

PATENT SPECIFICATION

(11)

1 340 948

DRAWINGS ATTACHED

(19)



- (21) Application Nos. 33318/71 (22) Filed 15 July 1971
19643/72 27 April 1972
(23) Complete Specification filed 5 July 1972
(44) Complete Specification published 19 Dec. 1973
(51) International Classification B01D 43/02
(52) Index at acceptance
F4G 1F 1H 1J 1Q3 2G

(54) IMPROVEMENTS RELATING TO SLUDGE DRYING

(71) I, PETER JOHN NORRIS of 13 Maltravers Drive, Littlehampton, Sussex, a British subject, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the drying of sludges in what are normally referred to as beds each having a surface designed to permit a liquid ingredient or liquid ingredients of the sludge to drain there through whilst a solid ingredient or solid ingredients of the sludge remains or remain behind on the said surface.

The expression "sludge" as used herein and in the claims should be construed not in any narrow specific sense, but to include any liquid waste containing between 1% and 15% of solids in suspension, by weight. One or the liquid ingredient may, but need not necessarily be, water.

Such beds will hereinafter be referred to as "drying beds" and, in applications where the said liquid ingredient or the said liquid ingredients predominantly comprise, water, as "dewatering beds."

The disposal of the sludge from such beds, as well as drainage as aforesaid, presents certain difficulties, particularly in the case of sewage sludge, and the invention will therefore hereinafter be explained in its application to sewage disposal, its object being to reduce or eliminate these difficulties particularly, though not exclusively, in such applications.

According to a first aspect of the present invention, in a drying bed as hereinbefore defined, the said surface is that of a layer or slab of porous, no-fines concrete as hereinafter defined, contained within a boundary bank or wall.

By the expression "no-fines concrete" as used herein is to be understood a concrete made from coarse aggregate and cement

(with or without a plastics or other additive) or cement fondu or any other suitable binder, such as a synthetic resin or bitumen, but not containing the fine aggregate normally present in conventional concrete.

Sludge drying and disposal also frequently presents a problem in water treatment plants, and according to a second aspect of the invention, in a process for the treatment or purification of a water supply, a sludge formed in the course of such treatment or purification is dewatered by depositing it in a dewatering bed defined by a drying bed in accordance with the said first aspect of the invention, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surface.

Problems of sludge handling also present themselves in the industrial processing of agricultural produce, and according to a third aspect of the invention, in a process for the treatment, purification or refinement of a liquid other than water, in which a sludge is formed in the course of such industrial activities, the sludge is dried by depositing it in a drying bed in accordance with the said first aspect of the invention, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surfaces.

Furthermore, the invention also includes within its scope plants for treating and/or purifying water by a process in accordance with the said second aspect of the invention and to plants and factories for treating, purifying and/or refining liquids other than water by a process in accordance with the said third aspect of the invention, as well as to water when treated or purified, and to liquids other than water when treated, purified and/or refined in a said plant or factory

[Price 25p]

or by a said process.

The no-fines concrete as hereinbefore defined from which the said layer or slab is made preferably comprises a single size aggregate of predetermined grade bonded together by a suitable binder which does not fill the interstices so that the resulting structure is honeycombed and fully porous. Such single size aggregate may preferably have a nominal size of $\frac{1}{8}$ " to $1\frac{1}{2}$ ", and may comprise any of the materials known to those skilled in the art for comparable purposes, provided they have sufficient strength and are compatible with the binder or binders used. