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(56) Documents Cited:
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Other: **WPI, EPODOC**

(54) Title of the Invention: **Dehydrator waste bin, heat resistant perforated bin bag and a thermal pre-treatment process to remove moisture from mixed municipal solid waste**
Abstract Title: **Bin treating waste with hot air**

(57) A waste bin thermally treats solid waste with air above 70 degrees C. The bin can receive waste in the production place and the hot air can evaporate the moisture to dehydrate it. Excess moisture can be removed by gravity 18 through perforations in a heat resistant bin bag 1 to a holding removable tank 2 located in the base. The hot air and water vapour will preferably be re-circulated 3 until the hot air has values near to the saturation point after which water is condensed out into the tank. Finally, hot air from the heat exchanger can pass through a filter 10 to remove contaminants and reduce the odours before release 11 into the environment. Dehydrated waste may be removed from the bin by extracting the perforated bin bag 1. A new heat resistant perforated bin bag 1 could then be placed into the bin to receive new waste for treatment.

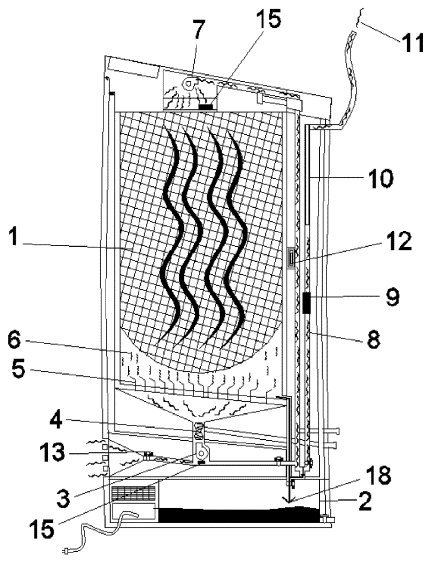

Figure 3

GB 2508692 A

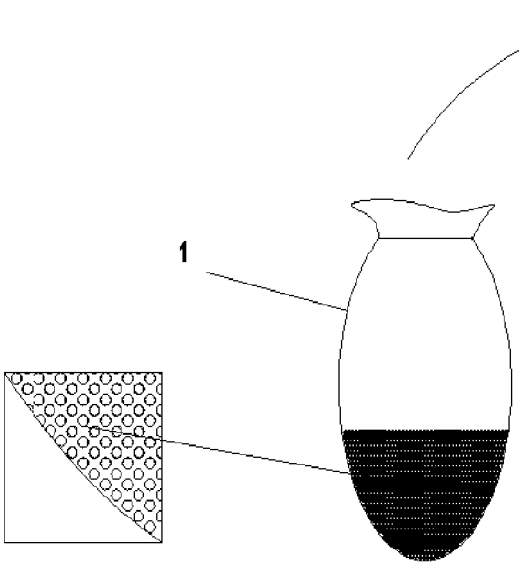

Figure 2

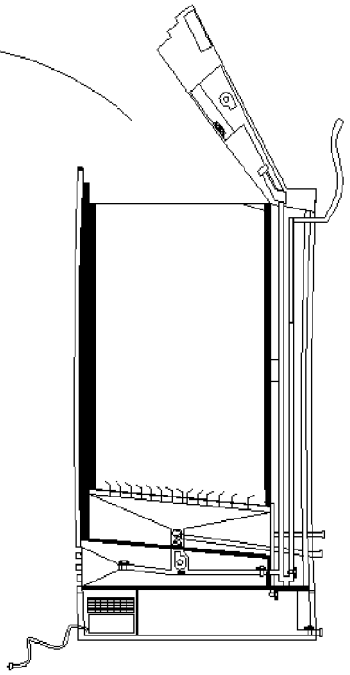

Figure 1

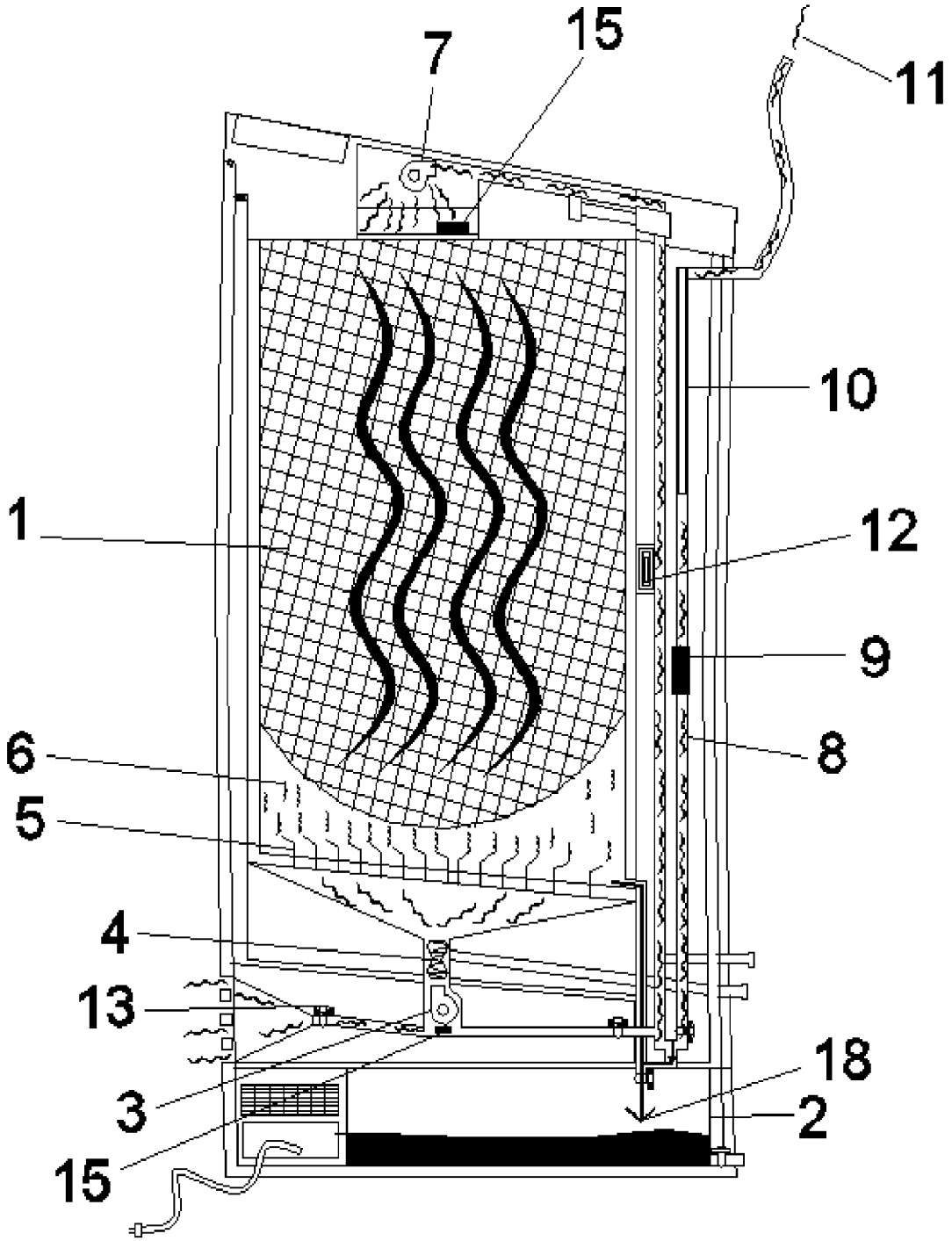

Figure 3

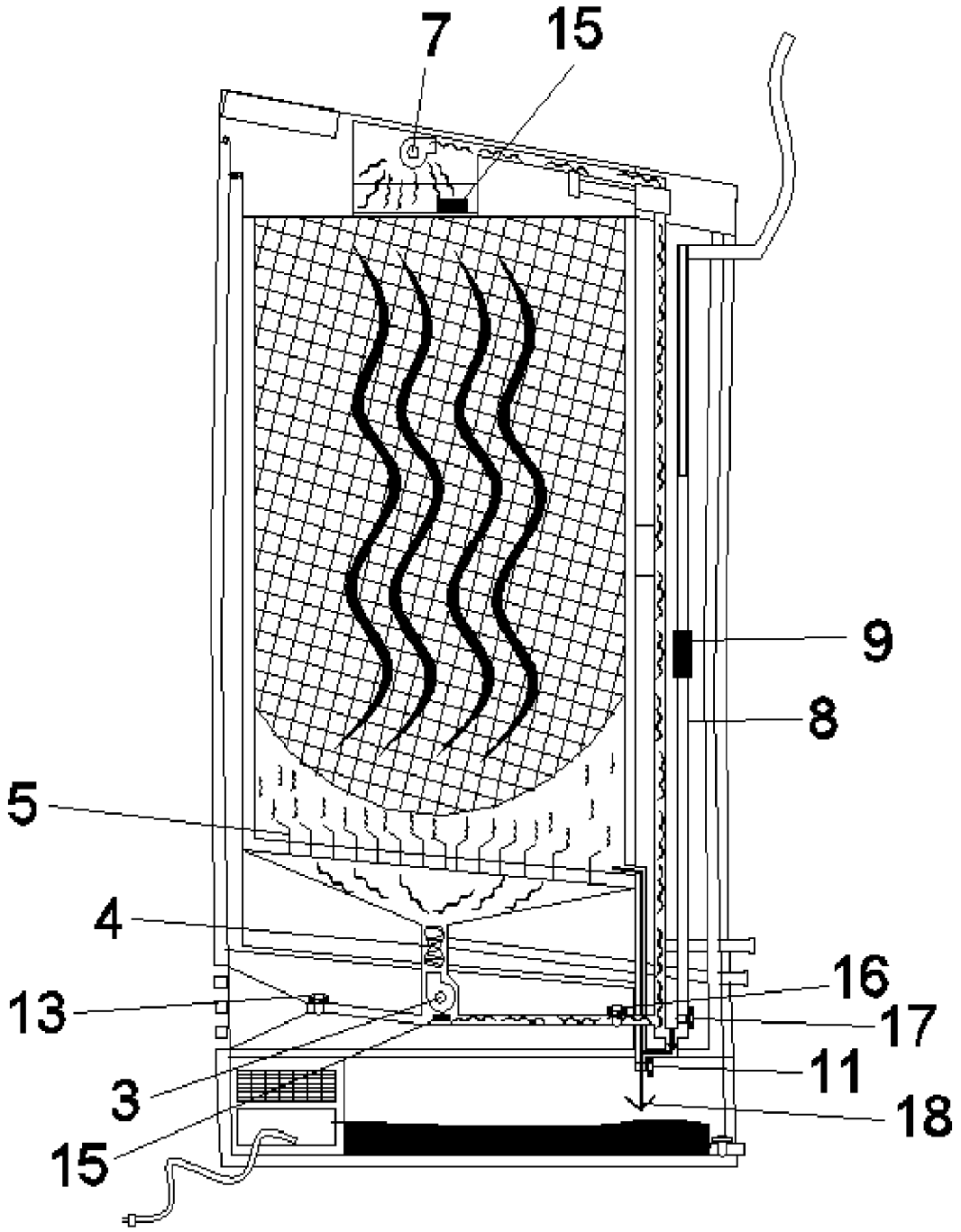

Figure 4

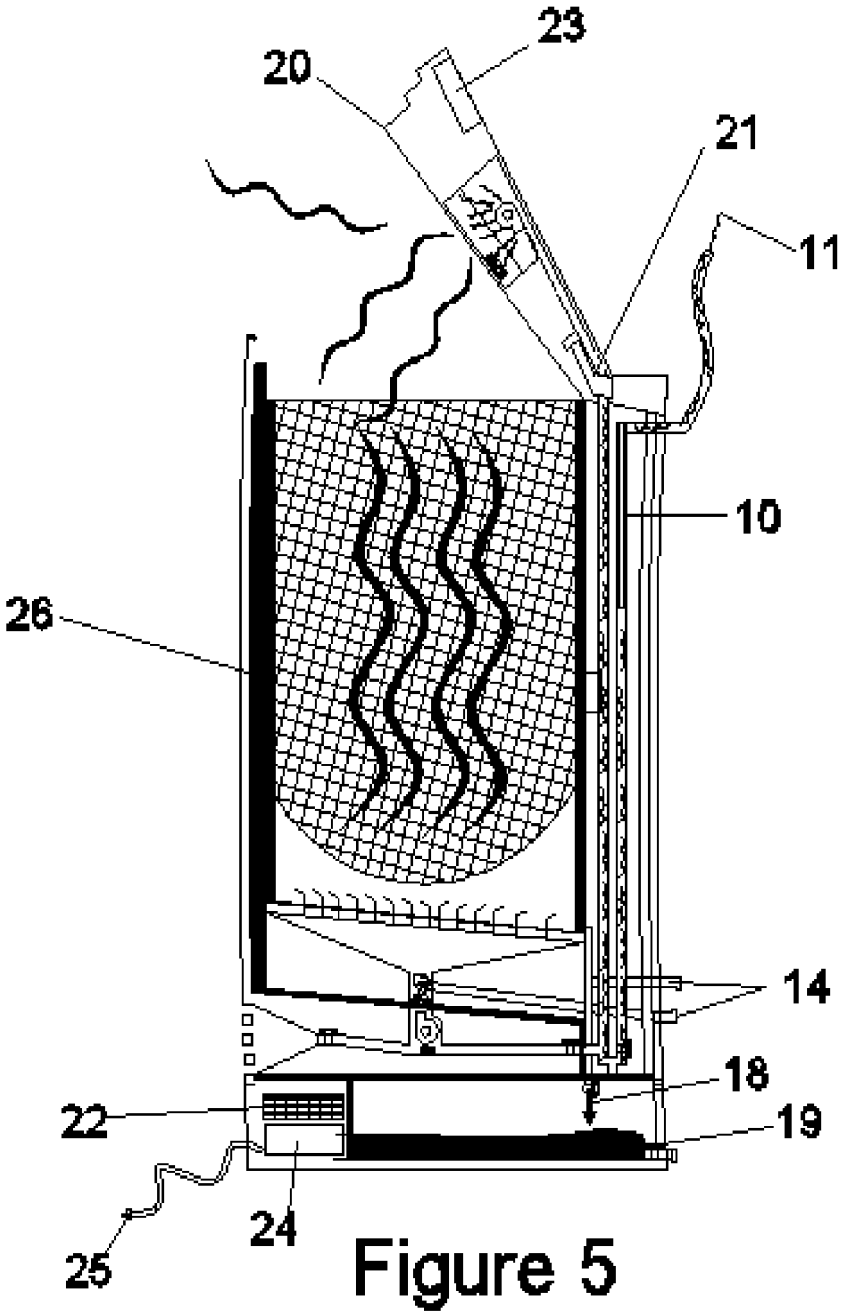

Figure 5

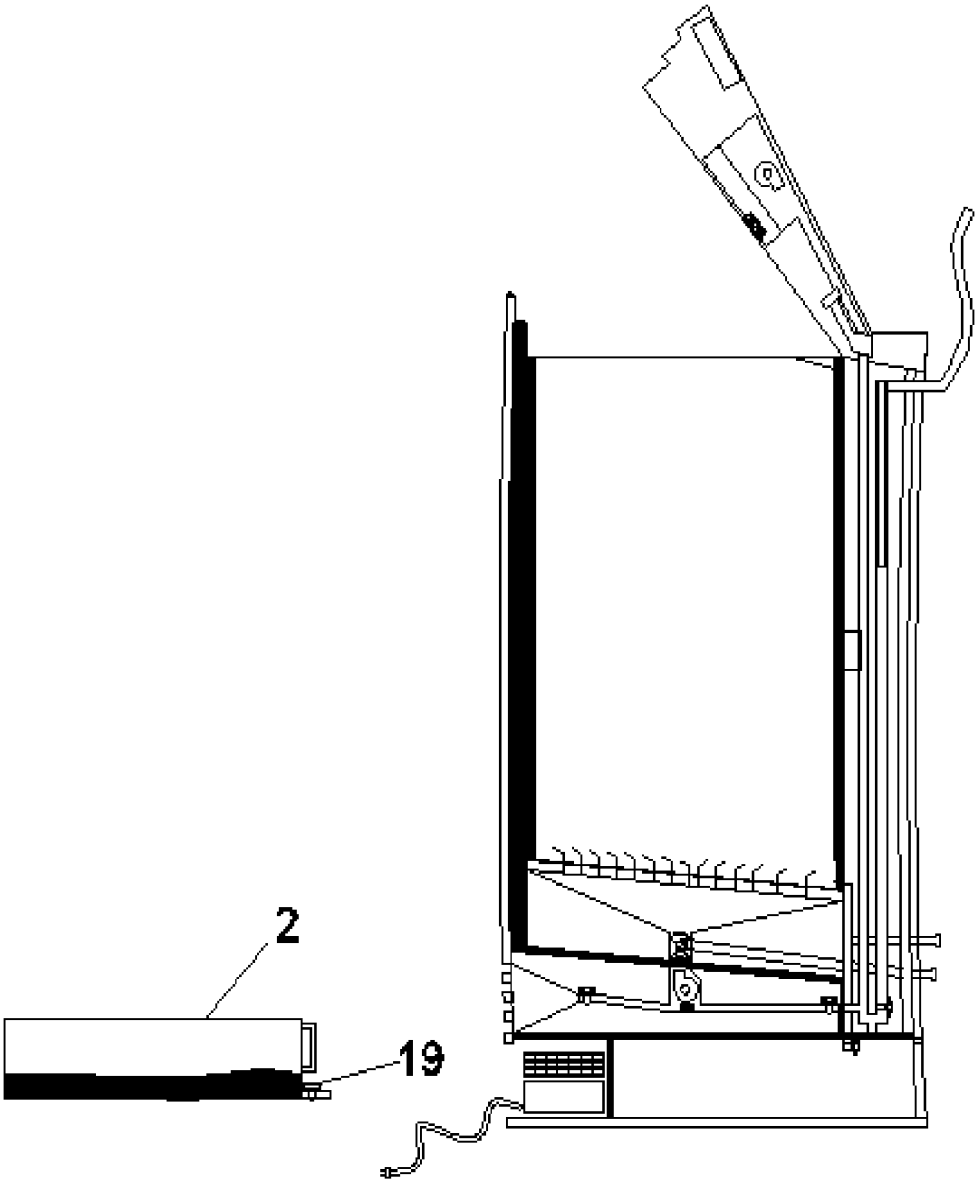

Figure 6

DEHYDRATOR WASTE BIN, HEAT RESISTANT PERFORATED BIN BAG AND A THERMAL PRE-TREATMENT PROCESS TO REMOVE MOISTURE FROM MIXED MUNICIPAL SOLID WASTE IN THE PRODUCTION POINT.

