

STANDARD OPERATING PROCEDURE FOR MAKING “PELLETS FROM PLASTIC WASTE”

*For Urban Local
Bodies Of Uttar
Pradesh*



Regional Centre for Urban & Environmental Studies

(Estd. By Ministry of Housing and Urban Affairs, Govt. of India)

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Embedded in the heart of India, a land where cultures have evolved and religions emerge. The greatness of Uttar Pradesh lies not only in this confluence, but also in the emergence of cultural and religious traditions along some of the greatest rivers in the Indian sub-continent – the Ganga and the Yamuna. Throughout history, great cities have emerged and established along great rivers. Within India, the Ganga and the Yamuna have nurtured a culture because of which religious faith, rituals, culture and intellectual enlightenment have evolved in places along the two rivers.

Uttar Pradesh is the 4th largest state in terms of geographical area covering 9.0 per cent of the country's geographical area. It is also the most populous state in India consisting of 19.96 crore (199.6 million) inhabitants as per 2011 Census, out of which 15.51 crore live in rural areas and 4.45 crore in urban areas. There has been a net addition of about 1.09 crore persons in the urban areas during 2001-2011. Thus, about 16.50% of the total population and 11.80% of the urban population of India reside in Uttar Pradesh. Out of 4041 statutory towns of India 648 (i.e. 16%) exist in Uttar Pradesh. Percentage of urban population to total population of the State stands at 22.28 as per 2011 Census whereas; this percentage was 20.78 in 2001. Thus, an increase of 1.50 percentage points has been recorded in the urban population during 2001-2011. However, the level of urbanization (22.28%) in the State is quite low as compared to all India figures of 31.16%. The decadal growth of urban population during 2001-2011 has been 28.82 per cent as against 31.80 per cent during 1991-2001. Administratively Uttar Pradesh is divided into 75 districts under 18 divisions which are They are Agra, Aligarh, Azamgarh, Allahabad, Kanpur, Gorakhpur, Chitrakoot Dham, Jhansi, Devi Patan, Faizabad, Bareilly, Basti, Vindhyachal (Mirzapur), Moradabad, Meerut, Lucknow, Varanasi and Saharanpur. Together comprised of 14 Nagar Nigams(NN), 202Nagar PalikaParishads(NPPs) and 438 Nagar Panchayats(NPs).

The major sector of Uttar Pradesh economy is agriculture. Wheat, pulses, oilseeds, rice, sugarcane, and potatoes are the main crops grown here. Sugarcane is an important cash crop grown here. Tourism, computer hardware and software, information technology products and handicraft are other major contributors to the state's economy.

Introduction to Solid Waste Management

Solid waste management is the collecting, treating, and disposing of solid material that is discarded. It also offers solutions for recycling items that do not belong to garbage or trash. With this increasing population, solid waste management in the country has emerged as a challenge not only because of the environmental and aesthetic concerns, but also because of the huge quantities of waste generated every day.

Waste management is all about how solid waste can be changed and used as a valuable resource i.e. waste to wealth. It is the process of treating solid wastes and offers variety of solutions for recycling items that don't belong to trash. It is about how garbage can be used as a valuable resource. Solid waste management should be embraced by each and every household including the business owners across the world. One of the negative effects of industrialization is the creation of solid waste.

According to Britannica, “Solid-waste management, the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. Improper disposal of municipal solid waste can create unsanitary conditions, and these

conditions in turn can lead to pollution of the environment and to outbreaks of vector-borne disease—that is, diseases spread by rodents and insects.”

Solid waste management is one among the basic essential services provided by municipal authorities in the country to keep urban centres clean. It is one of the important obligatory functions of the urban local bodies in India. However, it is among the most poorly rendered services in the basket—the systems applied are unscientific, out-dated and inefficient; population coverage is low; and the poor are marginalized. Waste is littered all over leading to insanitary living conditions. Municipal laws governing the urban local bodies do not have adequate provisions to deal effectively with the ever-growing problem of solid waste management. With rapid urbanization, the situation is becoming critical.

