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METHOD OF REFUSE DISPOSAL

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FIG. 1

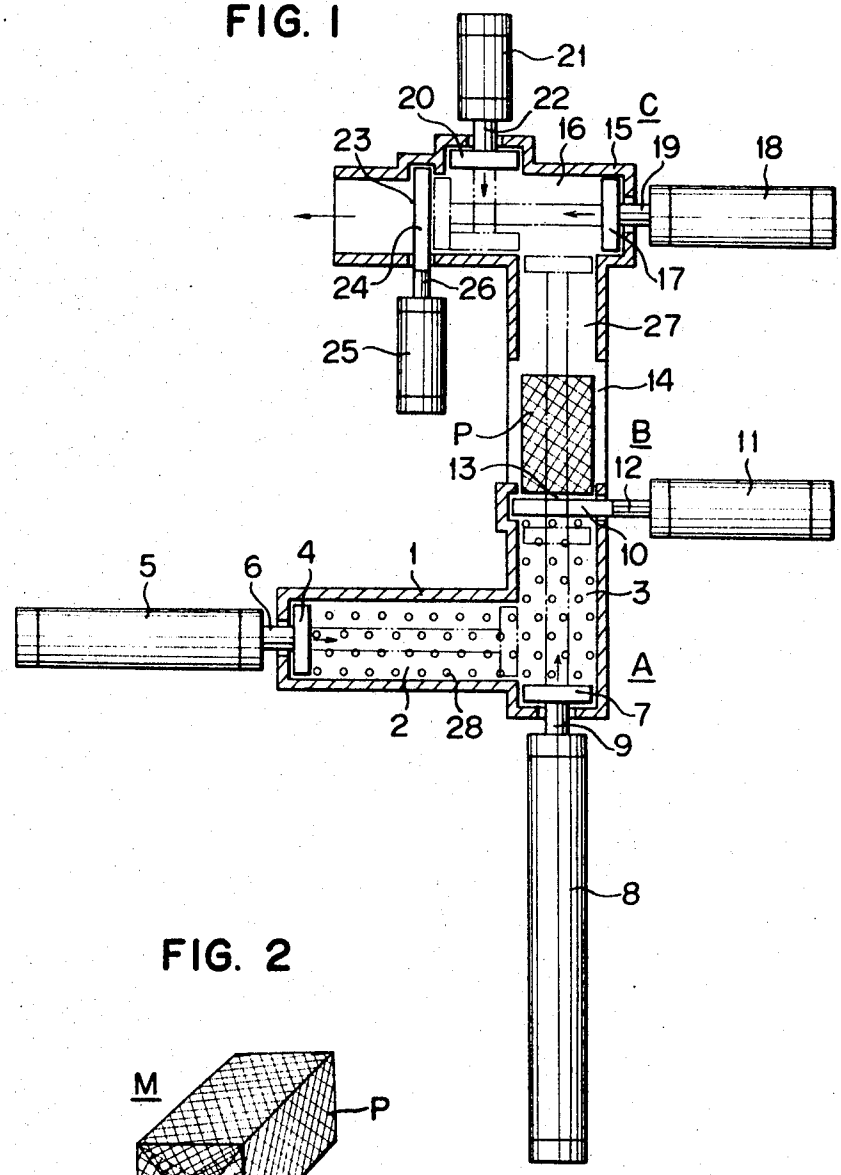

FIG. 2

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METHOD OF REFUSE DISPOSAL

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ABSTRACT OF THE DISCLOSURE

Method of refuse disposal, particularly of garbage, trash, waste and the like, by solidifying batches of the refuse, reducing thereby its volume and increasing its apparent specific gravity, so as to form substantially solid refuse blocks of predetermined shape, and applying a cover to the solidified refuse blocks.

The present invention relates to a method of refuse disposal, particularly for garbage, trash, waste and the like, especially from kitchens, food processing factories, food stores or the like, daily discharged in huge quantities.

