To Design smart Incinerator with Catalytic Converter attachment, fabricate and test for exhaust emissions.

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Group_no.1
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Outline of Presentation

Introduction

- There are 336 million menstruating women in India, of which 36 per cent use undisposable sanitary napkins — that totals to 121 million women, estimates the Menstrual Hygiene Alliance of India (MHAI).
- Calculating that for the year — implies that India has 12.3 billion undisposable sanitary napkins to take care of every year, majority of which are not biodegradable/compostable.
- Menstrual waste is disposed as part of routine waste ending up in landfills, thrown in open spaces and water bodies, burnt, buried (shallow burial) or flushed down toilets. Each poses a different type of risk to the environment. Burning releases carcinogenic fumes in the form of dioxins and furans.
- So our moto is “To design smart mini Incinerator with Catalytic Converter attachment, fabricate it and test for exhaust emissions for maintaining hygienic living habit”.

Objectives

1. To carry out better burning.
2. To reduce bad odour coming out of exhaust.
3. To prevent the direct escape of suspended particles into the atmosphere .
4. To carry out maintenance and cleaning of the incinerator with ease.
5. To reduce electric consumption.
6. To make a smart automatic machine.
7. To filter the exhaust so as to reduce escape of pollutant gases.
8. To have low manufacturing and running cost.
9. To have timely output of Temperature and pad count .

Problem Definition

- **To design, fabricate and test a machine to successfully incinerate menstrual waste, reduce energy consumption and maintain exhaust emissions.**

Literature survey

Research paper

Paper/Article name	Year of Publication	Conclusion or Result
WASTE TO ENERGY BY INCINERATION	2014	With the growing problems of waste management in the urban areas and the increasing awareness about the ill effects of the existing waste management practices on the public heath, the urgent need for improving the overall waste management system and adoption of advanced, scientific methods of waste disposal, including incineration is imperative.
Menstrual Hygiene, Management, and Waste Disposal: Practices and Challenges Faced by Girls/Women of Developing Countries	2018	Menstrual hygiene should be promoted by implementing a course on menstruation and menstrual hygiene management. There is a big need to encourage adolescents at school levels to practice safe and hygienic behaviours.

Literature survey

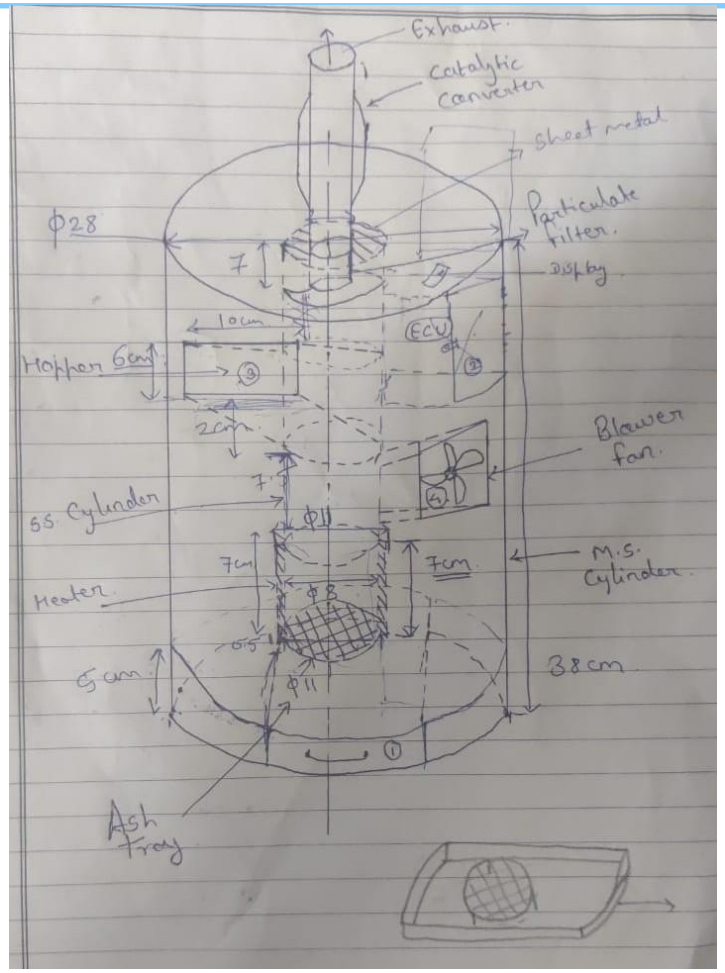
Research paper :

