DOMESTIC REFUSE AND GARBAGE DISPOSAL SYSTEM

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ABSTRACT OF THE DISCLOSURE

A system for transforming municipal domestic refuse and garbage into a low-grade fuel. Refuse and garbage are collected and placed in a feed hopper which distributes it through a separator-disintegrator. The separator-disintegrator reduces the top size of the refuse and garbage and simultaneously dewater the refuse and garbage. From the separator-disintegrator, the refuse and garbage passes through a magnetic separator to remove ferrous metals therefrom. The refuse and garbage is then passed between compressive rollers to exert a compressive force thereon and squeeze water from the disintegrated refuse and garbage.

Water is removed from the refuse and garbage until the material contains no more than 25% by weight water and it is then placed in an extruder to form fuel blocks therefrom. In some instances, instead of the refuse and garbage going into the extruder, the dewatered refuse and garbage coming out of compressive rollers in a sheet form may be disintegrated into a pulverulent material to provide for burning in a finely divided state. The separator-disintegrator is formed from a rotating slinger and a counter-rotating conical basket, the internal wall of which is serrated and provided with bore holes so that water may escape therefrom. The slinger and counter-rotating basket cause quick disintegration of material dropped into the separator-disintegrator. The compressive rolls of the system are placed within a tank which permits water to escape around the walls and which permits adjustment of the rollers depending upon the dewatering pressures required in the processing system.

BACKGROUND OF THE INVENTION

The modern urban society in the United States has caused growing problems of municipal refuse and garbage disposal. Domestic refuse and garbage has increased, per capita, with the advent of modern packaging and modern food preparation and processing. It has also increased with the advent of many disposable products such as paper napkins, paper plates, paper containers of all types, paper and plastic milk cartons, disposable plastic bottles, and other single-use disposable packaging items.

As cities and suburban areas grow, the very practical problem of how to dispose of the domestic refuse and garbage collected in the cities and suburban areas has become acute. Some of the more conventional methods of disposing of domestic refuse and garbage are to use sanitary land fills or to provide incineration of the refuse and garbage. These methods have proved impractical.

Sanitary land fills require large amounts of open space which are not available in many municipal areas. Further, runoff from sanitary land fills contaminates streams and causes water pollution problems. In addition, the sanitary land fills are difficult to operate and often increase the cost of transportation of refuse and garbage from the points of collection to an area where there is enough open space for a sanitary land fill.

Incineration of refuse and garbage causes problems of air pollution. Further, since a large percentage, by weight, of municipal refuse and garbage is water, incineration is a very inefficient way to dispose of this material. All of the water, in the incineration process, must first be boiled off by turning it to steam. Further, the fuel used for incineration must be provided to increase the temperature of the material, which is heavily water-laden, to a point where combustion will take place.

The United States Public Health Service has recognized the great problem of municipal domestic refuse and garbage disposal in the United States. It has stated that the volume of solid waste has grown more rapidly than the population at the same time that available economic space for waste disposal has declined. The consequences are that the garbage can, refuse pile and junk heap have moved out of the individual back yard, garage or attic into public areas.

Tests have determined that average municipal refuse and garbage collected contains approximately 45% to 75%, by weight, water. This relatively large percentage of water contained in refuse and garbage creates problems of garbage and refuse disposal which have not been successfully approached in finding a solution to refuse and garbage disposal. The present invention is directed to a practical solution for municipal domestic refuse and garbage disposal.

SUMMARY

The present invention is directed to a processing system for domestic refuse and garbage which is collected from municipalities. Basically, the present invention provides for the collection of domestic refuse and garbage and its transportation to a processing plant. At the processing plant, the refuse and garbage is first disintegrated to reduce the maximum size of any particle of refuse and garbage to pieces having no overall dimension larger than twelve (12) inches. While this disintegration is taking place, a portion of the water content of the refuse and garbage is naturally removed simultaneously with the disintegration. This water removal occurs as bottles and cans are broken, cartons are broken and torn, and large items of waste are broken into smaller items.

After this preliminary disintegration and dewatering, the material, all less than twelve (12) inches in overall dimension, is passed through a magnetic separator to remove ferrous metals therefrom. The ferrous metals are reclaimable as scrap. Further, the ferrous metals do not contaminate the remaining material as it proceeds through the system.

After the ferrous metals are removed, the disintegrated refuse and garbage is passed into a device to exert a compressive force thereon. The compressive force has the effect of compacting the disintegrated refuse and garbage and, at the same time, further squeezing water therefrom. The water removed from the refuse and garbage is treated to permit it to be safely discharged into rivers and streams without pollution of the rivers and streams. The solid wastes, on the other hand, are dewatered to the point that they contain no more than 25%, by weight, of water.