BACKGROUND

[001] The process of managing MSW in many places around the world starts with the depositing of waste in a container or a plastic bag; generally the first store container or bag is located near the place where the waste was produced. Then, waste stored is transported by the producer to a collection point in the street or to a second container to be collected by local authorities or private companies. In developed countries the MSW is transported (sorted or not) to pre-treatment plants, treatment plants or a final destination in the landfill. Usually In developing countries MSW is transported to a final destination in the landfill. Sites suitable for landfill are in decline in both developed and developing countries and governments from both sides have the strong desire to recover as much materials as they can from the MSW and to promote safer, more environmental friendly disposal. Generally more control over this situation is present in developed countries where taxes on disposal of waste are helping to divert the waste from the landfill.

[002] Generally, with some exceptions, waste management and technologies used in developed countries (i.e. kerbsite collection, mass recovery facilities MRF, composting, anaerobic digestion, vermicomposting, mechanical biological treatment, incineration, pyrolysis, gasification, autoclave, orchid technology, and plasma) are not used in developing countries due to them being expensive to build and operate. In addition, the costs to transport the MSW are high and sometimes affect the frequency that waste is collected from the producer leaving households storing the waste for a longer time than is desirable in terms of risk to health and causing nuisance.

[003] Odour nuisance and health risks are another common characteristic in waste management for developed and developing countries. Moisture present in the waste materials has an influence over the whole waste management system. In the production point (i.e. household kitchen) moisture in the waste and temperature influence the biological decomposition of the organic matter which trigger the production of odours and the reproduction of microbiological specimens. Generally, local authorities tackle this event by collecting the MSW every two or three days. However, when the collection system fails, the householder has to store the waste in their residence or transfer it to the picking point; in some cases, odours can be so strong that bin bags have to be carried to the picking point outside of the production place even before being totally full with materials. The human risk of infection (i.e. bacteria, viruses, insects and rodents) can increase with this situation. In addition, the production of greenhouse gases accompanies microbiological decomposition.

[004] Transporting waste from the picking point usually involves dealing with waste that is in a more decomposed state than the waste kept in the household. Overloaded bins, smell and leachate are more common and its contact with humans will depend on the collection technology used. The fuel used for transporting is proportional to the tonnage of waste transported and the distances transported. This means that the more moisture content there is in the waste, the heavier the waste is to transport and the less material there is for recovery. In developing countries where hand-picking in the streets is a common process, decomposed waste increases the human risk and contamination spreads when the moisture-waste is extracted from the bin bag.

[005] Moisture content in MSW also has an influence on the different technologies developed to pre-treat or treat municipal solid waste, for example on; the sorting process (Kebside collection, MRF), biological process (composting, anaerobic digestion, vermicomposting, mechanical biological treatment) and thermal treatments (incineration, pyrolysis, gasification, autoclave, orchid technology, plasma). Most of these technologies require having optimum values of moisture in order to have an efficient process. Odours can also be a nuisance during any of the above processes. Usually, pre-treatment and treatment processes for MSW are applied after waste is transported to a facility and not in the production place like the household.

[006] The most common final disposal technology used around the world is the landfill. The generation of greenhouse gases is predominant in landfills usually triggered by the organic matter and moisture contents. Generally, most of the landfills around the world do not have gas collection systems or gas treatment systems, which has become an environmental issue. In addition, moisture can be a factor that affects the stability of the landfills.

[007] On the other hand, managing MSW by using devices located in the production place had been suggested in other patents:

[008] U.S. Pat. No. 20040127355 discloses a process and device for processing organic waste. The process for making the **outcome** involved: reducing raw organic waste into pieces, drying the raw organic waste (after or before it is reduced), and optional mixing of the pieces with a binder or water forming the mixture into a shape and drying the formed mixture into a solid. The invention may be used to manage household or commercial organic waste.

[009] The device patented to this process involves two modules: receiving module and processing module. The receiving module has an internal space for collecting and holding organic waste. A gate is open to transfer the organic waste from the receiving module to the processing module (which may be freestanding or alternatively may be installed under a kitchen counter). The processing module involves blades for reducing the organic waste to size. The water and pieces of organic matter pass into a forming chamber where the binder (or mix of binders) or other additives are injected. A screen floor in the chamber allow free liquid water to pass a drying rod assembly while a slurry of pieces of organic matter, binder and surface held water remain in the top of the screen floor. Heating elements heat the slurry directly and indirectly by heating the rod assembly (prior to heating, the slurry may optionally be pressed). As the slurry dries into a solid, moisture is drawn off through a moisture scavenging port and then released into the atmosphere directly through filters to remove odours (optionally condensed). After the solid is dried, it drops to a receiving platform. The user may then take the solid away or store it in a pull out drawer at the base of the apparatus. Finally, the apparatus may also be adapted for other configurations.

[010] The success of the process is based on the initial sorting process of organic matter by the producer at the production point, in adding water or binder in the right proportions, and finally, as an option, mixing the organic matter with slurry. However, these tasks which include moving, separating, buying additives and slurries and controlling moisture, can cause people to be frustrated with this process (i.e. people can become bored with the environmental concerns or spending time following this process). It can become extra work for the waste producer, which would not be compatible with time limitations.

[011] The number of bins in the house can be increased due to the patented device requiring a complementary bin to receive the inorganic portion of the materials. Locating the patented device can be a

nuisance if it implies reforms to the structures of the kitchens, i.e. extend existing spaces or allowing for the device to be connected to the sinks/drains which can increase the cost of installation and operation of the system to the waste producer.

