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keywords

solid waste management,pellet stove pellets,calorific value of municipal solid waste,refuse derived fuel,electricity from waste,alternative energy sources,biomass renewable energy

Abstract

Cleaning up Municipal Solid Waste to produce Fuel Pellets; The MSW fuel pellets production process including separation--drying--screening--size

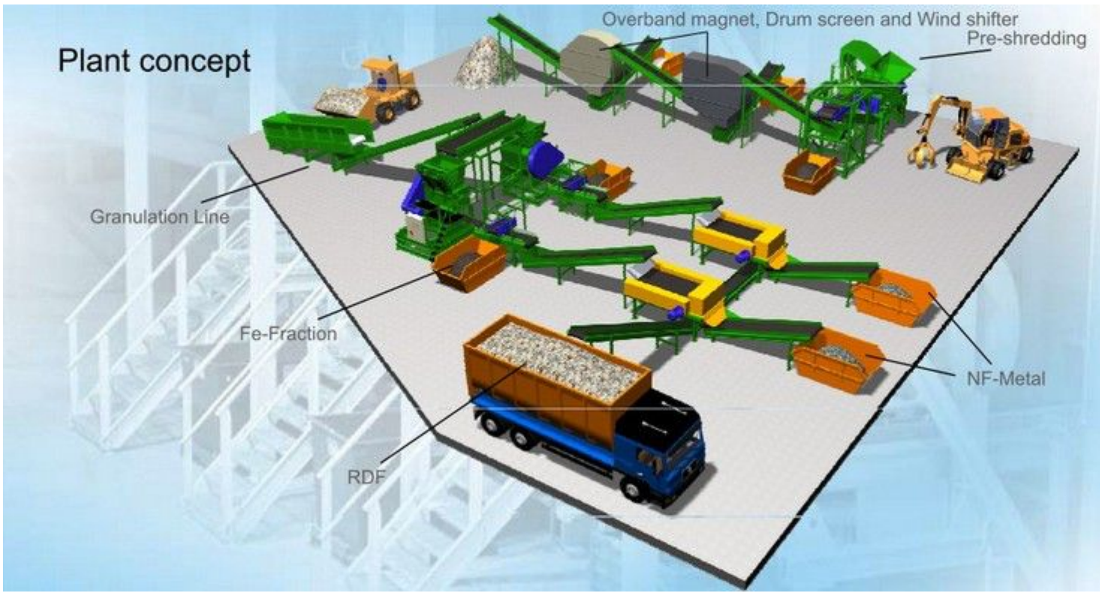
production-pelletizing-cooling-packing. The calorific value of raw MSW is around 1000 kcal/kg while that of fuel pellets is 4000 kcal/kg. On an average, about 15 – 20 tons of fuel pellets can be produced after treatment of 100 tons of raw garbage.

Analysis on Municipal Solid Waste Pellets Making

1. The Necessity of Pelletizing Municipal Solid Waste into Refuse-derived Fuel Pellets

Solid wastes are any discarded materials. They can be solid, liquid, semi-solid or containerized gaseous material. In the light of a survey conducted by World Watch Institute, the total volume of municipal solid waste (MSW) is about 1.3 billion tons per year in the world (MSW is measured before disposal, so data on it include material that is later diverted for recycling). Moreover, it is predicted that the number will be doubled annually by 2025.

The disposal of MSW is a matter of increasing concern for governments all around the world. Previous managements are still adopted by municipalities and goverments. Innovative ideas are on the way.



1.1 MSW Management

1.1.1 Pyrolysis

Pyrolysis is a process of chemically decomposition of organic materials by heat in the absence of oxygen which produces various hydrocarbon gases. During pyrolysis, the molecules of object are subjected to very high temperatures leading to very high vibrations. Therefore every molecule in the object is stretched and shaken to an extent that molecules starts breaking down. The rate of pyrolysis increases with temperature. Fast pyrolysis produces liquid fuel known as bio oil. Slow pyrolysis produces gases and solid charcoal. Solid products of this process contain metals, glass, sand and pyrolysis coke which cannot be converted to gas in the process. Pyrolysis is extensively used in the petrochemical industry and can be applied to municipal waste treatment where organic waste is transformed into combustible gas and residues.

1.1.2 Incineration

Incineration technology is the controlled combustion of waste with the recovery of heat to produce steam that in turn produces power through steam turbines. The incineration process produces two types of ash. Bottom ash comes from the furnace and is mixed with slag, while fly ash comes from the stack and contains components that are more hazardous. Such systems rely on minimum guaranteed waste flows. It indirectly promotes continued waste generation while hindering waste prevention, reuse, composting, recycling, and recycling-based community economic development. It costs cities and municipalities more, provides fewer jobs than comprehensive recycling and composting, and also hinders the development of local recycling-based businesses.