Paper/Article name	Year of Publication	Conclusion or Result
Experimental research on direct gasification and melting incineration of municipal solid waste	2005	The direct gasification & melting furnace is a resource-recovery-type technology with the following advantages: The furnace has a vertical structure and enables both gasifying and melting in one furnace. Thus, it coexists simple and safety operation, and realizes detoxification.
CENTRAL POLLUTION CONTROL BOARD Ministry of Environment, Forest & Climate Change, Govt. of India	2018	Norms on how to dispose bio medical and sanitary waste, Effective measures and guidelines.

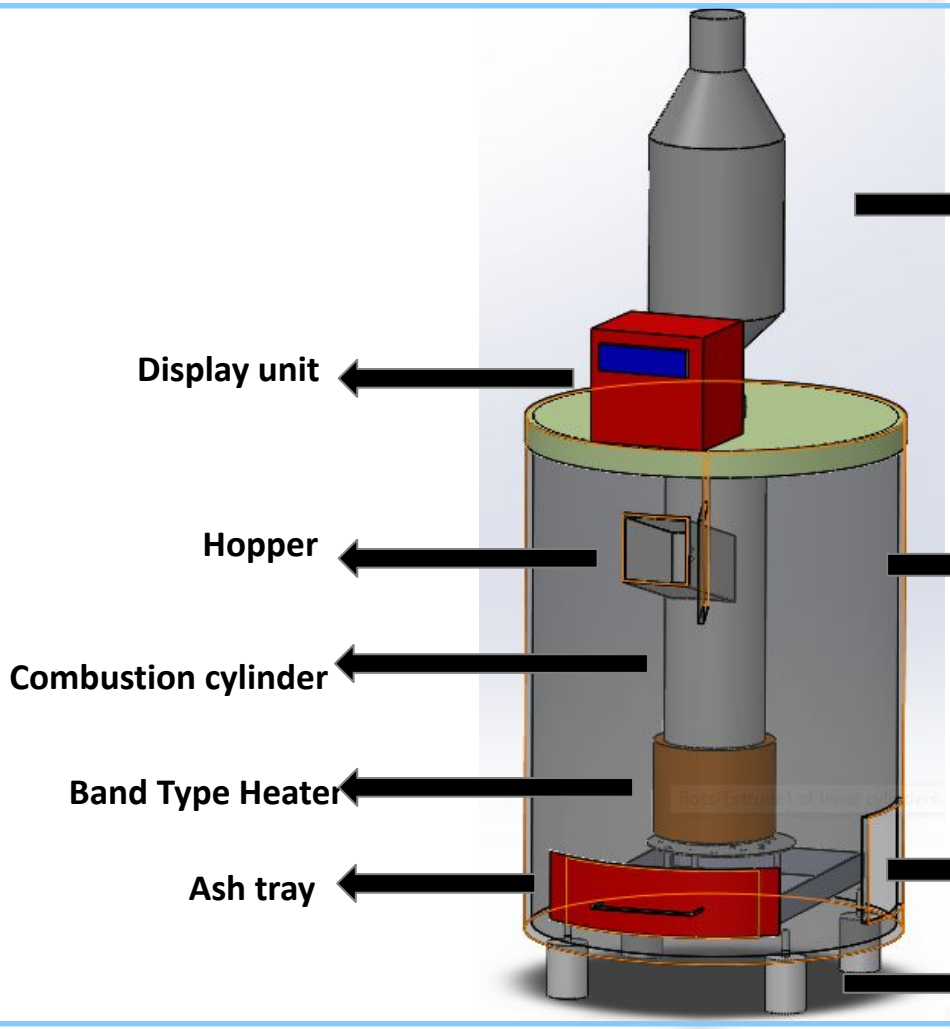
Abstract

The incinerator is designed and an entirely new machine has been fabricated and tested. This incinerator is relatively low cost, with a capacity of 5 napkins per cycle and with a power consumption of 0.55 KWh per cycle. The Manufacturing cost of the incinerator is Rs.5000/-. The incinerator uses a band type heater with a 500 Watt power rating placed around an SS304 cylindrical shell and a 12 V DC powered fan. The incinerator comes with the incredible features of heater-auto On/Off , air circulation with fan for better combustion process and a counter mechanism using IR sensor with an Arduino controller attachment all these features can be sharply controlled. A small LCD display is used to provide the temperature and counter of pads. It also has an exhaust layout that contains a particulate filter that can filter up to 1-micron size particle and a MM diesel walker catalytic converter to tackle the Central Pollution Control Board (CPCB) norms for incinerators that are implemented and a provision has been made by using naphthalene balls for eliminating the bad odour released during burning. The total power consumption of the machine will be 550 Watt and the time for a burning cycle is 25 minutes for 5 pads, and the cost of burning 5 pads per cycle is Rs.2. The machine can carry out a total of 10 cycles per day. The cumulative weight of the machine is 8 kg.