[012] In addition, if by mistake mixed materials went to the patented device, then parts of the device could be affected i.e. the blades or the efficiency in the screening and drying.

[013] The energy expended by the waste producer can be increased too much with the mechanical function of reducing the size of the organic waste (using shredding, mashing, crushing, milling or chopping). In addition, thermal energy can also increase by adding water to facilitate size reduction and then removed as water vapour to produce a solid output. However this makes sense in terms of the mechanical process as it can be counterproductive in terms of energy saving. In the case that drying occurs before the size reduction process, the energy used for mechanical cutting can also be greater as the materials to be cut may be more compacted.

[014] Finally, for the above reasons this process and device proves difficult to apply in places like household kitchens within flats, small houses, in some restaurants where sorting and space are issues. However, this process and device can be well applied in other places like houses with yards and auto-sufficient farms.

[015] U.S. Pat. No. 20090023204 discloses a device for the storage and treatment of the biodegradable wet solid waste. The device consists of a bucket shaped container with a mesh bottom and a removable cover with a hole at the centre. The container is provided with a leachate collection basket at the bottom which is mounted on an iron stand to hold the device. Openings are provided on the lateral surface of the basket for ventilation.

[016] This treatment is defined by: the quantity of material stored and processed, the presence of microorganisms in the waste deposited (fresh waste or waste being processed), the moisture content in the waste, and the circulated air in the waste mass coming from outside atmospheric conditions (relative humidity, temperature, pressure).

[017] In other words, the treatment is a combination of biological decomposition of organic matter and a drying process (for the same material) using atmospheric air. Atmospheric conditions define if the treatment became balanced in major proportions to the biological activity or to the drying activity; this means that the treatment is a natural treatment and not a human controlled treatment and therefore the speed of the treatment relies on atmospheric conditions of the air circulated between the organic matters. This non-controlled treatment can also influence the type of material obtained after the treatment (i.e. humus, un-mature compost or dehydrated organic matter).

[018] The above can be a disadvantage to the waste producer as it can be confusing to identify when materials are ready to be extracted from the net to be replaced by new incoming materials. If for example the moisture is reduced by drainage or air circulation, then the microorganisms reduce their activity and the organic matter cannot reach the different periods of decomposition (sterilization, active decomposition, secondary decomposition, and maturation to stabilization). In this case, un-mature compost can continue its decomposition even after storage and continue to produce gas and odour.

[019] In addition, the treatment into the device does not use agitation meaning that there is not a proper mix of materials (new materials with old materials); therefore, inoculation of the new material could be

limited, and the composting process cannot be speeded up i.e. some microorganisms are more active at different periods of decomposition due to adaptation to the temperature in the organic matter [thermophyles microorganisms (38 °C to 55 °C) are faster processors and proliferators among the psychrophyllic and mesophyllic microorganisms]. Additionally, some microbiological organisms could be washed out of the process by the draining water; also, water drained is not thought to be used as inoculation in this system. Therefore, as it was said, material stored can be formed by fresh material while other material can be mature composts.

[020] This treatment cannot work properly in small flats or houses without an appropriate yard, as the microbiological or drying process can take longer than expected (depending on atmospheric conditions) and therefore a disruption between new material produced and material being stored can occur. i.e. it is not the same to use this treatment in a tropical environment as it is in a seasonal/changeable environment. Additionally, organic matter needs to be sorted for inorganic materials before starting the process which means more space requirements.

[021] US pat. 2011 /0238598 A1 discloses a system, method and process for targeted waste (paper board based fast food service items) including a waste collection device. The waste collection device includes: a collection vessel upper portion, a collection vessel processing/shedder mechanism, a collection vessel housing, and a collection vessel lower portion. Additionally, the device uses a perforated waste collection bag to drain liquids or water drips down into the collection vessel lower portion.

[022] The waste collection device is suggested to be located at a store or retail location where users dispose, for example, water from used paper coffee or beverage cups and then drop the cup into the collection bin. When the user retreats, an electronic control unit turns on the collection vessel shredder mechanism automatically to begin the shredding operation of the used cup. The shredded pieces of the cut cup are sprayed with disinfectant or biocide (alternatively disinfection by ultraviolet light, micro-waving and/or irradiating is also proposed). The waste liquid or water drips down into the collection vessel lower portion.

[023] The device also presents with a fan to drag in air from outside the device. The pressurised air entering inside the collection bin vents air downwardly into the collection vessel housing. This is provided with vent holes to vent pressurised air inside the collection vessel housing, outside the waste collection device.

[024] Generally shredding paper is required to facilitate the pulping process of paper; this process is generally done on an industrial scale in a paper recovery facility and not by the waste producer. However, the patented device involves the process of shredding and drying materials to favour recycling which in terms of the energy used, these two processes should represent a higher percentage of energy consumption.

[025] Usually waste stored in a household bin has an average density of around 250 kg/m^3. Therefore, if material is reduced in size by a shredding process, then the density will increase (generally values over 300 kg/m^3). The change in density of the materials by reducing size can affect the sorting process (mechanical or hand picking/sorting). In addition, the variation in density can also affect the pathways between the materials (macro-pores) where drying atmospheric air passes. Consequently, more energy (as pressure) is needed in the drying air to overpass the resistance produced by the reduction of the macro-pores, and therefore the fan in the device will consume more electrical energy.

[026] It is therefore discussible if the process of shredding materials needs to be done for the waste producer in its own device or by the paper recycling facility. Therefore, the patented device can result operating expensive to the waste generator.

[027] On the other hand, it is discussible if materials can dry faster or better if they are reduced in size. Shredded materials in contact with air dries faster if they are summited with constant movement, like cascade movement (i.e rotating heat drum). This process is usually an industrial process where the time allowed for storing wet materials or to dry materials is the minimum possible. However, in a production place the time expected to fulfil an average bin bag could vary from minutes to days. Generally on average a 50 litres plastic bag can be filled to 80% during a period of one to two days by a family of 4 people producing 0.5 kg/per-day. Therefore, it is discussible if shredding material is really necessary in this device and therefore it is discussible if the process of shredding materials favours the waste producer.

