

PRODUCTION OF SOLID FUELS FROM REGIONAL WASTES

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Abstract

Various industrial wastes such as food wastes, papers, cardboards, plastics, textiles, rubber, leather, wood, glass and metallic wastes should be recycled or be reused in some industrial sectors. A certain types of wastes such as rubber, plastic, nylon and leather wastes can be recycled in their own sectors. However, some types of wastes are mainly municipal wastes and these wastes should be removed by converting them into the ash form and less harmful dirt condition should be provided by sterilisation of wastes in residential areas. Burning of these type municipal wastes and some types of organic wastes such as olive seed, tree leafs, pine corns, rose wastes or animal dirt is very beneficial to the economy of country and also protection of environment.

INTRODUCTION

Dispose of various industrial wastes to open fields and necessarily burning of them and then dispose of ashes of wastes may cause many environmental issues. Acidic and basic waste solutions in slurry form are firstly neutralised and subsequently refused or treated for clarification of water. In mining sector, produced wastes are generally dumped to the open fields near to mines. These dumping areas are recultivated for not to disturb the environmental view. However, in big cities and metropolis, produced municipal wastes are dumped to open fields near to suburbs and seriously threat the human health and all nature alive. Organic wastes and even metals, glass, paper and plastics may create contamination and biologically threat the environment [1]. Evaluation of organic type wastes produced in the cities by combustion and conversion to ashes in the incinerators, then mixing to agricultural lands are recently needed for the protection of environment and the economy of country. Additionally, in the incinerators, the toxic gases of burned wastes should be kept.

The incinerators are very efficient in big cities and metropolis with high populations over one million people for elimination of hazardous organic wastes, Figure 1. Heat produced in the incinerators may be used in the region. Additionally, power stations based on wastes may be found and operated in some cases of collection of high amount of municipal and industrial wastes [2]. In those type of power stations, regional wastes are removed and also the other type of wastes compacted and transferred from other cities. Power production may reach the values of that of thermal power stations using low quality solid fuels such as lignites.

Various organic wastes such as olive seed, tree leafs and dried animal dirt may be evaluated in the energy production. However, high amount of use in the power stations may not be possible due to not production of these wastes in the regional industry and cities. Therefore, those wastes may be used as solid fuel in local areas for heating purposes.

In Isparta, Turkey, rose wastes produced in the rose processing plants are disposed in slurry form. This organic waste biologically threatens the local environment. Hydraulic transport of the rose wastes in the plants to local waste pools in the region or transfer to streams have taken great attentions of regional people and environmentalists. The evaluation of this type wastes is not possible by burning in power stations due to low production capacities. However, those organic wastes are beneficiated as solid fuel in the region.

In this paper, the rose wastes representatively taken from rose processing plants in Isparta are thought as solid fuel and the classification of those wastes among solid fuels are determined.