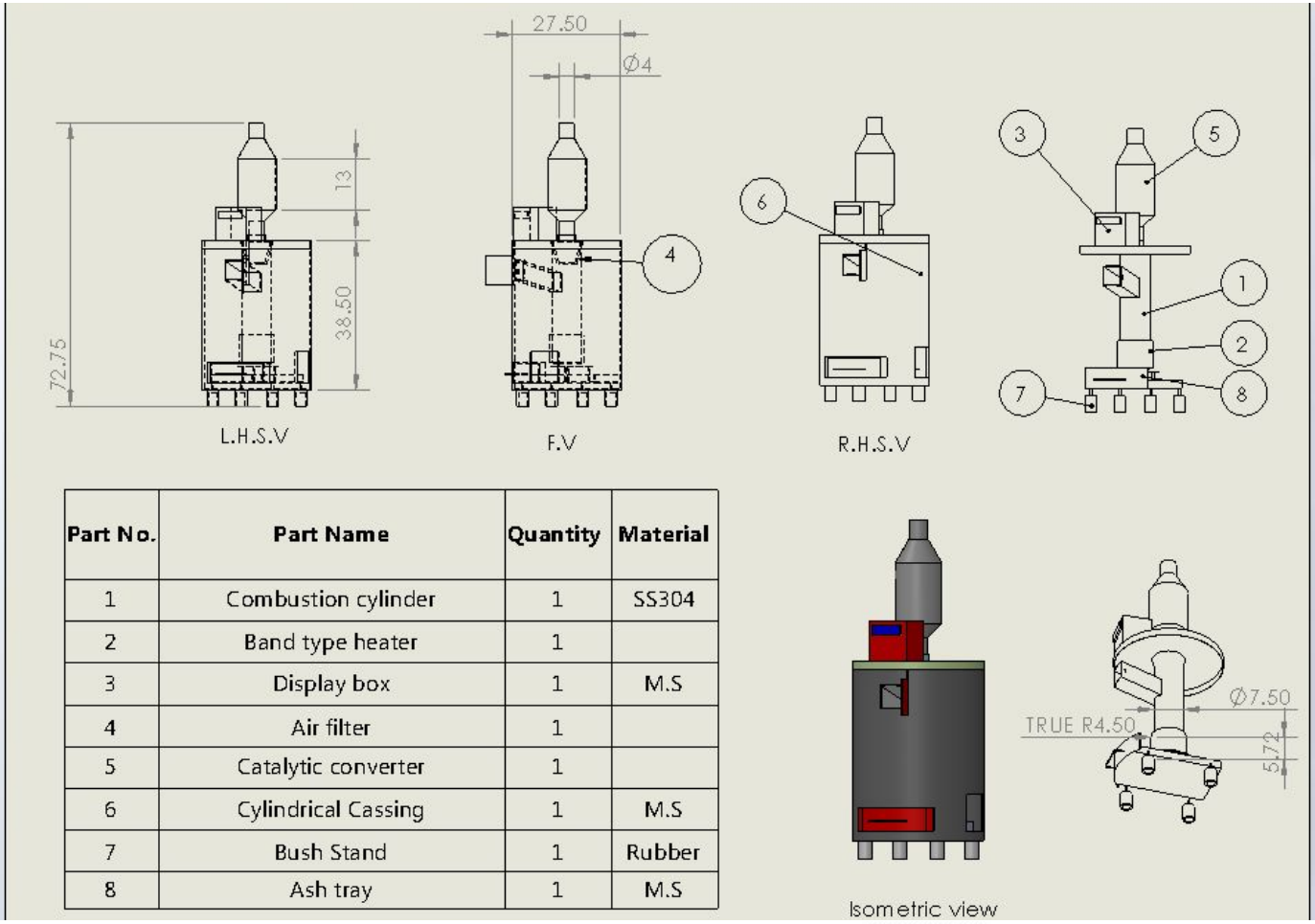
2D-Design of machine



3D Assembly of machine



Solid works design

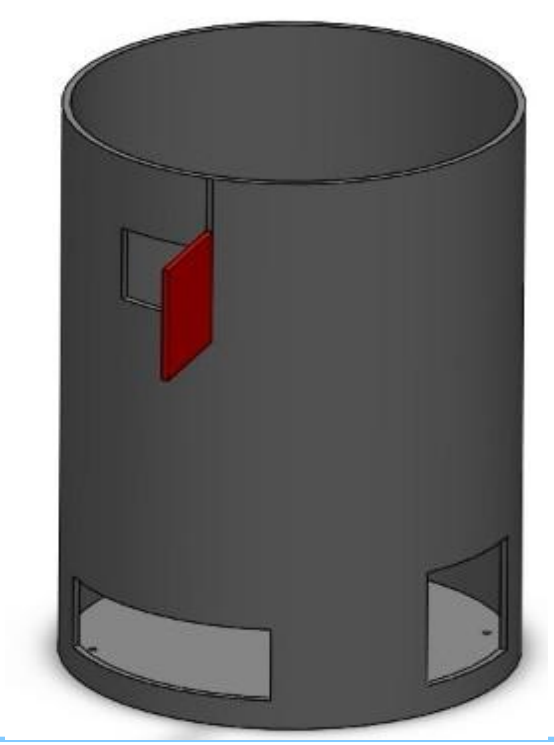


Part No.	Part Name	Quantity	Material
1	Combustion cylinder	1	SS304
2	Band type heater	1	
3	Display box	1	M.S
4	Air filter	1	
5	Catalytic converter	1	
6	Cylindrical Cassing	1	M.S
7	Bush Stand	1	Rubber
8	Ash tray	1	M.S

Outer cylinder

Outer Cylinder	Length 37 cm Dia 27.5 cm Gauge 1mm Material M.S