[028] On the other hand, it is not clear if for the sorting process a high drying process is required. Generally around the world, a common form of sorting materials is hand picking. Sorting materials by hand or machinery will be more difficult if materials are chopped to reduce their size.

[029] In addition, US pat. 2011 /0238598 A1 discloses the device equipped with ultraviolet light (UV) to sanitise the materials; UV light has different ranges, the short range UV considered "germicidal UV" is a 254 nm. However, germicidal UV light is effective in reducing only the airborne micro-organisms that pass directly through the light rays. The effectiveness of the UV over the number of microorganisms eliminated as resistant microorganisms is higher if they are exposed more than once to break them down; it can be done by circulating the materials repeatedly in front of the UV light to ensure multiple passes of microorganisms in front of the UV.

[030] In addition, the US pat. 2011 /0238598 A1 disclosed in his device an air treatment using outside air; which can be understood as atmospheric air used to remove moisture from materials after the shredded. The outside air is not heated by any means (UV light doesn't produce heat on air, neither commercial micro-wave) and therefore the treatment described in the patent does not correspond to a heat treatment.

[031] The capacity to remove moisture from atmospheric air will depend basically on three variables: temperature, pressure and relative humidity. At sea level, air can absorb a certain amount of water until it reaches a saturation point (at 100% relative humidity) after which water starts to precipitate. The saturation point can be reached by two ways: by adding humidity to the air or by reducing the temperature of the system. For example, at sea level $1m^3$ of standard air can carry a maximum of 0.9 grams of water if the temperature of the air is -20 degrees Celsius, 4.9 grams if the temperature is 0 degrees Celsius and 30.4 grams of water if the temperature is 30 degrees Celsius. How much water is in the air compared with how much there could be before it starts condensing is known as relative humidity. Considering for example that atmospheric air at 20°C can hold up to 17.3 g/m^3, and supposing that at selected moments the air happens to contain 10 grams of water per cubic meter (at 20°C); then, the relative humidity will be 58%. Then, as soon as additional water is added (> 7.3 grams per m^3), then water will not be held by the air and precipitation will start until balance is recovered. To avoid the precipitation of water the temperature of the air needs to increase or the volume quantity of air needs to be increased. Therefore, in the patented device the quantity of air introduced into the device can vary depending on the quantity of moisture to be removed and the conditions (temperature, relative humidity and pressure) of the atmospheric air.

[032] Additionally, the time materials are expended in the device or the caudal of the air used to remove moisture can be affected by the changes in the atmospheric conditions.

[033] Despite the device introducing atmospheric air to dry materials, this air treatment cannot be considered a heat treatment because the atmospheric air is not inducing changes in its temperature nor is there any indication that an external heater is used to heat the air prior to entry into the device. In addition, the device does not specify an insulation system used to maintain the heat in the device and/or to increase the efficiency of heat transferred. Therefore, hot air for the purpose of sanitation is not used in that device.

[034] In the patented device, to sanitise the shredded materials ultraviolet light (UV) is used; shredded materials in the device are exposed for some seconds to the ultraviolet light (UV) to sanitise (to avoid overload in the upper part of the device the material is shredded and deposited in the plastic bag in a question of seconds). However, if the exposure time is not enough, then microorganisms can survive in the materials despite the UV light. Since microorganisms can be shielded from ultraviolet light in small cracks and other shaded areas, these lamps are used only as a supplement to other sterilisation techniques.

[035] The study **Inactivation of Food Spoilage Fungi by Ultra Violet (UVC) Irradiation** presented in the **International Journal of Food Microbiology** in 2008 showed that 37.83% of fungal spores of *Aspergillus niger* spread on the surfaces of agar plates survived after 15 seconds of exposure to direct ultra violet light (254 nm, UVC dose 2322 J/m2). To inactivate 94% of these microorganisms an exposure time of 30 seconds was necessary and 60 seconds to inactivate 99%. *Aspergillus niger* is a potentital spoilage mould in bakery products (the baking process destroys most mould spores in baked products, however, subsequent surface contamination with mould spores can occur after baking through the addition of toppings such as nuts, sugar and spices and also during the cooling and packaging processes.

[036] The ultra violet (UV) light is proposed as a disinfectant mechanism that does not generate heat which may char films or generate condensation problems (i.e. polyethylene, polypropylene, and poly (methyl methacrylate) are sensitive to oxidation and UV radiation). Effectiveness of this process depends on the UV absorbency of the materials.

[037] Additionally, it is necessary to clarify that UV light is not generally used to heat atmospheric air, as is the case for micro-waving.

[038] The patent makes a reference to sterilisation of materials by using microwave and non-microwave drying techniques as alternative methods to drying the waste. Micro-waving technologies are not generally used to heat atmospheric air because adjustment of the frequency (resonance frequency) is required to make the air content in the atmosphere (O2 or N2) oscillate. In other words, these gases can remain unaffected by microwave energy so there would be no heat generation. In addition, micro-waving technology to heat air can be extremely inefficient as well as carrying possible health issues. The change in frequency can also imply that the new frequency is not equal to the frequency required to heat other materials or water to induce evaporation; which therefore means that the micro-waving drying technique is not used in this patent.

[039] Therefore, in this patent, ultra violet (UV) light, micro-waving, refrigeration, freezing and/or irradiation are proposed as direct disinfecting mechanisms; which are suggested to be complemented by disinfectant spray mechanisms. However, not one of the mentioned sterilising mechanisms is suggested to be used with

the aim of heating the atmospheric air in order to facilitate drying of the materials and then inactivation of microorganisms. In addition, there is not the intention to heat the air that penetrates the macropores of the materials in order to dry them.

[040] After the analysis of different technologies to treat MSW, the authors of this patent consider that it would be desirable to provide a technology to treat MSW in the production place that can be affordable for everybody and at the same time enhance the process of sorting and recovering inorganic and organic matter. This would then ensure minimum quantities of materials left to be carried to a final disposal place in the landfill, as well as help to optimise the energy used in the transport system for the MSW.

STATEMENT OF THE INVENTION

[041] The present invention relates to an Dehydrator waste bin called WilcoBIN, a heat resistant perforated bin bag and a thermal pre-treatment process for the gentle dehydration of mixed municipal solid waste (MSW), and the like, in the primary production place.

