

## Urban Waste-To-Energy by Pyrolysis Process

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### **ABSTRACT**

*Energy scenario is changing dramatically and rapidly in favour of biomass technologies. Day-by-day new biomass fuels are being introduced in the list of energy resources. Organic matter derived from biological organisms (plants, algae, animals etc.) are called biomass. The energy obtained from biomass is called Biomass Energy. Biomass is being used for production of process heat and electricity, producing gaseous and solids fuels, liquid chemicals etc.*

*The waste-to-energy processes convert organic wastes to intermediate or secondary energy forms such as heat, biogas, alcohol, fuels, chemicals, etc. The waste is classified as:*

- Urban (Municipal) waste.
- Industrial organic waste, Process waste.
- Agricultural farm waste.
- Rural animal waste.
- Forest waste.
- Fishery, Poultry, Butcherry waste.
- Animal and human excreta.

**Key Words:** Organic waste; Dramatically; Butcherry waste

### **I. INTRODUCTION**

Biomass can be converted into fuel gases for use in chemical industry and for mixing with petrol (gasoline). Biomass can be practically gasified by pyrolysis to obtain charcoal and gas. Carbonisation (Pyrolysis) of wood gives wood gas and other by products such as tar, volatile acids, alcohol.

Pyrolysis is a process of heating the biomass in a closed vessel in the absence of oxygen at temperature of 500-900°C, to convert into solid, liquid and gaseous forms. The gases produced are a mixture of methane, nitrogen, carbon dioxide, carbon monoxide and other hydrocarbons. The liquids produced are oil-like materials and the solids are similar to charcoal.

Materials which are difficult to handle by other processes like rubber, plastics and all forms of organic matters are being processed by pyrolysis. To recover acetic acid, methanol, charcoal and turpentine, the pyrolytic destructive distillation wood are been used from past decades.



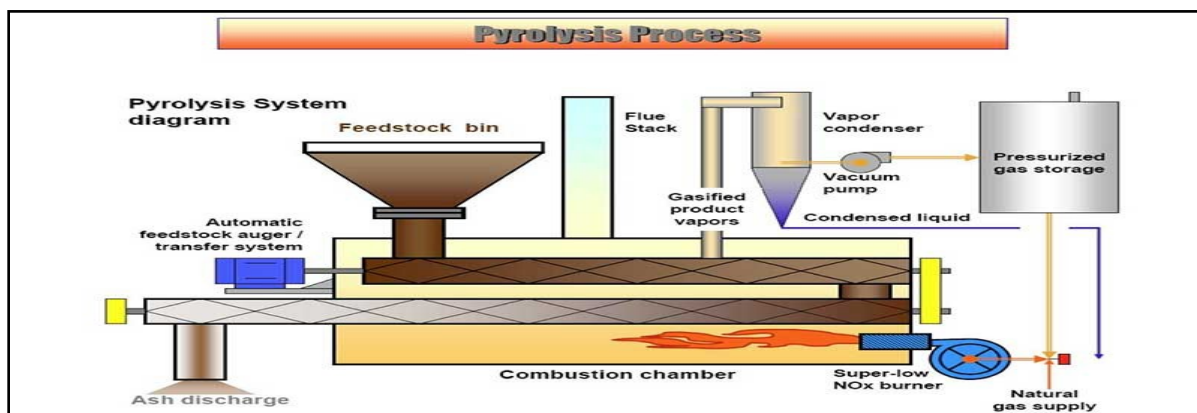
**FIGURE:1**

## II. ENERGY CONVERSION PROCESS

PROCESS	INPUT FEEDSTOCK	CONVERSION TEMPERATURE	CONVERSION PRESSURE	CHARACTERISTICS OF PROCESS	PRODUCT FORM	PROCESS YIELD (% OF ORIGINAL MASS)
Pyrolysis	Dried Feedstock	500°C to 1300°C	Atmospheric	All of the gas and 1/3 of the char produced is used to supply heat in typical process. Oxygen-free environment used.	-Oil -Char -Gas	40% 20%

## III. PYROLYSIS OF URBAN WASTE TO OBTAIN METHANE

Pyrolysis is an elderly process used commonly for making charcoal from wood. This process can be used for obtaining methane gas (CH<sub>4</sub>) and other hydrocarbon gases and oil from wood and urban waste. Solid urban waste is carefully prepared by receiving, storing, shredding, passing through air classifier, drier, magnetic separators etc. and the combustible matter is separated from non-combustible metals, glass, etc.



**FIGURE:2**

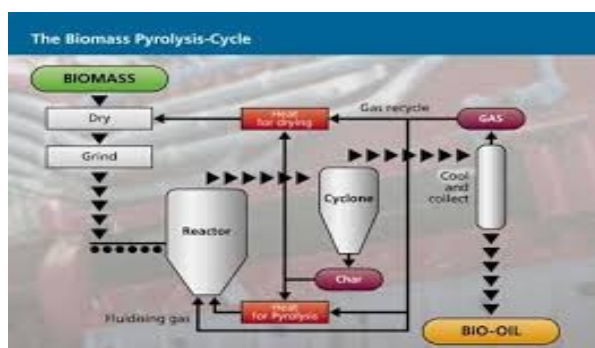
The waste biomass is heated in the pyrolysis process to about 500-600°C to obtain methane (CH<sub>4</sub>), and the gas obtained has various other constituents like CO, CO<sub>2</sub>, H<sub>2</sub>O etc depending upon the composition of fuel and the temperature of pyrolysis. The main problems in pyrolysis process are:

- Careless dumping of volatile matter and metal sparks during processing leads to explosion in the pyrolytic reactor.
- The urban waste has a wide mixture of constituents, high moisture content.
- The gas has low heat value compared with natural gas.
- Several constituents are present in gas, among which some are toxic and corrosive.