The solid wastes leaving the compressive rollers are then prepared in a form for efficient combustion. The solid wastes may be extruded into blocks of fuel as hereinafter more fully described. They may also be finely divided into a pulverulent material which may be burned in the finely divided state. In some instances, fuel oil or fine coal may be added to the solid waste material to increase its fuel properties.

It has been determined that the fuel available from waste material collected as domestic refuse and garbage can be utilized to operate the system for treating the refuse and garbage so that there is an economic saving to a municipality in creating fuel from the waste material.
With the foregoing considerations in mind, it is an object of the present invention to provide a system for forming low-grade fuel from municipal domestic refuse and garbage.

Another object of the present invention is to provide a system for dewatering refuse and garbage which effectively removes the need for land fills and incinerators.

Another object of the present invention is to provide a system for dewatering refuse and garbage so that it may be effectively utilized as a fuel.

Another object of the present invention is to provide a continuously operating system for treating municipal domestic refuse and garbage to form a low-grade fuel therefrom.

These and other objects of the present invention will become apparent as this description proceeds in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view, partially in section, of a municipal refuse and garbage disposal plant utilizing the system of the present invention;

FIGURE 2 is a schematic flow diagram showing the process of the present invention;

FIGURE 3 is an elevational view, partially in section, of the separator-disintegrator utilized in the present invention;

FIGURE 4 is a sectional elevation of the compressive rollers and tank utilized in the system of the present invention;

FIGURE 5 is an elevational view, partially in section, of the extruder utilized in the present invention;

FIGURE 6 is a perspective view showing one form of fuel block formed by the present invention.

Referring to the drawings, and particularly to FIGURES 1 and 2, it may be seen that a municipal refuse disposal plant 10 has, as its major components, a feed hopper 12, a rotary separator-disintegrator 14, a ferrous metal separator 16, a compressive roller tank 18, and an extruder 20.

As shown in FIGURE 1, the plant entrance 22 permits access into the plant of a municipal refuse and garbage truck 24. Refuse and garbage from the truck 24 may be dumped directly into the feed hopper 12. The feed hopper 12 channels refuse and garbage, just as it is collected in the municipal refuse and garage disposal plant, to the rotary separator-disintegrator 14. The feed hopper 12 has feed doors 13 to control the rate of flow of material into the separator-disintegrator 14.

Referring to FIGURE 3, it may be seen that the rotary separator-disintegrator 14, is formed of a housing 26 within which a generally conical body 28 is journaled for rotation on bearings 30. Between the housing 26 and the conical body 28 is a generally annular water chamber 32 for a purpose hereinafter to be described.

The conical body 28 of separator-disintegrator 14 has a serrated internal wall 34. The serrations on internal wall 34 form sharp surfaces which promote the disintegration of refuse and garbage therein in a manner to be described.

The conical body 28 contains a plurality of holes 36 formed therethrough to permit flow of water from within the body into the annular water chamber 32 surrounding the body 28. A rotating slinger 38 is concentrically disposed within the conical body 28 and may be raised and lowered to vary the distance between the circumferential surface of the slinger 38 and the serrated internal wall 34 of conical body 28. Both the slinger 38 and the conical body 28 of separator-disintegrator 14 are drivingly connected to a standard electrical drive motor and transmission housed in housing 40. The slinger 38 and the body 28 are so connected to the drive motor that they rotate in opposite directions when in motion.

When municipal domestic refuse and garbage from feed hopper 12 enters the top of separator-disintegrator 14, it falls upon the slinger 38. As the slinger 38 rotates, the refuse and garbage, by centrifugal force, is thrown outwardly against the serrated internal wall 34 of the conical body 28. The conical body 28, meanwhile, is rotating in a direction opposite to the direction of rotation of the slinger 38 so that as the refuse and garbage strikes the serrations of internal wall 34, it is broken and disintegrated, causing bottles to break, cartons to be torn and ripped, and large pieces of material to be broken and torn until no item remains which has a dimension larger than twelve (12) inches.

As the refuse and garbage is disintegrated within the conical body 28, water released from the refuse and garbage is, by centrifugal force, forced outwardly through holes 36 in body 28 into the annular water chamber 32 between the body 28 and the housing 26. From the annular water chamber 32, the water passes through a waste water drain 42 to a water treatment facility (not shown) which treats the water so that it can be safely discharged into rivers and streams. As the water passes through drain 42, the disintegrated and partially dewatered refuse and garbage from the conical body 28 passes downwardly through the removal port 44 of separator-disintegrator 14.