ADVANTAGES

[042] Materials leaving the WilcoBIN will be sterilised and smells will be reduced. This will allow pre-treated materials to be stored for longer periods in case this is required. Consequently the smell at the picking points will be reduced too. In addition, the weight of pre-treated materials will be reduced through reduction in the moisture content, and therefore the energy required by the collection and transport vehicles will be reduced too.

[043] The WilcoBIN technology could be used in any country in the world, allowing the people to have high-tech treatment of MSW at reasonable values. Processes like sorting will be favoured by working with dehydrated waste. In addition, dehydrated organic matter from the WilcoBIN can be recovered and treated further with microorganisms by reintroducing water and inoculating the material with microorganisms (i.e. organic matter treated to produce compost or in an anaerobic process to produce gas). Recyclables will be recovered more easily and in a greater quantity with less energy while a smaller quantity of materials will be sent to the landfill.

[044] Other kinds of waste for example toilet waste, nappies can be treated with this system which will reduce the risk of bacterial contact.

[045] As WilcoBIN allows the use of solar energy, the electricity consumed or other non-renewable sources of energy can be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[046] A detailed description of the invention will be described below with reference with the following drawings:

[047] FiG. 1 is a general view of the of the Dehydrator Waste Bin called WilcoBIN; While FiG. 2 (page 9) is an schematic representation of the Heat Resistant Perforated Bin Bag.

[048] FIG. 3 is a schematic cross-section of the WilcoBIN showing the different devices and the process of heat fresh air, moving it through the waste until reaches a clean stage in the filters.

[049] FIG. 4 shows a cross-section of the WilcoBIN and the re-circulation process of the hot air.

[050] FIG. 5 shows a cross-section of the WilcoBIN and a door opening, including the air extracting to avoid odours when the door is opened.

[051] FIG. 6 shows a croos-section of the wilcoBIN and the water holding removable tank.

DETAILED DESCRIPTION OF THE INVENTION

[052] The objective of this **new propose invention called WilcoBIN** is to provide an apparatus and a heat resistant perforated bin bag to enhance the transport, sorting, recovery and recycling of MSW to overcome or alleviate the above described drawbacks.

[053] WilcoBIN is proposed as a pre-treatment of the waste in the production place (i.e. household, toilets, office, shops, and restaurants). It will function in two ways: as a storage waste bin located in the production place and as the pre-treatment system. WilcoBIN is a gentle dehydrator of the mixed MSW and comprises of a hot air supply 6, a recirculation system (Figure 4), a heat exchanger 8 (**which is equipped with a thermoelectric Cooler Peltier 9)**, a vibrating unit **12** (which will be used for the eventual mixing of MSW during the dehydrating process which allows relocation of materials inside the perforated bin bag) and air filter system **10**. In addition a perforated bin bag 1 allows pre-treatment of the produced waste with hot air while being stored by the producer, as well as acting as a flexible container which holds the materials to allow them to be carried to the picking point.

[054] The pre-treatment of the waste in the WilcoBIN cannot be considered as a continuous or as a batch process due to the waste that will be deposited in the bin as it is being created by the producer.

[055] The dehydrating process starts with the heating of air. An automatic valve 13 open to allow a fan 3 to introduce atmospheric air which will past through Coils 4 to gain calorific energy. Alternatively, air can be heated by using different resources such as: solar energy, electricity or gas. Pipes for gas, hot air from solar heat trappers, or hot air from a provider are an offered alternative **14**. The air will be heated to reach temperatures between 70 to 100 degree Celsius. Hot air will then ascend through micro tubes 5 and after through the perforated bin bag 1 to be in contact with the solid waste deposited in the WilcoBIN. The process will be carried out at around 1 atmosphere pressure. The hot air (70 $^{\circ}$C and above) will remove moisture from the waste, reducing the possibility of bacterial degradation of the organic matter. Moisture content will be removed until materials reach values of between 20 to 25% of moisture content.

[056] Relative humidity and temperature of the air at the entrance/exit of the WilcoBIN will be monitored using hygrometer/thermometer devices 15; therefore, the quantity of water in the hot air leaving the WilcoBIN at the extracting fan 7 will be determined permanently. The hot air leaving the WilcoBIN will be recirculated by opening an automatic gas vale **16 allowing the hot air to reach the fan 3.** At the same time, other automatic gas valves (13 and 17) will be closed to avoid the introduction of fresh air or a negative pressure over the filter 10. The reintroduced hot air will continuously remove moisture content from the waste until it reaches values near to the saturation point. When the hot air reaches values near to the saturation point, the automatic gas valve 16 will be closed while the automatic gas valves 13 and 17 will be opened allowing the hot air going directed through heat exchangers 8 to condensate the water. Excess moisture and water condensation 18 will be stored in a container located at the bottom of the WilcoBIN 2 after an automatic valve 11 is opened**.** The water container 2 can be extracted from the WilcoBIN (figure 6) so the user can dispose the waste water collected through a drain. Alternatively, condensated water can be carried to a drain pipe through the valve **19**.

[057] Hot air leaving the heat exchanger, containing a small amount of humidity, will be passed through a filter 10 to retain particles and microorganisms that survived the thermal process, and to decrease the

odours. Air leaving the WilcoBIN 11 will comply with the admissible levels required for protecting humans and the environment.

[058] All the valves, fans and electronic devices, as well as the electronic sensors, i.e the proximity sensor (which detects when the user is stood at the bin to open and close door 20 of the WilcoBIN using an electric piston 21) will be controlled **by an electronic system 22.** This electronic system will also inform the user if the WilcoBIN is full and if its material content is dry through a screen 23. The electronic system will capture data from the process which then can be exported, as required, to a computerised system. In addition, an electric battery 24 and an electric wire 25 will be installed to supply the requirements for the electricity.

[059] After opening the WilcoBIN door the extracting fan 7 will work to send the hot air and odours to the heat exchangers while the customer deposits or takes out the material, or changes the perforated bin bag from the WilcoBIN. The fan will also help during the recirculation process if hot air required more power to reach and pass through the filters.