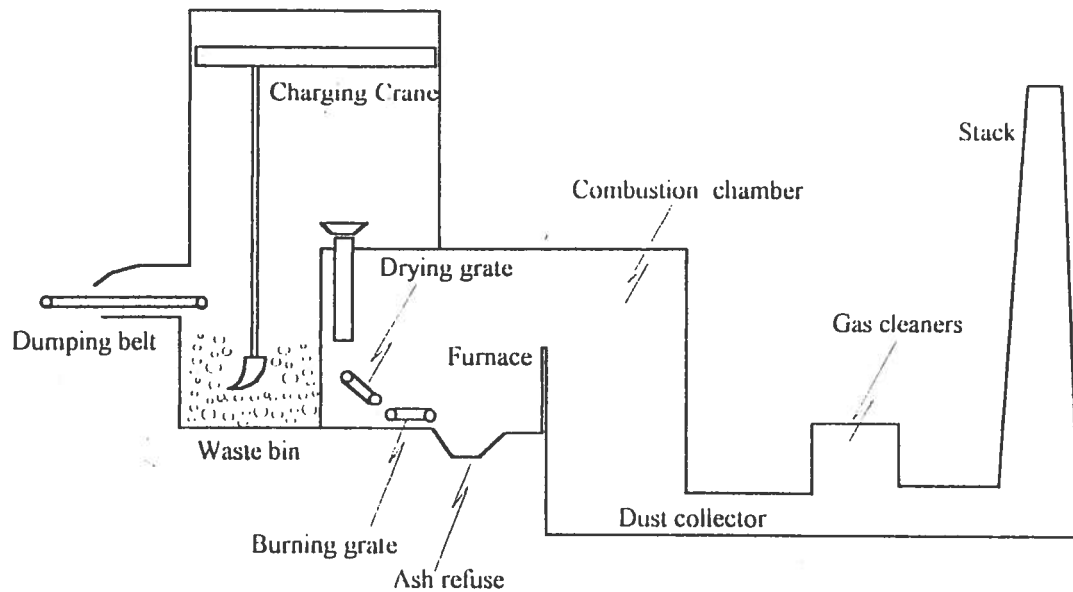


Figure 1. Simplified sketch of an incinerator burning municipal waste.

WASTE EVALUATION AND DISPOSE

Regional industrial wastes and municipal wastes are mainly transported by primarily nylon bags or other metallic carriers and later various methods such as lorries, conveyors, pipelines and pneumatic lines. The main variables affecting waste handling are as follows;

- topography of transporting route and dispose area
- waste pool sizes and location
- floating material content of wastes
- waste transfer rate
- transporting distance
- waste material size or size distribution
- waste moisture
- climate of the region

Regional wastes in the country are generally handled by lorries and disposed to open dumping fields. In some cases, the wastes transported as slurries and in certain cases as fine materials may cause serious environmental contamination during transportation. Therefore, in the borders of cities, municipal wastes are transported to close distance dumping areas near to

suburbs and in this condition, solid wastes are mixed with water or compressed air and transported to incinerators by pipelines. Pneumatic transportation may be advantageous for light particle wastes.

The differences in altitudes of topography of transportation route in mobile and hydraulic handling are the main variables affecting transporting route and handling method preference and design. Increasing differences in altitudes may cause high operating costs due to slope-up mobile or hydraulic transport. At the transport of high tonnages of wastes, conveyor handling may be very efficient. However, maximum slope of route should be under 19-20° and also maximum particle size of waste materials should be 200 mm. Waste particle size between 125 and 150mm is much suitable for conveyor transport. Additionally, excessive fine materials transport by open conveyors may be hazardous. However, hydraulic transport is much advantageous for the waste materials at the size of minus 50 mm and in this pipeline transport finer materials than 0.6 mm should be separately transferred due to high amount of water mixed with waste material. For the wastes under 0.6 mm different type of pipeline stations should be designed and founded.

In the incinerators, organic wastes are burned and high amount of steam, SO_x, NO_x, CO, other toxic gases, soot and hydrocarbons are evolved to the atmosphere. Therefore, in those plants, various gas cleaning and dust collection systems are needed. The gas cleaners and dust collectors are as follows;

● Centrifuge separators	0.5μm-1mm
● Wet Scrubbers	0.2μm-0.1mm
● Cloth Filter	0.05μm-0.05mm
● Filter Beds	0.01μm-0.1mm
● Air Filters	1μm-0.1mm
● High Efficient Air Filters	0.01μm-0.01mm
● Impact Separators	+0.01mm
● Thermal Sedimenters	0.01μm-0.05mm
● Mechanical Separators	0.05μm-0.5mm
● Electrostatic Separators	0.01μm-0.05mm

Cyclones, high efficient centrifuges and wet scrubbers may collect the particles over 1μm with 90% efficiency. However, decreased particle size under 1μm can decrease the performance of dust collectors. However, electrostatic separators may solve this problem and hold the particles between 0.1μm and 20μm with high performance levels at even high gas volumes. Electrostatic separators can hold the 0.1μm dust particles with 95% hold-up efficiency. However, in those separators, high moisture gases may explode. Therefore, this may be very dangerous in dust collection of municipal wastes.