Accumulation of solid waste in open areas is an eyesore, diminishing real estate and property value, a breeding ground for insects and other vectors (rats and mice, wild and domesticated animals, as well as humans who may come in contact with contaminated wastes). It also causes odor nuisance, reflects the unorganized nature of the community and creates a poor environment for growing children. Improper and unorganized disposal of Municipal Solid Waste (MSW) in open areas and landfills have a negative impact on the living conditions of human beings as well as the overall environment. It results in spread of communicable and Non-communicable diseases among human beings and animals, thus affecting the welfare, livelihood and economic productivity. In addition, it causes contamination of soil, surface water, ground water and generation of toxic and greenhouse gases. However, using adequate information, resources and efficient management practices, one can turn solid waste into a useful resource.

The Environment Ministry Solid Waste Management Rules 2000 have been revised after 16 years. The Rules are now applicable beyond municipal areas and will extend to urban agglomerations, census towns, notified industrial townships, areas under the control of Indian Railways, airports, airbase, port and harbour, defence establishments, special economic zones, State and Central government organizations, places of pilgrims, religious & historical importance.

The responsibility of generators has been introduced to segregate waste into three categories – Wet, Dry and Hazardous Waste. Now the generator will have to pay ‘User Fee’ to the waste collector and a ‘Spot Fine’ for littering and non-segregation, the quantum of which will be decided by the local bodies. The government is keen on the integration of ragpickers from the informal sector to the formal sector.

Now waste processing facilities will have to be set up by all local bodies having 1 million or more population within two years. In case of census towns below 1 million population, setting up common, or stand-alone sanitary landfills by, or for all local bodies having 0.5 million or more population and for setting up common, or regional sanitary landfills by all local bodies and census towns under 0.5 million population will have to be completed in three years.

The Government has also constituted a Central Monitoring Committee under the chairmanship of Secretary, Ministry of Environment, Forest and Climate Change to monitor the overall implementation of the Rules. The Committee comprises the Ministry of Urban Development, Ministry of Rural Development, Ministry of Chemicals and Fertilizers, Ministry of Agriculture, Central Pollution Control Board, three State Pollution Control Boards /Pollution Control Committees, Urban Development Departments of three State Governments, rural development departments from two State Governments, three urban local bodies, two census towns, Federation of Indian Chambers of Commerce & Industry (FICCI), Confederation of Indian Industry (CII) and two subject experts. The Committee will meet once a year to monitor the implementation of these Rules.

The rapid rate of urbanization and development has led to increase in consumption of plastic products vis-à-vis plastic waste generation. It is a fact that plastics waste constitutes a significant portion of the total municipal solid waste (MSW) generated in India. Plastics are non-biodegradable and remain on earth for thousands of years. The burning of plastics waste

under uncontrolled conditions lead to generation of different hazardous air pollutants (HAPs), depending upon the type of polymers and additives used. However, the end-of-life plastics can be recycled into a second life application but after every thermal treatment/recycling deterioration in quality of recycled plastic products. Thus plastic waste can be recycled only 3-4 times. The visibility of huge quantity of plastic waste has been perceived as a serious problem and made plastics a target in the management of solid waste.

Recycling of Plastic Waste

Recycling and re-utilization of waste plastics have several advantages. It leads to a reduction of the use of virgin materials and of the use of energy, thus also a reduction of carbon dioxide emissions.

Benefits of Recycling:

- Reduces Environmental Pollution
- Energy savings : 40 - 100 MJ/kg (depends on the polymer)
- Economic Benefits • Reduces demand for virgin polymer
- Preferred to Land Filling
- Generates Employment
- Reduces depletion of Fossil fuel reserves

Difficulties in Recycling:

- Hard to separate from non-plastics (no 'magnet' equivalent)
- Differing composition of plastic resins means they are largely incompatible
- Degradation of polymer chains on recycling
- Recycled polymer is of lower quality than virgin polymer
- Most waste plastics films specially thin plastics films have limited market value, therefore effort is not spent in collecting them
- Identification of reuse and recycling opportunities
- Markets for Plastics; Lack of Infrastructure
- Low value of recovered Plastics
- Subsidies for recycling program

As per the provisions of the “Solid Waste Management Rules, 2016” every ULB is made responsible through point no. 15 (h) , which reads as:

15. Duties and responsibilities of local authorities and village Panchayats of census towns and urban agglomerations.- The local authorities and Panchayats shall,-