Referring again to FIGURES 1 and 2, as the partially dewatered and disintegrated refuse and garbage leave the separator-disintegrator 14, it passes to the ferrous metal separator 16. In FIGURE 2, the ferrous metal separator is shown with a conveyor belt 46 which receives the metallic material and the magnetic conveyor belt 48 containing magnetic elements which passes in close proximity to conveyor belt 46. Magnetic conveyor belt 48 picks up the ferrous metallic components and discharges them away from the remainder of the disintegrated and partially dewatered refuse and garbage. The refuse and garbage from belt 46 then passes to the compressive roller tank 18.

As seen in FIGURE 1, a slightly different type of magnetic separator 16 is utilized. In FIGURE 1, a conveyor belt 51 contains magnetic elements so that the ferrous metallic particles are retained on the belt as they pass around its drive rollers. The refuse and garbage pass into the compressive roller tank 18 while the metallic particles are carried around on the belt into hopper 52. From hopper 52, the ferrous particles pass onto a conveyor 54 to be reclaimed as scrap material. The exact type of ferrous magnetic separator utilized in the system is not critical and the type of magnetic separator forms no part of the present invention.

The partially disintegrated and dewatered refuse and garbage passes from the ferrous metal separator 16 into the compressive roller tank 18 which is formed from a tank body 56 and compressive rollers 58 as best shown in FIGURE 4. The compressive rollers 58 are rotatably positioned on frames 60 and 62. The frames 60 and 62 are movable relative to the tank body 56 so that the distance and space between the frames 60 and 62 may be adjusted.

The frames 60 and 62 pivot about pivot points 66 and 68, respectively, which are also the axes of drive sprockets for porous conveyor belts 66 and 68 which, in turn, surround the sets of compressive rollers 58.

A piston-cylinder arrangement 72a is attached to frame 60 to move frame 60, its associated compressive rollers 58, the drive sprocket and the porous conveyor belt 68 about pivot 64. In a like manner, the piston-cylinder arrangement 72a is attached to frame 62 to move frame 62, its associated compressive rollers 58, the drive sprocket and the porous conveyor belt 70 about pivot 66.

When the frames 60 and 62 are moved toward each other, the space between them is decreased and increased compression takes place for an equal amount of material passing between the porous conveyor belts 68 and 70. When the frame 60 and 62 are moved apart, additional material may be passed between the porous conveyor belts 68 and 70.

The tank body 56 of compressive roller tank 18 has, hinged bottom portions 74a and 74b which may be adjusted so that the elongated opening 76, between them,
may be adjusted. Water drains 78 are located in each of the hinged bottom portions 78a and 78b of tank body 76. Piston-cylinder arrangements 80a and 80b operate and position the hinged bottom 74a and 74b of tank 56. The exact positioning of the hinged bottoms 74a and 74b is determined by the rate of passage of material through the system.

It will be seen that as the partially disintegrated and dewatered refuse and garbage enters the top of compressive roller tank 18, it is carried by porous conveyor belts 68 and 70 downwardly and together to opening 76. As the material is compressed between the conveyor belts 68 and 70, which are forced together by rollers 58 on frames 60 and 62, the water in the disintegrated refuse and garbage is forced through the porous conveyor belts to the outward portion of tank body 56. This water falls to the bottom of tank body 56 into the hinged bottom portions 74a and 74b. From there, the water is carried by water drains 78 to a water treatment facility (not shown) wherein the water is treated so that it may be safely discharged into streams and rivers.

As the solid waste material leaves the bottom of compressive roller tank 18 through opening 76, it may be sprayed by fuel or coal fines to enrich the fuel content of the material. As shown in FIGURE 2, a spray nozzle 81 may be disposed to spray fuel oil onto the sheet of material emerging from the tank 18.

The sheet of waste material leaving tank 18 contains no more than 25% by weight water. The percentage by weight of water contained therein may be controlled by the amount of compressive force exerted within tank 18, as well as the degree of disintegration which takes place within the separator-disintegrator 14 as controlled by the position of the slinger 38 with respect to the conical body 28. The closer that the slinger 38 is moved to the conical body 28, the greater amount of disintegration occurs in the waste material and, of course, the greater amount of water removal that occurs.

The sheet of waste material emerging from tank 18 may be prepared in several ways to provide a configuration suitable for combustion. The sheet may be collected and subjected to shredding by mechanical knives to finely divide the material and provide a pulverulent combustion fuel.