Produced ash and soot in combustion are efficiently hold-up by dust collectors. Addition to dust collection, toxic gases such as CO, NO_x, SO_x and hydrocarbons should be cleaned from stack gases. According to the environmental acts and laws in the countries, maximum sulfur dioxide emission should be limited with 365 mg/m³ for 24 hours. Dust amount should be maximum 260 mg/m³ for 24 hours. CO emission should be maximum 9 ppm concentration level in 8 hours. Nitrogen oxides should be under 100 mg/m³ and hydrocarbons under 160 mg/m³ in 3 hours. In order to provide toxic gas control in the incinerators, different types of chemical methods may be used as follows;

- absorption in chemical liquid medium
- passing stack gas in solid materials such as active carbon, lime, alumina and silica gel
- condensation in a liquid gas medium such as liquid nitrogen and ice

Organic wastes such as olive seeds, tree leaves and wood chips may be evaluated by converting the waste material in a packed or compact form by compression. However, high amount of water content of wastes may cause serious environmental issues and energy lost. Those wastes should be dried in the incinerator or in air. Excessive amount of water of wastes should be separately kept as a liquid part in compaction or in the open dumping field.

EXPERIMENTAL STUDY

Chemical analysis of rose wastes representatively taken from rose processing plants were made. The standard test methods used in the classification of solid fuels were carried out. The results of chemical analysis of the samples of rose wastes are given in Table 1.

Table 1. Chemical analysis of rose wastes

	Original rose waste	Air dried rose waste	Dried rose waste	Carbon based
Ash, %	6.7	10.4	12.8	-
Moisture, %	47.5	18.7	-	-
Flue matter, %	38.3	58.7	72.2	82.8
Fixed carbon, %	7.5	12.2	15.0	17.2
Total	100	100	100	100

The rose wastes disposed in slurry form are dried in air by holding the waste on a nylon sheet for a few days in a controlled room. Those rose wastes are then comminuted and brought to a very fine size, minus 1 mm. Subsequently, those waste fine compressed with binder addition. As binder tar and gasoline were used. Additionally, fine coal samples were added to rose wastes to improve the quality of coal. A certain amount of rose waste addition to coal has decreased the ash and total sulfur contents of coal samples. Even the addition of rose wastes to coal increased the flue matter of coal samples. However, hygroscopic moisture of rose wastes were high, 18.7%, and this high moisture content decrease the qualities of coal briquettes produced from the mixture coal and rose wastes. The resistivity to water of the briquettes are very low due to high moisture capture. To improve this quality gasoline was used and the briquettes were capable to resist moisture.

The calorific values and sulfur contents of rose wastes are given in Table 2. Air dried rose wastes contain maximum 0.5 % total sulfur and they are very advantageous among the other type of solid fuels. When the high sulfur coals are mixed with rose wastes with high weight ratios total sulfur contents of coal briquettes greatly decrease and those low sulfur briquettes provide the environmental specifications for solid fuels. Additionally, calorific values of air dried rose wastes is very close to the calorific values of some lignites and even over those of some solid fuels. The calorific value of rose wastes is 4325 kcal/kg and can be classified as second class solid fuel among the solid fuels with this calorific value.

Table 2. Total sulfur and calorific value of rose wastes.

	Original rose waste	Air dried rose waste	Dried rose waste	Carbon based
Sulfur, %	0.3	0.5	0.6	-
Calorific value kcal/kg	2500	4325	5320	6100

CONCLUSION

It is clearly understood that huge amount of wastes produced in the world must be recycled or beneficiated by certain techniques. In this point of view, the organic wastes such as wood, wood chips, olive seeds, animal dirt, rose wastes, nut shells should be beneficiated in energy production as solid fuel. The most efficient use of this type organic waste can increase the qualities of other solid fuels and even provide the efficient evaluation of other solid fuel deposits.

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