(h) setup material recovery facilities or secondary storage facilities with sufficient space for sorting of recyclable materials to enable informal or authorised waste pickers and waste collectors to separate recyclables from the waste and provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, textile from the source of generation or from material recovery facilities; Bins for storage of bio-degradable wastes shall be painted green, those for storage of recyclable

wastes shall be printed white and those for storage of other wastes shall be printed black;

Where as Role and Responsibilities of Urban Local Bodies as per “Plastic Waste Management Rules 2016” states as under:

Rule 5: Plastic waste management-

(1) The plastic waste management by the urban local bodies in their respective jurisdiction shall be as under:

(a) plastic waste, which can be recycled, shall be channelized to registered plastic waste recycler and recycling of plastic shall conform to the Indian Standard: IS 14534:1998 titled as Guidelines for Recycling of Plastics, as amended from time to time.

(b) local bodies shall encourage the use of plastic waste (preferably the plastic waste which cannot be further recycled) for road construction as per Indian Road Congress guidelines or energy recovery or waste to oil etc. The standards and pollution control norms specified by the prescribed authority for these technologies shall be complied with.

(c) Thermo set plastic waste shall be processed and disposed off as per the guidelines issued from time to time by the Central Pollution Control Board.

(d) The inert from recycling or processing facilities of plastic waste shall be disposed of in compliance with the Solid Waste Management Rules, 2000 or as amended from time to time

Rule 6: Responsibility of Local Body-

(1) Every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers.

(2) The local body shall be responsible for setting up, operationalisation and co-ordination of the waste management system and for performing the associated functions, namely:-

(a) Ensuring segregation, collection, storage, transportation, processing and disposal of plastic waste;

(b) ensuring that no damage is caused to the environment during this process;

(c) ensuring channelization of recyclable plastic waste fraction to recyclers;

(d) ensuring processing and disposal on non-recyclable fraction of plastic waste in

accordance with the guidelines issued by the Central Pollution Control Board;

(e) creating awareness among all stakeholders about their responsibilities;

(f) engaging civil societies or groups working with waste pickers; and

(g) ensuring that open burning of plastic waste does not take place.

(3) The local body for setting up of system for plastic waste management shall seek assistance of producers and such system shall be set up within one year from the date of final publication of these rules in the Official Gazette of India.

(4) The local body to frame bye-laws incorporating the provisions of these rules.

The Uttar Pradesh Policy on Solid Waste Management also states the following:

Roles & Responsibilities of Urban Local Bodies as given at point III:-

➤ **Secondary Collection:**

2. Setup material recovery facilities or secondary storage facilities in wards with sufficient space for sorting of recyclable materials to enable informal or authorised waste pickers and waste collectors to separate recyclables from the waste. Provide easy access to waste pickers and recyclers for collection of segregated recyclable waste such as paper, plastic, metal, glass, and textile from the source of generation or from material recovery facilities.

➤ **By Laws to be made and strengthening of the organisational structure:**

6. Register and issue photo I-cards to all rag pickers.

➤ **Primary Collection:**

12. All Resident Welfare and market associations, gated communities and institution with an area >5,000 sq. mt. should segregate waste at source in to valuable dry waste like plastic, tin, glass, paper, etc. and handover recyclable material to either the authorized waste pickers or the authorized recyclers, or to the urban local body. The bio-degradable waste should be processed, treated and disposed of through composting or biomethanation within the premises as far as possible. The residual waste shall be given to the waste collectors or agency as directed by the local authority.

Keeping in view the above provisions in mind the Urban Local Bodies have to take the following steps immediately:

1. By Laws to be made and strengthening of the organisational structure:

- ULB should prepare a byelaw to prohibit littering and burning of waste with penalty.
- ULB should prepare a byelaw for collection and segregation of waste, specifying user charges.
- The ULBs can also engage private operators for waste collection and processing, where the operator can negotiate the user charges with the household owners or establishments.
- Constitute Ward Swachhata Protsahan Committee in all Nagar Nigam and Nagar Palika Parishad.
- Prepare a solid waste management plan as per State policy within six months from the date of notification of State policy and submit a copy to the State Government.
- Register and issue photo I-cards to all rag pickers.