The amounts of refuse discharged nowdays in highly populous urban areas, and in the industrial mass production of foods, are quite substantial so that the effective disposal of refuse is an increasingly critical and important problem when aiming at maintaining proper environmental sanitation.

As a heretofore known example of refuse disposal, incineration should be mentioned which, however, is too expensive in view of the large amounts of fuel as well as time that have to be spent, particularly when disposing of wet garbage since it consumes much larger amounts of fuel. Uneven moisture content makes the incineration rather difficult and economically hard to control. Moreover, the discharged soot, smut or noxious gases produced due to incomplete combustion will give rise to atmospheric contamination.

When places are set up for incinerating refuse, in remote suburban areas selected to avoid drawbacks of this method of refuse disposal, much more cost and/or labor may be involved than might be required for transporting and dumping the refuse. However, the underground or underwater submersion of refuse, another example of hitherto practised manner of disposal, requires vast spaces for burying the refuse in its original, unaltered condition, as collected; this would evidently result in most unsanitary conditions which have to be avoided.

It is one of the major objects of the present invention to provide a method of refuse disposal by solidifying the refuse into compact, substantially solid blocks of fixed size, convenient and suitable for disposal and/or use in a utilitarian manner in the reclamation of sea or river embankments and the like, for underground or underwater submersion; alternately, economical and sanitary incineration of the refuse blocks is also possible.

Another object is to dehydrate the refuse to a substantial degree, preferably while solidifying or compacting the same, so as to reduce the weight of the refuse blocks, prevent bacteria growth, and make the blocks suitable for any one of the afore-mentioned purposes, including incineration and use for land reclamatiton.

Yet another object is to wrap the solidified refuse blocks with an appropriate cover material which has the multiple purpose of holding the refuse together, preventing decomposition and bacteria growth, and allowing the utilitarian uses owing to easy transportability of the solidified and wrapped refuse blocks. The cover material prevents bad odor, noxious gases, keeps away flies and other insects, and greatly enhances sanitary conditions wherever the refuse blocks are made, manipulated, used and/or disposed of.

Still another object is to use in the inventive method a sheet-like elongated piece of said cover material, most suitable for economical and expeditious processing.

It is a further object to increase the apparent specific gravity of the solidified refuse blocks so that they may be used, for example, for the reclamation of sea embankments or other underwater areas.

In accordance with one of the major features of the inventive method of refuse disposal, the loose refuse is subjected to solidification or compacting by a number of possible steps, such as in a suitable press or compression box. Depending upon different kinds of refuse to be disposed of, or upon the purpose or use to which the compacted (and wrapped) refuse blocks are to be put, varying amounts of compressive forces may be applied; the final means of disposal and/or other factors may also be considered. For example, if the refuse blocks are to be submerged under the sea, a powerful solidifying or compacting action has to take place so as to result in relatively hard blocks having an apparent specific gravity allowing the blocks to sink readily underwater. If, however, blocks are to be made for ordinary incineration, the applied force may be much smaller than in the former case, just enough to make the blocks combustible yet easily transportable, if necessary.

In accordance with another important feature, the solidifying step preferably includes powerful dehydration by one of a number of possible means, such as compressing, heating, subjecting to vacuum, and so on. This is important for preventing decomposition within the refuse blocks, and in case the blocks are to be incinerated.

For purposes of convenience, the invention envisages the production of refuse blocks of predetermined sizes, easy to manipulate, transport and incinerate, as the case may be. For sea reclamation and similar purposes, the refuse blocks may be used as bricks or similar elements, and their proportions and sizes may be determined accordingly.