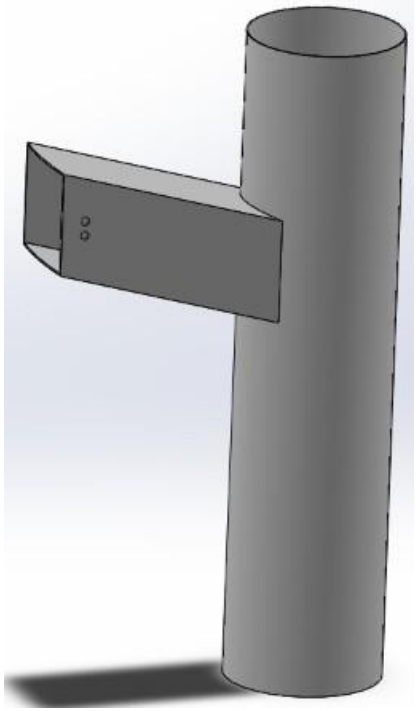
Door Dimensions
10 x 7.5 cm



Hopper and burning chamber

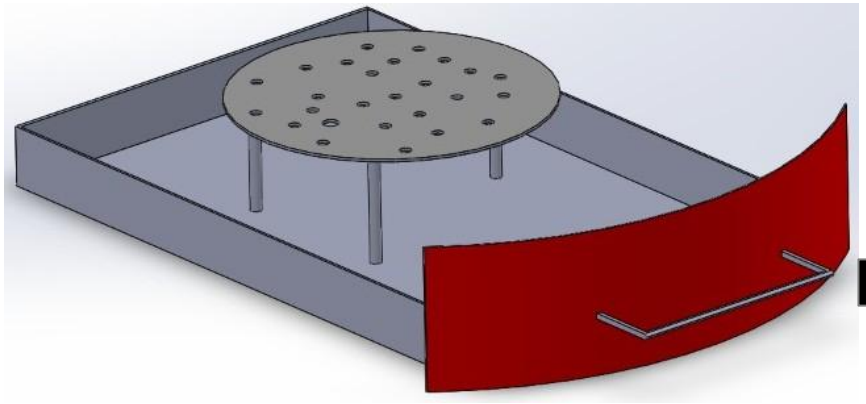
Inner cylinder	Length 29 cm Dia 8 cm Material SS304 Gauge 2 MM
Hopper	Length 11.5 cm 5×5 cm square pipe

Hopper and burning chamber are made of SS304.
SS304 has good corrosion resistance and is moderately expensive and easily available with variation in size and gauge.