2. Establishing of MRF Centres as per Requirement:

A materials recovery facility is a specialized plant that receives, separates and prepares recyclable materials for marketing (**Processing of Recyclable**

Waste) ULB's to construct a MRF Centre which is a secondary segregation place. Its main Components are:

- No fixed shape and design
 - Shade with walls and Gate
 - Waste sorting platforms
 - Washing area
 - Drying area
 - Storage area
 - Light , fan and Exhaust
 - Toilets
 - Tap Water with storage and boring
- On arrival of material it has to be sanitized.

3. Integration of Rag-pickers:

{ Informal waste collector - includes individuals, associations or waste traders who are involved in sorting, sale and purchase of recyclable materials. }

For the integration of rag-pickers from the informal sector to the formal sector, the Urban Local Bodies must take the following steps:

- Should conduct a quick survey to identify the Rag-pickers.
- Register them and give them a Photo ID card.
- Try to know the total monthly income of each Rag-picker.
- Now give them Safety equipment like : Boots, Gloves, Masks, Proper picking sticks and soap.
- Identify the main Kabari wala of your town and fix the rates for all the material which is collected by Rag-pickers.
- Every evening collect segregated waste after taking weight from Rag-pickers, and make a note of it in a register.
- Every week sell the collected waste to Kabari walla on agreed rates, except plastic waste.
- Now pay the Rag-pickers as per the weight of waste collected and sold to kabari walla at the rates received. For plastic waste ULB to pay as per rate of Kabari walla.

In this way the rag-pickers will get more money, as middle men would be eliminated. And they would also get safe and better environment to work. The ULB would benefit, as less amount of waste would be required to handle.

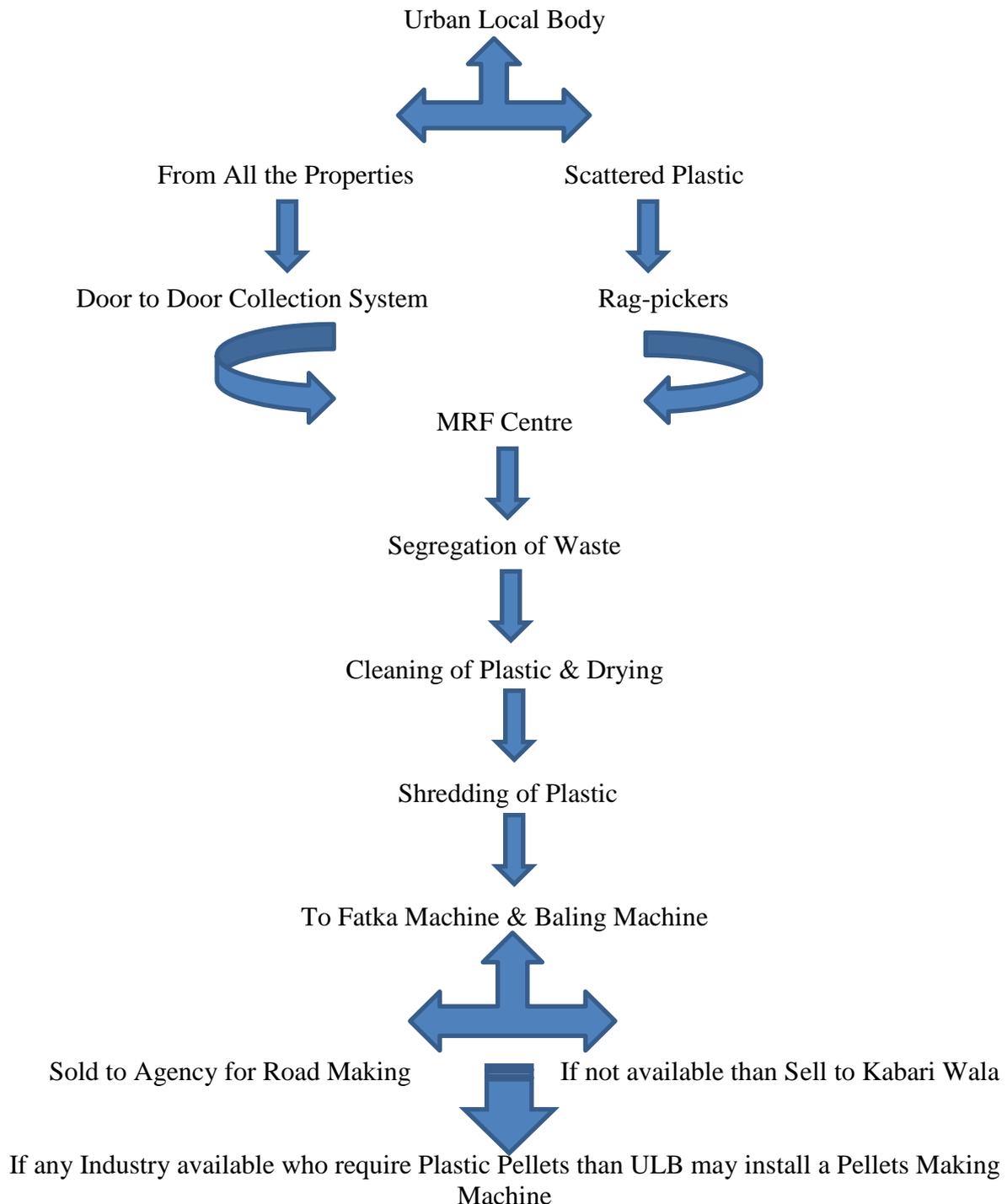
4. Suggestive time table to make the system functional.