A further important feature of the inventive method relates to the wrapping of the already solidified refuse blocks. For this purpose, plastic sheets such as vinyl chloride, polyethylene or the like may be used, reinforced preferably with wire netting or the like; also, sheet-like covers may be used such as plastic sheets, metallic foils, with or without reinforcement as mentioned before. Alternatively, reticular covers such as wire nettings, strips of canvas, steel bands or the like may also be employed. If it is important to shut off offensive odors, film-like wrapping means are used; however if this is not required, such as in direct incineration, the reticular cover is suitable.

Before or during the solidifying step, chemical substances may be added, or gases may be administered, to prevent subsequent fermentation, decomposition, fungus growth, and the like. Depending upon the nature of the refuse, selected substances or compositions thereof may be used, as will be understood by those skilled in the art.

The solidifying and/or the dehydrating steps may be combined with efficient de-aeration, having a purpose similar to that of the addition of chemical substances or gases. If the crevices or interstices between the refuse particles are substantially de-aerated, the solidified refuse blocks will maintain their physical configuration for a longer period of time, or, will actually not become decomposed as they would without the afore-mentioned preventive treatments.

Yet in accordance with an essential feature of the inventive method, a preliminary as well as a secondary solidifying step may be applied, the latter after the wrapping step. Thus, the compressive forces are applied both

to the loose refuse, and subsequently to the already wrapped blocks, further increasing the consistency, and rendering the refuse blocks suitable for further application or disposal, as explained before.

According to the present invention, tremendous piles of refuse may be solidified, and preferably the moisture expelled therefrom at the same time, to a substantial degree, whereupon the solidified blocks are wrapped up with the cover, so that solid, easily portable blocks are obtained which have a very small volume. When such blocks are buried underground or underwater, sanitary disposal of the refuse is achieved within a limited space; when incinerated, expenses are greatly reduced and operations will become more efficient. Moreover, the compacted or solidified refuse blocks may be used to develop land by reclaiming from the sea, from rivers, and the like.

It should be noted that a specific, exemplary device for carrying out the refuse disposal method of the present invention is disclosed in applicant's co-pending patent application filed on even date, entitled "Device for Refuse Disposal," Ser. No. 569,991. While said other application covers but one possible embodiment of a device for carrying out the novel method of the present application, various procedural steps are considered herein for achieving the desired result, beyond the disclosure of the co-pending application.

The present invention will be better understood, and additional advantages thereof will become more apparent, upon perusal of the following description, taken in conjunction with the appended drawing, wherein:

FIG. 1 is a somewhat schematic, planar, cross-sectional view of an exemplary device for carrying out the new refuse disposal method; and

FIG. 2 is a perspective view of a solidified and wrapped refuse block made according to the method of this invention (not necessarily with the device of FIG. 1).

For an easier cross-reference with the above-mentioned co-pending application, it should be noted that the two figures of the present application respectively correspond to the FIGS. 2 and 6 of the other application (the present FIG. 1 being reversed with respect to its top and bottom, and somewhat simplified).

Before discussing alternative procedural steps forming part of the inventive refuse disposal method, the steps will be described which are taken when using the illustrated exemplary device.

EXAMPLE 1

The method of the present invention can be performed with a preliminary or first solidifying stage A, a succeeding wrapping stage B, and an optional secondary or second solidifying stage C following after stage B.

The stage A may comprise a compression box **1**, so devised that a feeder chamber **2**, having a square cylindrical port, and a compression chamber **3** proper are provided in an L-shape, and communicating with one another. The preliminary solidification according to the inventive method may be carried out in said chamber **3**. In the chamber **2**, a force plate **4** is slidably inserted from its remote end, and is secured to a ram **6** of an oil-pressure or similar actuating cylinder **5**. By applying a hydraulic fluid to the appropriate end of the cylinder, the force plate **4** will reciprocate in the chamber **2**.

In a similar manner, chamber **3** includes a force plate **7** secured to a ram **9** of an oil-pressure cylinder **8**, slidably inserted from the end of the chamber **3** adjoining the chamber **2**. The force plate as well as its cylinder are long enough to pass through the chamber **3** and extend to the side of another compression box, identified by numeral **15**, forming part of the secondary solidifying stage C. In the path of the plate **7**, the chamber **3** has an opening **13** provided with a slidable door or plate **10**, secured to a ram **12** of an oil-pressure cylinder **11**, so as to open or shut the opening **13**.