[060] The WilcoBIN walls will be cover with insulation materials 26 to avoid heat losses during the dehydration process and to reduce the risk to the humans by heat transfer.

CLAIMS

The invention claimed is:

1. A process and a device named WilcoBIN to pre-treat mixed MSW waste in the production place with hot air (above 70 degree Celsius).

2. A process and device named WilcoBIN utilises hot air (above 70 degree Celsius) to remove the moisture content in the mixed MSW waste in the production place to values of 25% or less; the percentage calculated is based on the weight of the water in the pre-treated materials divided by the weight of the pre-treated materials including the water within it.

3. A process and device named WilcoBIN which includes the recirculation of a percentage of hot air to increase the efficiency of moisture removal.

4. Process and device called WilcoBIN which comprises means for capturing water vapour emitted while drying mixed MSW in the production place.

5. Process and device called WilcoBIN which comprises means for converting the captured water vapour to liquid water which can then either be stored in a receptacle or evacuated to the drain.

6. A heat resistant bin bag with perforations.

7. A device named WilcoBIN which uses a heat resistant perforated bin bag to allow circulation of ascending hot air and drainage of excess water.

8. A designed device named WilcoBIN that uses energy to heat atmospheric air to remove moisture.

9. A designed device named WilcoBIN comprising of an air purifier (or filter) to clean the air leaving the WilcoBIN.

10. WilcoBIN is the first thermal pre-treatment of waste in the production place.

11. A device named WilcoBIN which dries mixed MSW waste to values of water content of 25% (or less) using hot air at temperatures of over 70 degree Celsius.

12. Inside the WilcoBIN the pressure can be atmospheric, positive or negative when the pre-treatment with hot air is applied.

13. A designed device named WilcoBIN comprising of electronic systems that control the; proximity sensor, weight sensor, temperature sensor, humidity sensor, electronic valves and fans (centrifugal, axial or blowers). The electronic system will also make use of a display screen to provide the user with up-to-date information about the process, and the capability to capture this data and export, as required, to a computerised system for analysis.

14. In another embodiment of the invention, the device named WilcoBIN may also be adapted to other configurations, for example the capacity, the shape or the colour may be changeable although the intention to pre-treat mixed MSW with hot air in the production place remains unchanged.

15. In another embodiment of the invention, the frame and the interior container of WilcoBin can be made for different materials including any plastics or non-corrosive metals. Additionally, insulation material will be used within the WilcoBIN to contain the heat used in the process.

16. In another embodiment of the invention, WilcoBIN can use wheels to facilitate its mobility.

17. The phrase: WilcoBIN 'Think outside of the Bin'.

Amendments to the claims have been filed as follows:

The invention claimed is:

1. A process and a device named WilcoBIN to pre-treat mixed MSW waste in the production place with hot air (between 70 to 100 degree Celsius).

2. A process and device named WilcoBIN utilises hot air (between 70 to 100 degree Celsius) to remove the moisture content in the mixed MSW waste in the production place to values of 25% or less; the percentage calculated is based on the weight of the water in the pre-treated materials divided by the weight of the pre-treated materials including the water within it.

3. A process and device named WilcoBIN which includes the recirculation of a percentage of hot air to increase the efficiency of moisture removal.

4. Process and device called WilcoBIN which comprises means for capturing water vapour emitted while drying mixed MSW in the production place.

5. Process and device called WilcoBIN which comprises means for converting the captured water vapour to liquid water which can then either be stored in a receptacle or evacuated to the drain.

6. A heat resistant bin bag with perforations.

7. A device named WilcoBIN which uses a heat resistant perforated bin bag to allow circulation of ascending hot air and drainage of excess water.

8. A designed device named WilcoBIN that uses energy to heat atmospheric air to remove moisture.

9. A designed device named WilcoBIN comprising of an air purifier (or filter) to clean the air leaving the WilcoBIN.

10. WilcoBIN is the first thermal pre-treatment of waste in the production place.

11. Inside the WilcoBIN the pressure can be atmospheric, positive or negative when the pre-treatment with hot air is applied.

12. A designed device named WilcoBIN comprising of electronic systems that control the; proximity sensor, weight sensor, temperature sensor, humidity sensor, electronic valves and fans (centrifugal, axial or blowers). The electronic system will also make use of a display screen to provide the user with up-to-date information about the process, and the capability to capture this data and export, as required, to a computerised system for analysis.

13. In another embodiment of the invention, the device named WilcoBIN may also be adapted to other configurations, for example the capacity, the shape or the colour may be changeable although the intention to pre-treat mixed MSW with hot air in the production place remains unchanged.

14. In another embodiment of the invention, the frame and the interior container of WilcoBin can be made for different materials including any plastics or non-corrosive metals. Additionally, insulation material will be used within the WilcoBIN to contain the heat used in the process.

15. In another embodiment of the invention, WilcoBIN can use wheels to facilitate its mobility.

16. The phrase: WilcoBIN 'Think outside of the Bin'.

Intellectual Property Office

Application No: GB1316374.6 **Examiner:** Mr Joe Cornfield

Claims searched: - **Date of search:** 28 January 2014

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1, 2, 11	US5116363 A1 ROMWEBER waste is treated with air above 250F (121C) to dry it (column 3, lines 5-20)
X	1, 2, 11	US5322603 A KAWASAKI waste is treated with air above 180C to dry it (column 6, lines 5-35)
X	1, 2, 11	GB2297553 A STYROMELT waste is treated with air above 115C to dry it (page 11, lines 3-10)
X	1, 2, 11	JP06300441 A MATSUSHITA waste is treated with air above 100C to dry it (abstract)
X	1, 2, 11	JP64027652 A IGARASHI waste is treated with air at 90C to dry it (abstract)
X	1	JP07205148 A MATSUSHITA waste is treated with air above 130C (abstract)
X	1	US5470521 A WENZEL waste is treated with air above 250F (121C) (abstract)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

B65F

The following online and other databases have been used in the preparation of this search report

Intellectual Property Office

WPI, EPODOC

International Classification:

Subclass	Subgroup	Valid From
B65F	0001/14	01/01/2006
A61L	0011/00	01/01/2006
B65F	0001/06	01/01/2006