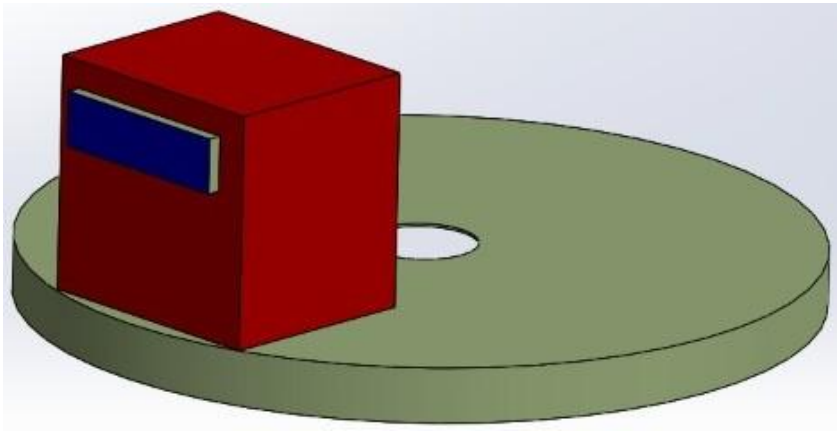
Ash tray

Ashtray	15× 25 cm Material M.S With 11 cm (Dia) net



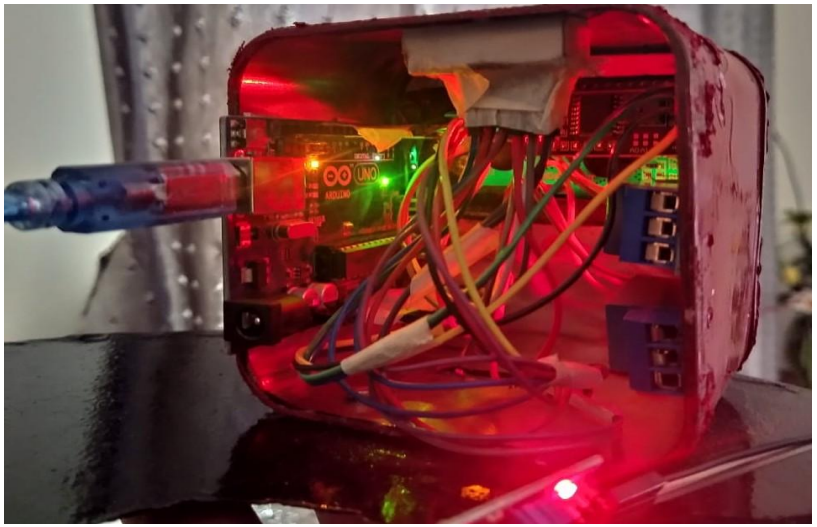
Electronic box Mounted On Circular Lid

Electronic box	9x9cm Material M.s
Circular Lid	Length 2 cm Dia 37.2 cm Material M.S



Electronic box with LCD Display and components

LCD display displays information on the temperature of burning chamber and the count of pads inserted from the hopper.

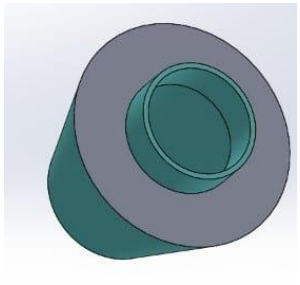


Catalytic converter with Particulate Filter

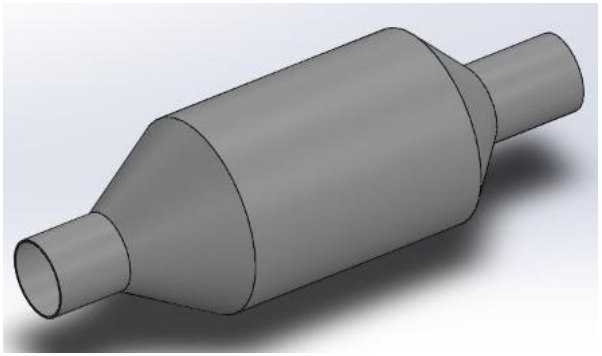
Catalytic converter	Length 28 cm Dia 10 cm
Airfilter	Length 8.5 cm Upper dia 8 cm Lower dia 5 cm

K&N particulate Filter:
Traps particulate upto 1um.
Can be easily cleaned and reused.