A plurality of discharge holes **28** may be provided in the bottom and/or sides of the compression box **1** (including both chambers **2** and **3**) to allow water and other liquid substances to be discharged during the procedure.

Between the stages A and C, there is a control chamber **14**, constituting the wrapping stage of the exemplary device. It is here shown with open side walls so that a wrapper or packing cover P may be applied to the solidified or compacted refuse block. It may be added at this point that FIG. 2 shows the completed refuse block M having the wrapper therearound; this is obtained upon performing the optional secondary solidifying step, as will be explained hereafter.

In the stage C, the compression box **15** comprises a square cylindrical compression chamber **16** with a force plate **17** secured to a ram **19** of an oil-pressure cylinder **18**, similarly to the stage A, disposed for longitudinal movement within the chamber. Another force plate **20** is secured to another ram **22** of a further oil-pressure cylinder **21**, spaced apart from the just described force-plate system of this chamber, preferably in one of the side walls. The compressing direction of the force plate **20** is at right angles to that of the plate **17**.

Between the control chamber **14** of stage B and another side wall of the chamber **16**, there is a port **27** in rectilinear arrangement with chambers **3** and **16**, and furthermore there is a slidable door or plate **24** (similar to door **10**) at the remote, open end of the chamber **16**, opposite the force plate **17**. The door **24** is secured to a ram **26** of an oil-pressure cylinder **25**, and is operated thereby for opening or closing the open chamber end, identified by numeral **23**.

When practising the inventive method with the exemplary device shown in FIG. 1 and just described, a load of refuse collected, for example, by dump trucks, in a quantity of about 170 kg., is introduced into the feeder chamber **2** of the compression box **1**. The average apparent specific gravity of such refuse is around 0.25 t./m.^{3}. Hydraulic fluid is now introduced into the cylinder **5** so as to push forward the force plate **4**, thereby pressure-feeding the refuse into the compression chamber **3**. Thereafter the force plate **7** is made to advance, preferably while the plate **4** is in its advanced position (shown in dot-dash lines), thereby performing the solidification of the refuse, under pressure of about 70 kg./cm.^{2}, between the plate **7** and the door **10**.

The refuse is thus formed into substantially solid, cubic blocks having about 0.24 m.^{3} of volume (measuring 60 x 70 x 57 cm., as a matter of example), and about 0.71 t./m.^{3} of apparent specific gravity, the volume thereof having been compacted or compressed down to about 1:2.8. As will be explained somewhat later, this may constitute the preliminary solidification of the refuse.

Preferably, the cover P formed into square cylindrical shape, and consisting, as a matter of example, of a vinyl sheet reinforced with a wire netting, is placed behind the door **10**; after opening the latter, the force plate **7** is made slightly to advance so that the compacted block of refuse is forced into the cover. The two ends of the cover can then be closed or tucked around the block so as to wrap it up from all sides. Thereafter the force plate **7** is further advanced and the wrapped-up refuse block is thus forced into the compression chamber **16** through the port **27**. The sheet may also be used for wrapping the compacted or solidified refuse blocks in the unmodified state, and the wrapping operation may of course be carried out manually, semi-automatically or automatically by proper means available at stage B.

If a secondary solidification of the once compacted and subsequently wrapped refuse is required, this is carried out by advancing the force plate **17**, thereby moving the wrapped refuse block in the area adjacent the door **24**. Thereafter the force plate **20** is advanced, and the secondary solidification is thus carried out, again under a pressure of about 70 kg./cm.^{2}, between said plate **20** and the side walls of the compression chamber **16**. Preferably, the force plate **17** is maintained in its advanced position

(about halfway between the solid-line and the dot-dash line positions).