#### IV. PYROLYSIS PROCESS FOR WASTE DRY BIOMASS

Many different processes have been developed but the choice of process depends upon the following:

- Rating of plant and purpose.
- Available technology.
- Capital cost allocated.
- In feed biomass.
- Requirements of end products.



**FIGURE:3**

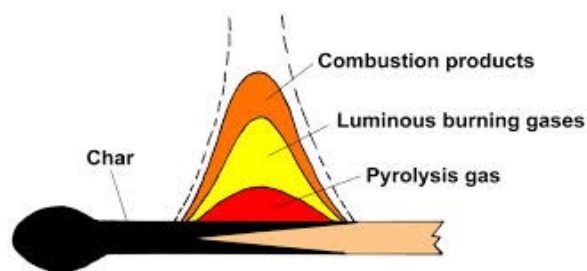
The above figure illustrates a schematic of a typical process.

Firstly the waste dry biomass is received and stored. The Shredder cuts the dry infeed to small pieces of app. 2.5 cm dia. The Air classifier moves the lighter dry shredded biomass pieces with its flow and separates the heavy non-combustible metal pieces/glass pieces from the fuel. The fuel is dried in the drier and the dried fuel is fed into the Pyrolytic Reactor.

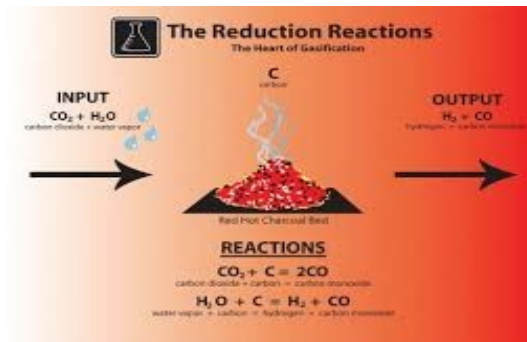
The pyrolytic reactor converts the dry infeed to char and fuel gas. The Cyclone separates the char from the fuel gas plus organic oil. The wet scrubber separates the organic oil, fuel gas, and sludge. The gas purifier filters the gas and delivers it to gas outlet pipe.

#### V. PYROLYSIS OF WOOD (WOOD GASIFICATION)

Presently the largest use of wood and wood-waste is by paper, pulp and lumber industry. These industries burn wood to obtain process heat. In some industrial units, wood and wood waste is burnt producing heat and electricity in cogeneration plant. Basically fresh natural wood are having the moisture content between 30 to 50%, which can be reduces to about 20% by natural drying and the average heat value of dry wood is between 19MJ/kg to 21 MJ/kg.



**FIGURE:4**



**FIGURE:5**

In the pyrolysis of wood, the main infeed is dry wood. In addition dry agricultural biomass may also be used. The pyrolysis of wood gives mainly the subsequent:

- 1) Charcoal
- 2) Charcoal, Methane gas and Organic oils.

Charcoal production is carried out by pyrolysis of wood at high temperature (1000 to 1200°C) in absence of air. Charcoal is used as a solid fuel having a heat value of 25 to 32 MJ/kg. Charcoal

is also used in metallurgical processes as a absorber of gases and vapours, production of carbon, decolorising agent etc.

For obtaining charcoal plus methane gas from wood, the heat is supplied by auxiliary fuel source and the gas released from the pyrolysis collected into a separate gas collector.

### VI. DRAWBACKS OF PYROLYSIS PROCESS

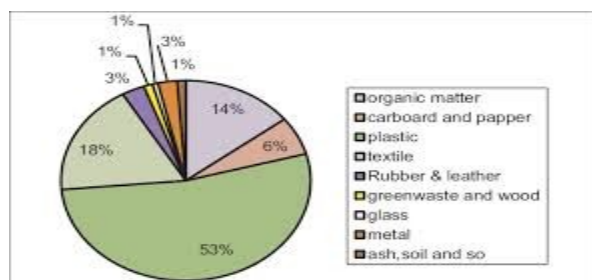
- Corrosion gases released by the process.
- Lesser efficiency due to thermal losses.
- Danger to explosion.
- Low heat value of the gas.

Due to the above difficulties, for urban waste-to-energy conversion the pyrolysis process has not proved to be successful.

### VII. CONCLUSION

Pyrolysis process offers an attractive option for disposal of urban solid waste, as in this process the toxic materials get encapsulated in vitreous mass which is relatively much safer to handle than incinerator. This process helps to control the atmospheric pollution at plant level, moreover NO and SO gas emissions do not occur in normal operations due to the lack of oxygen in the system.

These processes have an edge over incineration, as proper destruction of waste is ensured, besides net energy recovery.



**FIGURE:6**

### Physical Characteristics of Municipal Solid Waste in Indian Cities

POPULATION RANG E (IN MILLION)	N O. O F C I T I E S	P A P E R	RUBB ER, L EAT HER & SYNT HETI CS	G L A S S	M E T A L S	TOT AL CO MPO STA BLE MAT TER	IN ER T MA TE RI AL
0.1 to 0.5	12	2.91	0.78	0.56	0.33	44.57	43.59
0.5 to 1.0	15	2.95	0.73	0.56	0.32	40.04	48.38
1.0 to 2.0	09	4.71	0.71	0.46	0.49	38.95	44.73
2.0 to 5.0	03	3.18	0.48	0.48	0.59	56.67	40.07
5.0 & above	04	6.43	0.28	0.94	0.80	30.84	53.90

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