- **Door to Door Collection of Waste**
 1. **At fixed time every day. Say 7a.m to 11am.**
 2. **Take the collected waste to MRF centre. 11am -12 noon.**
- **MRF Centre**
 1. **Further segregation of waste by the collector and Rag pickers collected by them respectively. 1pm to 3pm**
 2. **Washing of dirty plastic. 3pm to 3.30pm.**
 3. **Other team to take over the process – to shredder and then To Fatka Machine & Baling Machine.**
 4. **Further if required to Pellets Making Machine.**

5. Establishing of Pallet making Unit by the ULB:

The ULB is required to collect all the Plastic waste collected at the MRF Centres and by Rag-pickers, and process it in the unit to make Pallets so that it could be sold to the PWD Deptt or the Road Construction Contractors in Road Making. The rate should be arrived after taking into account the following costs.

- Cost which ULB would have got if it had sold the plastic waste.
- Cost to ULB in Pallet making; Humane Resource Cost, Running of Plant Cost (Electricity etc), Capital cost which should be recoverable in five years.



What is Plastic Pellets Making Machine:

The plastic pellets making machine is a device that used to recycle and process waste plastics and make recycled plastic pellets. It is suitable for recycling common waste plastic products such as polyethylene (plastic film, beverage bottles, plastic bags, etc.) or polypropylene (waste woven bags, packing bags, tied ropes, etc.). Recycled plastic pellets can be produced through major steps such as extrusion, cooling, and pelletizing. The processed plastic pellets have a wide range of uses and can produce higher benefits.

Process:

1. Clean the materials – Through Fatka Machine

Since the raw material comes from discarded plastic products, it is inevitable that there will be residual pollutants, so the raw material needs to be cleaned before making recycled plastic pellets.



2. Crushing raw materials – Shredding Machine

Clean plastic raw materials need to be crushed by crusher to meet the processing standard of plastic pellets making machine.



3. Plastic pellet mill granulation – Pellet Machine

The waste plastic is crushed by a crusher and sent to the feeder by an automatic hoist and then feeder feeds the material into the plastic pellets making machine. After entering the plastic pellet mill, the material is mixed and re-plasticized under the action of compression and external heating of the screw. With the increasing of temperature and pressure, it presents a viscous flow state and is pushed to the head part by certain pressure. Finally, the plasticizer is cut into pellets by a cutter.



4. Plastic pellets cooling and packaging

As the temperature of the formed recycled plastic pellets by the plastic pellets making machine is still very high, it needs to be cooled through the cooling system. After cooling to normal temperature, it can be packaged with the packaging machine.



Plastic to Road Construction

The implementation of plastics in roads opens a new option for recycling post-consumer plastics. Plastic roads are made entirely of plastic or of composites of plastic with other materials.