The wrapped refuse block is thus further solidified so as to be about 2/7 of the original volume, that is, about 0.19 m.^{3} in volume, with an approximate size of 60 x 70 x 46 cm. The refuse block now has an apparent specific gravity of about 0.88 t./m.^{3}. The cover P now tightly adheres to the refuse so that it could not be separated therefrom, or only with difficulty.

The door **24** can now be opened and the force plate **17** advanced to the dot-dash position so as to deliver the block M out of the stage C past the opening **23**.

EXAMPLE 2

When solidified refuse blocks are needed for reclamation of seashores, rivers, or the like places, the method of the present invention can also be performed in a different manner.

The first-stage or preliminary solidification is carried out as in Example 1 on a load of about 170 kg. refuse by applying a pressure of about 70 kg./cm.^{2}. The average specific gravity of the refuse can be assumed to be around 0.25 t./m.^{3} when introduced into the solifidying stage.

The refuse blocks are wrapped with a vinyl sheet reinforced with wire netting, whereupon the wrapped refuse blocks are preferably subjected to the second-stage or secondary solidification, in a manner as described before, but with the application of a compressive force of about 150 kg./cm.^{2} (about twice that used in the first solidifying stage).

The solid refuse blocks will now assume an approximate volume of 0.19 m.^{3}, with an approximate block size as stated before; however, the apparent specific gravity will now reach approx. 1.2 t./m.^{3} or preferably more. This corresponds to an overall (two-stage) solidification down to about 1:4.8 of the respective volumes.

Wrapped refuse blocks of 1.2 t./m.^{3} apparent specific gravity or more may be sunk underwater, and they may serve as a foundation for further land reclamation procedures.

In the preceding two examples, solidifying and concomitant dehydration are carried out in the exemplary, illustrated device. It will be understood that presses, compression boxes and similar compacting means may be used with the same effect. However, it is possible to separate the two procedural steps and apply a forceful dehydrating step, preferably before the first solidification.

To this end, heating may be used in suitable containers, up to temperatures which will greatly depend from the nature of the particular refuse processed. Another efficient manner of dehydrating the refuse is by applying subatmospheric pressure thereto in a suitable closable container. This procedure, while conducive to dehydration, is also efficient in de-aerating the refuse, which is another step contemplated according to the inventive method, for preventing decomposition, fungus formation, and other organic processes that may persist even after forceful solidification and wrapping of the refuse.

To the same end, liquid, pulverulent or solid chemical substances may also be added to the refuse, preferably before or during the first solidification. While numerous such substances are known for various specific applications, it should be considered that the invention particularly aims at preventing anaerobic fermentation and decomposition processes, and thus substances known from sewage disposal and other related fields will be applied which perform in this sense. Inert and other gases are of course also within the possible chemical substances that can be administered to reduce untoward aftereffects in the wrapped refuse blocks.

In the preceding description, preference has been given to the application of a sheet-like, preferably plastic, wrapping material or cover. It should be understood, however, that it is entirely possible to spray on a layer of plastic, dissolved for example in an easily evaporable solvent, which will result in a maze of fibers or in a continuous plastic layer surrounding the refuse block. This alternative procedural step may of course be combined with the application of a wire netting or other reticular material.

It is also within the scope of the present invention to apply a first, for instance plastic, cover between the first and the second solidifying steps, the latter being then followed by the application of a second cover, e.g. in the form of a wire net, canvas strips, metal bands, or the like. The last-named cover means can of course be applied by means of bundling tools or devices known from the packaging industry.

It should be noted that no numerical values have been advanced in the preceding paragraphs with respect to the alternative dehydrating, chemical treating, additional wrapping and other procedural steps. However, it is believed that the factors influencing these values are too numerous to be evaluated or listed, even within a selected number of examples. It will, therefore, be considered self-explanatory to those skilled in the art that the primary and basic steps of the inventive method, like the solidifying and the wrapping, can be reconciled with widely varying variables of the afore-mentioned additional steps.