1.1.3 landfill

Landfills may cause numbers of problems. Damage can include infrastructure disruption, such as damage to access roads by heavy vehicles. Pollution of the local environment may occur as well, such as contamination of groundwater or aquifers by leakage or sinkholes or soil contamination.

As existing landfillls become filled to capacity and it is more costly to site new landfills, the development of alternative disposal methods is becoming essential. In addition, the wastes being buried contains considerable quantities of energy that can replace conventiaonal fossile fuels.

Producing energy from trash is known as a “waste-to-energy” option. Several such options have existed for many years and are in extensive use throughout Europe. One of the more exciting options that has been proposed within the last decade is to convert waste into solid recovered fuels (SRF). SRFs are engineered blends of nonrecycled combustible waste (general combustible components of MSW is paper, cardboard, plastics, textiles, rubber, leather, wood) condensed into fuel pellets or briquettes. Taking advantage of those fuel pellets or briquettes can be recovered to provide environmental, economic and resource conservation benefits.

1.2 Advantages of Pelletizing MSW into Fuel Pellets

The calorific value of raw MSW is around 1000 kcal/kg while that of fuel pellets is 4000 kcal/kg. On an average, about 15－20 tons of fuel pellets can be produced after treatment of 100 tons of raw garbage. Since pelletization enriches the organic content of the waste through removal of inorganic materials and moisture, it can be very effective method for preparing an enriched fuel feed for other thermo-chemical processes like pyrolysis/ gasification, apart from incineration. Pellets can be used for heating plant boilers and for the generation of electricity. They can also act as a good substitute for coal and wood for domestic and industrial purposes. Recycling rates have increased over the past few decades, such as in American, 1.5 pounds wastes are recycled and another 0.5 pounds are incinerated-out of the 4.4 pounds of trash being prodeced every day, but there are still about 50% of the waste ending up buried in landfills. Now, with the use of pelletisation technique, we could reduce the amount that is sent to landfills by about 10 percent and produce a fuel that is relatively clean and more energy dense than coal. This technology is especially suitable for plastics that are difficult to recycle, or that decompose slowly in landfills—like baby diapers.

1.2.1 environmental benefits

There are significant reductions of SOx, NOx and CO2, and the trapping of the chlorine combustion products such as HCI that are formed from the remaining plastics in the trash, which makes the pelletized binder-enhanced SRFs a part of the environmental solution, rather than a part of the problem.

1.2.2 economic benefits - large and potential comsumer markets

MSW fuel pellets (suitable to consume blending with coal) by the electric utility industry represents a very large potential market for the lime industry. Even with the conservative assumptions used in conducting the market analysis, an annual lime usage of over 1,410,000 tons per year was indicated. Other potential markets, including the cement industry, paper industry, agricultural processing, and military installations.

1.2.3 resource conservation benefits

Creating fuel pellets out of trash could significantly reduce the amount of trash that goes into landfills and could offset fossil fuel use.

2. Processings of truning trash into treasure

Trash is processed to remove recyclables, such as metals and glass, and unwanted residue and hazardous materials, with the remaining (combustible) positively selected fraction shredded and sent to fiberizing and pelletization or briquetting equipment.

2.1 pelletizing

As mentioned above, material suitable for pelletization is positively selected, with a small amount of residue set aside for disposal. The materials suited for fuel pellet production are shredded, fiberized and stored in storage silos.

In primary shredding, the materials are delumped into 25-40 size to enable easy drying and separation. Delumped materials are dried from 50% moisture to 25% moisture, either on a paved sun drying yard or in a mechanical dryer.

Dried waste materials are passed through a rotary sieve for separation of fine dirt and sand; fine materials can be sent as soil conditioner for further processing.

Screened waster materials is passed through density separation phase in air density separator. Heavy particles are rejected and sent for dumping.

Light fractio is passed through a cage mill for further size reduction with hot air for faster drying and misture is reduced from 25%-15%. Dried combustible material having 25-40mm size is refuse-derived fuel and its calorific value is about 3000 kCal/kg.

Refuse-derived fuel can be ground further in a secondary shredder for making it suitable for pelletisation, then it can be later combined with high-BTU admixture materials such as carpet waste, poly film or other acceptable plastic derivatives. They are transferred through **pellet mills** to produce the final fuel pellet with different diameters i.e. 10mm to 25mm, suitable for different uses.

These fuel pellets are hard and odorless, can be stored for up to three years without sigificant biological or chemical degradation, and due to their increased bulk density, are more durable and can be more easily transported. High bulk density and regular size makes its transport, storage, conveying and combustion easier as compared to other fuels.

