilling- Land and ground water pollution, odour, explosive gases, Toxic gases
(iii)Incineration- Emits toxic gases, creates health issues like breathing problem.
(iv)Composting- Suits only for organic waste.
(v)Recycling- Processing technology is expensive.

3. SENSORS USED IN THE PROCESS

3.1 TEMPERATURE SENSOR

A temperature sensor is a device, that collects the data about temperature from a particular source and converts the data into understandable form for a device or an observer.

Types of Temperature Sensors

- Thermocouples
- Resistor temperature detectors
- Thermistors
- Infrared sensors
- Semiconductors
- Thermometers

3.1.1 THERMOCOUPLE SENSOR

Thermocouple sensor is the most commonly used temperature sensor. This sensor is extremely rugged, low-cost, self-powered and can be used for long distance.

Type K Thermocouple

The type K is the most common type of thermocouple. It is inexpensive, accurate, reliable, and has a wide temperature range. The type K is commonly found in nuclear applications because of its relative radiation hardness. Maximum continuous temperature is around 1,100C.

Type K Temperature Range

Thermocouple grade wire, –454 to 2,300F (–270 to 1260C)
Extension wire, 32 to 392F (0 to 200C)

WORKING METHOD

A thermocouple is comprised of at least two metals joined together to form two junctions. One is connected to the body whose temperature is to be measured; this is the hot or measuring junction. The other junction is connected to a body of known temperature; this is the cold or reference junction. Therefore the thermocouple measures unknown temperature of the body with reference to the known temperature of the other body.

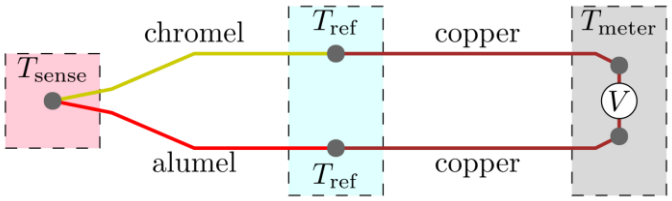

Fig-1: Working method of Thermocouple

3.2 TEMPERATURE CONTROLLER (PID)

On / Off control is a very simple form of control, which leads to oscillation of the process variable. This oscillation can affect the quality of the final product and is undesirable. The alternative is to use three term control, known as PID control.

A ' closed loop ' consists of :

- A process in the plant to be controlled.
- A sensor to detect the Process Value (PV) such as a thermocouple or pressure sensing device.
- A controller to provide control of that process, referred to in the overhead as the term PID.
- An output to an actuator or device to control the input stimulus to that process, such as heat.

Fig-2: Thermocouple Sensor

Fig-3: PID Temperature Controller

3.3 PRESSURE SENSOR

A pressure transducer, often called a pressure transmitter, is a transducer that converts pressure into an analog electrical signal.

Types of Pressure Sensor

- Strain Gauge Type
- Capacitive Pressure Sensor
- Piezoelectric Pressure Sensor

3.3.1 PRESSURE GAUGE

- Pressure gauge is a device which measures the pressure in a gas or liquid.
- Digital pressure gauges use advanced sensors and microprocessors to display highly accurate pressure reading on a digital indicator.
- Most digital pressure gauge rely on one of two measurement

Strain gauge
Piezo electric

WORKING PRINCIPLE

Piezoelectric crystals develop a potential difference (i.e. voltage is induced across the surfaces) whenever they are subjected to any mechanical pressure. These sensors have the crystal mounted on a dielectric base so that there is no current leakage. Attached to the crystal is a horizontal shaft to which a diaphragm is connected. Whenever the diaphragm senses pressure, it pushes the shaft down which pressurizes the crystal and voltage is produced.

4. PLASTIC SEPARATION METHODS

Following are the methods commonly used to separate the plastics

1) Density Based Sorting Method
2) Visible Light (Colour)
3) Optoelectronic Sorting of Plastic
4) Infrared Light (Resin Type)
5) X-ray (PVC)

Fig-4: Plastic Resin Codes

5. PLASTIC RECYCLING TECHNOLOGIES

Recycling of plastics should be carried in a manner to minimize pollution during the process and enhance efficiency and conserve the energy. There is different type of technology include following aspect

1. Mechanical Recycling- Recycling of plastics waste into reusable product.
2. Chemical Recycling – Gasification, blast furnace
3. Incineration- Burning of waste plastics to obtain energy.
4. Pyrolysis – Conversion of waste plastics into liquid fuels

5.1 PYROLYSIS PROCESS

Pyrolysis is the heating of an material in the absence of oxygen. Because no oxygen is present the material does not combust but the chemical compounds that make up that material thermally decompose into combustible gases and charcoal.

Most of these combustible gases can be condensed into combustible liquid, called pyrolysis oil (bio-oil).

Thus pyrolysis of biomass produces three products: one liquid, bio-oil, one solid, bio-char and one gaseous (syngas). The proportion of these products depends on several factors including the composition of the feedstock and process parameters .

- In this, type k thermocouple sensor is used. The temperature is monitoring in the temperature controller (PID). The temperature need for the pyrolysis is 310- 540 deg C, which is monitor using the sensor
- Pressure is applied using pressure gauge sensor.
- With the implementation of sensor, the process will be accurate, safe and achieved best output.