As a result of the inventive method of refuse disposal, the solid, wrapped refuse blocks can be transported in large quantities on vehicles so that the blocks can be transported and then dumped at low cost and without any difficulty. Semi-automatic or automatic means may be adopted since regular-sized, uniform blocks are involved in lieu of irregular masses of refuse. A larger quantity of refuse blocks can of course be processed, transported and disposed of than would be possible without the solidification and/or wrapping. First-class sanitary conditions are maintained throughout the operations, except perhaps for the primary handling of the incoming masses of refuse.

In the solidified and wrapped blocks, a substantial proportion of vegetable and other matter is demolished and broken up by the solidification; remaining moisture, if there is any at all, is uniform throughout the wrapped blocks and, consequently, even in a huge body of dumped refuse. This is of primary importance if the refuse blocks are to be incinerated; almost perfect combustion can thus be attained, with a minimum expenditure in fuel and no waste at all.

The foregoing disclosure relates only to preferred, exemplary features and alternatives of the inventive method, which is intended to include all changes and modifications of the examples and alternatives described, within the scope of the invention as set forth in the objects and the appended claims.

What I claim is:

1. A method of refuse disposal, comprising the steps of solidifying batches of refuse, reducing thereby their volume and increasing their apparent specific gravity, so as to form substantially solid refuse blocks of predetermined shape, and applying a cover to said refuse blocks, wherein said solidfying step includes a preliminary and a secondary solidification performed before and after said step of applying a cover, respectively.

2. The method as defined in claim **1**, wherein said cover is applied in the form of a reticular material.

3. The method as defined in claim **1**, wherein said cover is applied in the form of a sheet-like plastic material.

4. The method as defined in claim **3**, wherein said sheet-like material is reinforced with a reticular material.

5. The method as defined in claim **1**, wherein said cover is applied by spraying on a plastic material.

6. The method as defined in claim **1**, wherein said cover is applied by passing a plurality of elongated elements around said refuse blocks.

7. The method as defined in claim **1**, wherein said solidifying step includes the step of dehydrating said refuse by compression.

8. The method as defined in claim 1, further comprising the step of dehydrating said batch of refuse before said solidfying step.

9. The method as defined in claim 8, wherein said dehydrating step is performed by the application of heat.

10. The method as defined in claim 8, wherein said dehydrating step is performed by the application of subatmospheric pressure.

11. The method as defined in claim 1, further comprising the step of administering a chemical substance to said batch of refuse so as to prevent decomposition after said step of applying a cover.

12. The method as defined in claim 11, wherein said administering step is performed with a pulverulent substance added to said batch of refuse.

13. The method as defined in claim 11, wherein said administering step is performed by applying a gaseous substance to said batch of refuse.

14. The method as defined in claim 1, wherein said preliminary and said secondary solidification are performed by the application of compressive forces of at least 70 and 150 kgs. per square centimeter, respectively.

15. The method as defined in claim 14, wherein the volume of said refuse blocks after said preliminary and said secondary solidification is less than about $5/14$ and $5/24$ of the volume of said batches of refuse before said preliminary solidification, respectively.

16. The method as defined in claim 15, wherein the apparent specific gravity of said refuse blocks after said secondary solidfication is at least 1.2 tons per cubic meter if said batches of refuse have an average specific gravity of around 0.25 t./m.^{3}, allowing their use for sea reclamation and other underwater purposes.

17. The method as defined in claim 1, wherein said step of applying a cover includes first applying a sheet-like cover material to said refuse blocks between said preliminary and said secondary solidification, and then applying a plurality of band-like cover elements to the covered refuse blocks subsequent to said secondary solidification.

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U.S. Cl. X.R.

53—3, 21, 24, 25, 27; 100—3, 42; 264—129