Diesel oxidation Catalytic Converter:-
-catalysis of NO2,CO and hydrocarbons takes place.
-MM diesel catalytic converter manufactured by Walker.
-Pt:Pd:Rh=1:0:0.15gm/cu.ft



Particulate Filter



Band Type Heater With Thermocouple and insulation

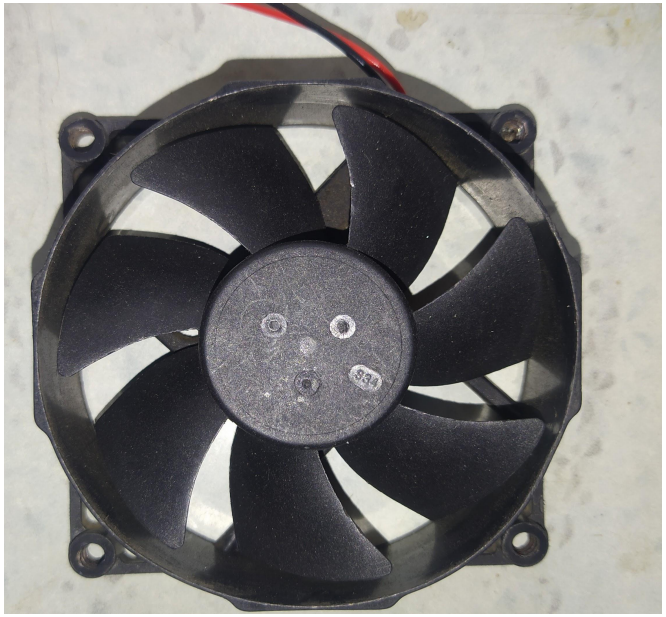
Ceramic Band type heater:-
-500W power rating.
-lower operation cost.
-Maximum temperature 450+ degrees.
-Less heat escapes to the air.

K-type Thermocouple:-
-Temperature measurement upto 800^{o} C.
-Specially used for high temperature applications.

Ceramic fiber insulation:-
-High temperature stability.
-Low thermal conductivity.
-Light weight insulation.
-Corrosion resistance.

Fan

Fan	8 x 8 cm width 3 cm



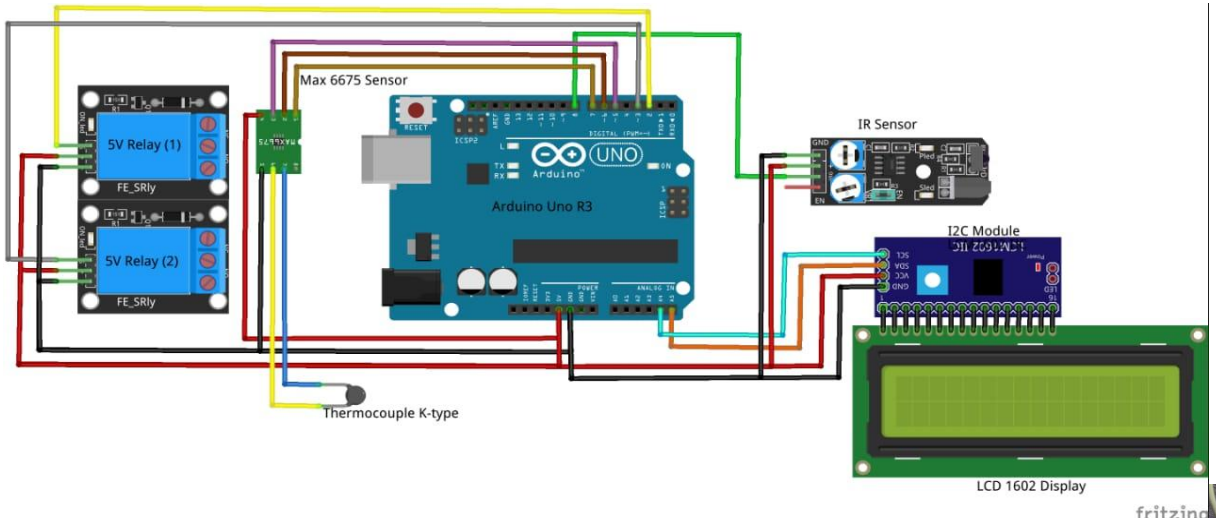
12V DC Fan:-
It is used to supply oxygen rich air for better combustion.