As shown in the drawings, the material emerging from the tank 18 may be formed into fuel blocks by the use of an extruder. The extruder 20, as best seen in FIGURE 5, has a housing 82. Within the housing 82, a feed screw 84 is journaled for rotation so that feed screw 84 forces the material from the extruder. The feed screw 84 is driven by a motor and a gear arrangement contained within housing 86. The material enters inlet port 88 of the extruder 20 and as the feed screw 84 rotates, the ever-decreasing size available between the helical elements of the feed screw 84 causes compaction as the material is forced toward the nose cone 90 of the extruder.

The nose cone 90 of the extruder is held on webs 92 so that as the material passes around nose cone 90 and emerges from the extruder nozzle 93, it is formed in the shape of an annular block as shown.

By producing an annular shape 94 having a bore running therethrough, the surface area of the block is increased which promotes combustion of the fuel block which is formed in the extruder.

As shown in FIGURE 1, the cutoff saw 96 is utilized to cut the extruded blocks as they emerge from extruder 20.

Again referring to FIGURE 1, the extruded blocks are carried by means of conveyor 98 to the position in the refuse disposal plant where they may be loaded onto a truck 100.

It may be seen that the foregoing system provides a method of continuously treating municipal domestic refuse and garbage to form fuel of a low-grade variety therefrom. It has been found that the material formed by the process of the present invention contains approximately sixteen million B.t.u. per ton when not enriched by fuel oil or coal fines. Further, this fuel content compares favorably with low-grade coal which contains approximately nineteen million B.t.u. per ton. It is possible, with the fuel formed by the treatment of the municipal domestic refuse and garbage to operate the plant required to produce the fuel. Further, excess fuel can be efficiently utilized or sold by the municipality operating the disposal plant.

According to the provisions of the patent statutes, I have explained the principle, preferred construction, and mode of operation of my invention and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:
1. A process for preparing domestic refuse and garbage for combustion comprising the steps of:
   (a) mechanically reducing the maximum size of said refuse and garbage to pieces having no overall dimension larger than twelve inches, and simultaneously separating by centrifugal force a portion of the water content therefrom;
   (b) separating at least a portion of the metallic components therefrom;
   (c) exerting a compressive force upon said refuse and garbage to remove water therefrom until said refuse and garbage contains no more than 25% by weight of water; and
   (d) thereafter forming said refuse and garbage into configurations suitable for combustion.

2. The process of claim 1 wherein a compressive force is exerted to remove water therefrom until said refuse and garbage contain not more than 15% by weight of water.

3. The process of claim 1 wherein the configuration into which said refuse and garbage is formed for combustion is a solid fuel block.

4. The process of claim 1 wherein the configuration in which the said refuse and garbage is formed is a finely divided pulverulent material.

5. The process of claim 1 wherein the reduction of the maximum size of said refuse and garbage and the simultaneous separation of a portion of the water content therefrom is accomplished by transmitting said refuse and garbage through a rotary separator.

6. The process of claim 1 wherein the said refuse and garbage which contains no more than 25% by weight of water is enriched by the addition of fuel oil thereto to increase its fuel-like properties.

7. The process of claim 1 wherein the said refuse and garbage which contains no more than 25% by weight of water is enriched by the addition of coal fines thereto to increase its fuel-like properties.

8. A process for preparing low-grade fuel from municipal domestic refuse and garbage comprising the steps of:
   (a) introducing the said refuse and garbage into a mechanical rotary separator-disintegrator having slinger and counter-rotating conical body which causes the said refuse and garbage to disintegrate into pieces having no overall dimension larger than twelve inches, and simultaneously separates by centrifugal force a portion of the water content therefrom to be removed into an annular water chamber in said separator-disintegrator;
   (b) introducing the said partially disintegrated and partially dewatered refuse and garbage into a ferrous metal separator to separate at least a portion of the ferrous metallic components therefrom;
   (c) introducing the said refuse and garbage into a compressive roller tank having a pair of porous conveyor belts driven and urged toward each other by
compressive rollers, said porous conveyor belts being so positioned that as the said refuse and garbage is carried therebetween, a compressive force is exerted on said refuse and garbage until the said refuse and garbage emerging from said compressive roller tank contains no more than 25% by weight of water; and

(d) thereafter forming said refuse and garbage into configurations suitable for combustion.

9. The process of claim 8 wherein the compressive force exerted within the compressive roller tank removes water from said refuse and garbage until said refuse and garbage contains not more than 15% by weight of water.

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