Parameters of refuse-derived fuel pellets are as follows

Parameter	Concentration(%)
Carbon	40.12
Hydrogen	3.31
Sulphur	0.41
Nitrogen	0.3
Oxygen	25.06
Moisture	14.7
Ash	16.1

2.2 briquetting

Before briquetting, municipal waste has to be processed for size reduction, adding binder agents and reducing the moisture content.

In general, the moisture content, fraction size, pressing temperature, and compacting pressure of compressed waste are the most important parameters to manufacture briquettes with acceptable quality. The pressing temperature and compacting pressure depend on the type of briquetting machine used. Fraction size has great influence on the briquetting process. The coarser the fraction is, the higher compacting power is needed for briquetting. Briquette has lower homogeneity and stability. By increasing the fraction size, the binding forces inside the material decrease which effects on faster decay by burning.

2.3 Applications of MSW Pellets or Briquetts

MSW fuel pellet or briquett has so many usages, such as being used for heating plant boilers, for the generation of electricity. Due to the special composition of them, they can also be an excellent substiture for fossil fuels.

As for the generation of electricity, the pellets or briquetts are transported to the combustion chamber, where they are burned, creating hot gases. These by-products are collected in the boiler section above the combustion chamber. Here the water is converted to steam, which powers an electric generator. The cooled combustion gases are then passed through pollution control devices before being released to the atmosphere.

3. Achievements having been Made in Solid Waste Management during the Past Decades in the World

Solid waste management until now has only been a social responsibility of the corporate world or one of the services to be provided by the municipality and a non-priority for national governments.

3.1 considerable success having achieved in solid waste management.

In German, with the introduction of the so-called recycling bin, it is estimated that seven kilograms per capita per year of high-grade material of metal and plastic other than packaging can additionally be material recycled.

An important non-market-based initiative contributing to increasing recycling rates for MSW in the UK was the establishment of WRAP UK in 2001, in response to the 2000 Waste Strategy for England and Wales. WRAP is an enabling organisation whose core activity is establishing voluntary partnerships between producers and recyclers of waste, and between them and users of products containing recycled materials. One example of a

WRAP initiative is the Cortauld Commitment, a voluntary agreement for retailers to engage them in reducing food waste and optimising the use and recycling of packaging.

In Japan: The gold standard for MSW will be to integrate it into a materials management approach known as a“circular economy,”which involves a series of policies to reduce the use of some materials and to reclaim or recycle most of the rest. Japan has made the circular economy a national priority since the early 1990s through passage of a steady progression of waste reduction laws, and the country has achieved notable successes. Resource productivity (tons of material used per yen of gross domestic product) is on track to more than double by 2015 over 1990 levels, the recycling rate is projected to roughly double over the same period, and total material sent to landfills will likely decrease to about a fifth of the 1990 level by 2015.

3.2 Challenge

Some of the main problems of using solid waste for fuel have been the poor quality of the fuel, its variability and its biological and chemical instability.

A research team at the University of Texas at Austin has carried out an experiment in connection with the question that: how many other nonrecycled plastics could be turned into fuels instead of wasted in landfills? Wanting to see the real-world capabilities of SRFs, we worked with partners in the plastics, recycling, pelletizing and cement industries to conduct an experiment in which nonrecycled waste was processed into SRF pellets. This SRF was then burned in a cement kiln, a process that normally uses a lot of coal and other fossil fuels; the SRFs replaced a fraction of these fuels. The experiment’s results demonstrate the potential for SRFs to displace fossil fuels for energy, but they also reveal some initial hurdles that must be overcome before SRFs can become a large-scale reality, such as in India, feasibility of pelletisation for MSW treatment has been tried and used for 3 different municipalities. Though the techonology is supplied by an indigenous manufacturer and is relatively a simple technology, there are several barriers that make the project additional and the emissions would continue to occur.

Financial Barrier: municipal corporations have budget allocated for waste management. However the additional cost for the waste treatment plant cannot be met under this budget. In the absence of any separate fund allocation for the activity, implementation of waste management and handling rules would go through very slow progress due to incurring additional cost on treatment as compared to the baseline cost of collection, transportation and dumping. Hence, setting up of a treatment system is always an additonal cost which a municipal authority will not be able to invest on without additional financial support. Private investors are also not investing in waste treatment projects, as the financial risk is high.

Existing practice: the major barrier would be continuation of the existing practice of open dumping. Implementation of a technology for disposal of the waste is going to be a slow process. Altough the need for proper waste management has been realised, the activity is taking lot of time, as solid waste manegement is a complete activity starting from collection to disposal and involves the support of both community and local body. This is evident from the fact that in spite of being the capital city, except for unmanaged landfills and setting up of few composting plants, there have been no treatment plants based on advanced technologies, in addition, there is also lack of awareness about different types of techonologies that can mislead the community in supporting implementation of apporpriate techonology.

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