Napthalene balls

Napthalene balls are used for eliminating bad odour released during burning.
4 napthalene balls are consumed during one cycle of burning.

Napthalene balls will be inserted in the particulate filter cavity

Circuit diagram



Interfacing of Different sensors and their functions:-

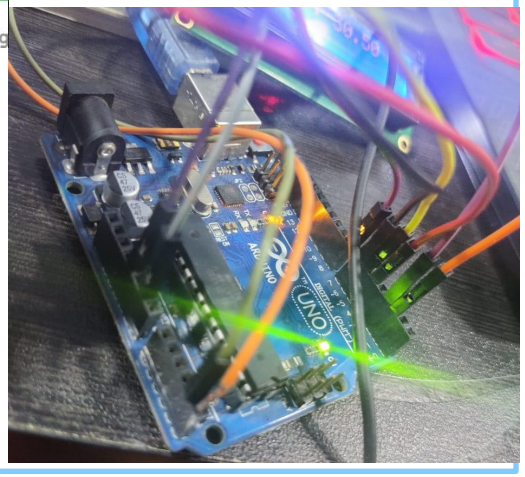
-IR sensor for getting the count of pads.

-Max 6675 sensor for temperature.

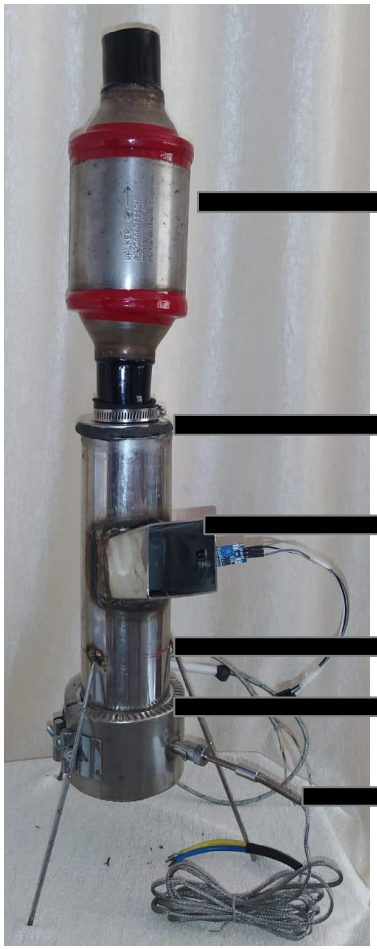
-Two 5V Relays for controlling the Band type heater and 12V fan.

-Lcd 1602 I2C display for displaying information.

-Arduino Uno R3 is used as a microcontroller.



Mini incinerator - Assembly



Catalytic convertor

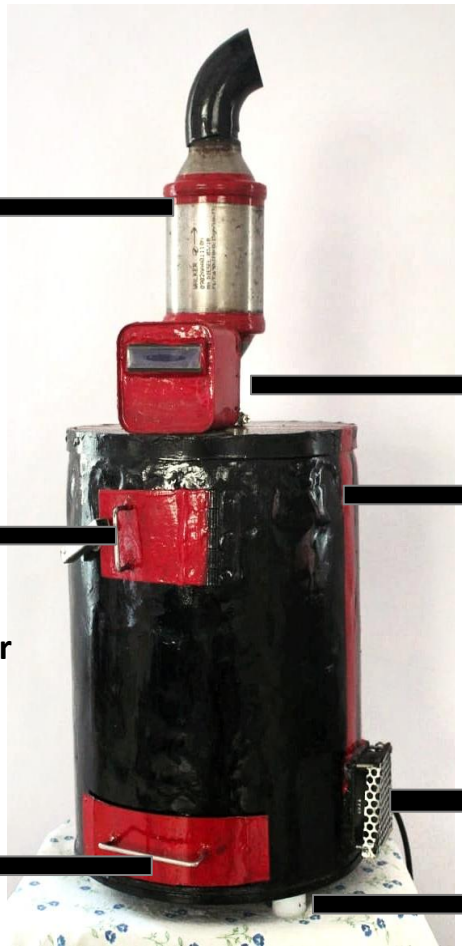
Particulate Filter

Hopper

Combustion cylinder

Band Type Heater

Thermocouple



Display unit

Cylindrical casing

Vent for Air inlet fan

Ash tray

Bush stand

Working of Machine

- There are three stages involved in process
- First stage:Counter of particular amount of pads in hopper using IR sensor.
- Second stage:heating of burning chamber when a certain amount of pads are collected ,circulation of Air using 12V small blower controlled by 2 separate relays.
- Third stage:Maintaining of Temperature using Thermocouple sensor controlled by Arduino.
- Blower will be provided for better burning.
- Auto cut off of power when temperature is reached maximum(400+degrees).
- Temperature and count of pads are displayed using a lcd attached to electronic components box.