The types of plastic that can be used for construction of roads are Polystyrene (PS) (Hard packaging, cartons, plates, vending cups etc.); Polypropylene (PP) (ketchup bottles, yogurt cups etc.); Polyethylene (PE) (both high and low density) (plastic bags, water bottle, shampoo bottle etc.). Please note that Poly Vinyl Chloride (PVC) sheets or Flux sheets should not be used.

Waste plastic is shredded into required size and mixed with hot stone (150 to 170 °C) with uniform mixing. When heated to around 150 to 170 °C, plastic melts and spreads over the stone aggregate in its molten state, giving a thin coating at the surface and acting as a binder. The points to note here are:

- Plastics cannot be melted separately to use for coating. On contact with the surface of the hot stone the plastic gel softens and coats over the aggregate. It is important to note that the size of the shredded plastic should be less than the surface area of the aggregate to get uniform coating, otherwise the binding will not be effective.

- The waste plastic when heated to temperature more than 250 °C may decompose producing gaseous products which results in air pollution, hence the temperature during heating shall be maintained between 150 to 170 °C. It is to be ensured that plastic is boiling and not burning.

Other Option for Big Urban Local Bodies-

The Urban Local Bodies who produce more than 10MT of Plastic Waste per day may go in for Plastic to Fuel projects. The type of technology /project should be decided, based on the type of plastic available. Some of the processes are discussed below:

- **Depolymerisation:** The low-temperature catalytic depolymerization line is used for processing of waste plastics. This device works on the principle of depolymerization (pyrolysis) of the polymer to hydrocarbon products, which are pyrolysis oil, pyrolysis gas, and a solid residue - carbon. The process De-polymerization is degradation of bonds to break down into monomers. This process is utilized for the degradation of plastic to lower hydrocarbons. Chemical Depolymerisation has successfully been employed to recover monomers from PET, polyamides such as nylons and polyurethanes. It has the ability to return a recovered resin to virgin resin-like quality, and the potential to recover a valuable feedstock from products that are economically challenging to recycle. The Depolymerization is carried out in a specially designed Reactor, in absence of oxygen and in the presence of certain catalytic additives. The maximum reaction temperature is 350°C. The entire feed material is converted into either of the products: Liquid RDF, gases and solids. The solids can be reused as fuel in cement industries while the gas is reused in the system as a fuel. The unused hot Air from the reactor is released through chimney.
- **Plastic to Fuel (Pyrolytic Conversion Technologies):** A new generation of conversion technology, specifically designed to manage non-recyclable plastics, has been developed, and commercial scale facilities that use pyrolysis technology to convert plastics into oil and fuel are being established in Europe and Asia. Pyrolysis is the thermal decomposition of materials at elevated temperatures in an inert atmosphere. The benefits presented by plastic to fuel (PTF) technologies are two-fold: (1) Transforming non-recyclable plastics into a valuable commodity (2) Creating a reliable source of alternative energy from an abundant, no/low cost feedstock.
- **Plasma Pyrolysis Technology (PPT):** Plasma Pyrolysis is a state of the art technology, which integrates the thermo-chemical properties of plasma with the pyrolysis process. The intense and versatile heat generation capabilities of Plasma Pyrolysis technology enable it to dispose of all types of plastic waste including polymeric, biomedical and hazardous waste in a safe and reliable manner. Pyrolysis is the thermal disintegration of carbonaceous material in oxygen-starved atmosphere. In Plasma Pyrolysis, firstly the plastics waste is fed into the primary chamber at 8500°C through a feeder. The waste material dissociates into carbon monoxide, hydrogen, methane, higher hydrocarbons etc. Induced draft fan drains the pyrolysis gases as well as plastics waste into the secondary chamber where these gases are combusted in the presence of excess air. The inflammable gases are ignited with high voltage spark. The secondary chamber temperature is maintained at 10500 °C. The hydrocarbon, CO and hydrogen are combusted into safe carbon dioxide and water. The process conditions are maintained such that it eliminates the possibility of formation of toxic dioxins and furans molecules (in case of chlorinated waste). The conversion of organic waste into non-toxic gases (CO₂, H₂O) is more than 99%. The extreme conditions of plasma kill stable bacteria such as bacillus stercorophilus and bacillus subtilis immediately.

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