5.2 OTHER THINGS TO BE CONSIDER

5.2.1 PLASTICS

Waste Plastic Pyrolysis can convert petroleum based waste streams such as plastics into quality fuels, carbons. Given below is the list of suitable plastic raw materials for pyrolysis

- Mixed plastic (HDPE, LDPE, PE, PP, Nylon, Teflon, PS, ABS, FRP etc.)
- Mixed waste plastic from waste paper mill
- Multi Layered Plastic

Fig-5: Waste Plastics

5.2.2 STEEL REACTOR

Steel Reactor is the container user in this process which should sustain the heat and should not allow the oxygen inside the container. If the container allows the oxygen then the plastic inside the container will start to burn

Fig-6: Sample Steel Reactor

5.2.3 HEATING SOURCE

For this purpose electrical coil heater of rating 1.5 KW is used to provide the thermal energy required for the cracking of the plastic molecules present inside the reactor. The heater shown in the following figure uses electric resistance as a heating source.

Fig-7: Electrical coil heater

5.2.4 COILED CONDENSER

Condenser is a device or unit which is used to condense vapour into liquid. The Condenser has a wall thickness of 4 mm and is made up of mild steel, which is surrounded by a water jacket. The condenser has pre-installed copper tubes running inside in a coiled fashion.
The copper tube consists of a vapour coming from the reactor and is surrounded by water from all sides. Continuous flow of water is made inside the condenser by connecting the pipe from tap. The condenser contains a outlet copper tube at bottom, from where we can extract the plastic oil. Coiled condenser is used for this experiment in which copper coil is inserted in to the water bath of carbon steel

Fig-8: Sample coiled condenser

6.OUTPUT OF PYROLYSIS

Fig-9: Sample output of pyrolysis Wax and oil

The above diagram are samples from polyethylene, in the first run out comes mostly paraffin like liquid that solidifies at temperatures below 20 degrees Celsius, the other clear sample is from the same paraffin that is gone through the process one more time.

6.1 RESIDUE

Finally some residue is obtained. The residue is like a tar which can be used in road process. So there is no wastage arises here at the end of the process.

Fig-10: Residue

APPICATIONS OF FUEL OIL

- Fuel for agricultural pumps
- Fuel for boiler
- Marine fuel (Bunker fuel)
- As input feed for petroleum refineries
- Large factories

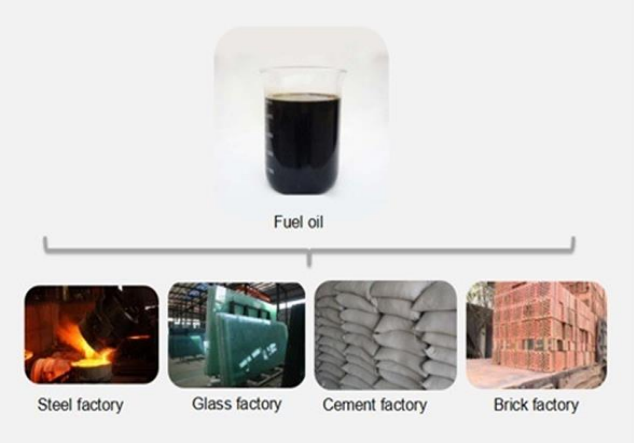

Fig-11: some of the applications

FINAL RESULTS OF PROCESS (Environment)

- Conversion of up to 100% of waste
- No Greenhouse and other harmful gas emission into the atmosphere
- No toxic waste to dispose of
- Reliable energy source, high energy output
- High conversion efficiency
- Low capital and operation costs
- Low energy consumption (as compared to the alternative management scenarios).

FINAL RESULTS OF PROCESS (Technology)

- In the separation process, Sensor used in great way
- In the pyrolysis process, both the sensor help to complete the process in safer way
- Accuracy is achieved
- Reduced public health risk
- Expected output is achieved

PYROLYSIS PROCESS RESULT

Conversion of waste plastic into liquid fuel can solve the problem of plastic waste recycling and the shortage of liquid fuel in developing countries like India. Thermal degradation of plastic can be done easily with economic means. The yield of the product can be increased by varying the process parameters like temperature, pressure, amount etc. The fuel produced in this study was found the properties comparable to the regular diesel fuel used in automobiles. So it can be concluded that the "Polyfuel" may be an alternative fuel of the future. The residue produced can be used in road making process, as no waste generated during the process, it can be called as zero discharge process or green process which avoids the pollution.

7. CONCLUSION

CLEAN-India is an acronym which stands for Community Led Environment Action Network. Efficient and effective waste management is best achieved at household levels. Conversion of waste plastic into liquid fuel can solve the problem of plastic waste recycling and the shortage of liquid fuel in developing countries like India. Thermal degradation of plastic can be done easily with economic means and also the implementation of sensor make the process more easier and safer. The fuel produced in this study was found the properties comparable to the regular diesel fuel used in automobiles. So it can be concluded that the "Polyfuel" may be an alternative fuel of the future. The residue produced can be used in road making process, as no waste generated during the process, it can be called as zero discharge process or green process which avoids the pollution.

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