New Manufactured Machine

Smart Mini Incinerator

Smart Mini Incinerator Machine Specifications:

-550 W
-Capacity = 5pads/cycle
-25 minutes/cycle.
-73 cms (height) × 27 cms (dia)
-8 kg weight.

Machine Specification

Smart Mini incinerator

1. Power required by smart incinerator is 550 W.
2. The machine capacity per cycle is 5 sanitary pads.
3. It takes 25 minutes to complete a cycle.
4. Dimensions of our machine are 73 cms (height) × 27 cms (dia) .
5. Weight of our machine is 8 kg.
6. SS304 material is used for burning chamber
7. Filters particle upto 1um.
8. Voltage required by Aurdino is 5V

Machine Features

1-A filter is used to reduce the number of suspended particles into the air from exhaust.

2-Pollution control with a catalytic converter attachment.

3-Heater and fan has auto on/off on reaching the feature requirements.

4-If 2 hours has elapsed and counter has not reached 5 counts then auto start Machine.

5- A small LCD display is used to provide the temperature and counter of pads.

6-Air is circulated for better complete combustion process.

7-Provision has been made to overcome bad odour.

8-Maintenance and cleaning can be done easily by using removable mesh.

Workshop photos

Bill Of Material

- **Electrical Structure**

Sr.no	Component	Quantity	Cost
1	Arduino UNO R3	1	350
2	LCD 1602	1	90
3	I2C Controller for display	1	100
4	IR sensor	1	90
5	5V relay	2	100
6	Thermocouple with sensor	1	400
7	5V AC-DC adapter	1	150
8	12V AC-DC adapter	1	150
Total			1430

Bill Of Material

- **Mechanical Structure**

Sr.no	Component	Quantity	Material	Cost
1	Cylinder	1	SS 304	150
2	Heater	1	Band Type	500
3	Hopper	1	MS	50
4	Insulation	1	Ceramic Fibre	700
5	Cylinder (Casing)	1	MS	100
6	Exhaust Pipe coupling	1	MS	20
7	Electronic Box	1	MS	50
8	Sheet Metal(0.5mm)	1	MS	300
Total				3570

Machine Cost

Sr.no	Component	Quantity	Cost
1	Electronic Structure	1	1430
2	Mechanical Structure	1	1870
3	Walker catalytic converter	1	1700
Total Cost To Manufacture			5000

Results

	No of pads	Energy Consumed (in W)	Time required (min)	Expense for burning pad (Rs)	Temperature (C)
Dry test	5	481.5	17.33	0.8	347
Wet test	5	550	25	2	350

	HC(PPM)	CO2 (%)	O2 (%)	CO (%)	NO (PPM)
Dry test	9	0.04	19.44286	0.020286	0.571429
Wet test	14.7778	0.555833	20.02222	0.043778	0.3333
Avg. Values	11.889	0.2979	19.7325	0.032032	0.45236
Permissible Values	24	0.75	22	0.1	195

Results and Conclusions

1. Heat loss is prevented by thermal insulation.
2. An air filter for dust particles and catalytic converter for pollution control.
3. It is a smart device which senses the input and controls the Machine.
4. Heater and fan has auto ON-OFF on reaching the system requirement .
5. After 2 hours of stand by the machine starts automatically irrespective of no. of pads, provided of number of pads >1 .
6. Provision to eliminate bad odour released during burning.
7. Maintenance and cleaning can be done easily by using removable mesh.
8. When pad count of 5 is reached, machine starts automatically.
9. Better combustion process, by providing air circulation through fan.
10. Display unit is used to provide the temperature and pads count.
11. Maximum temperature reached during testing was 350 degree Celsius.

Present status

1. incinerator is designed and an entirely new machine has been fabricated and tested.
2.Smart mini incinerator is all ready to be used for application at home , hospitals, colleges , offices .

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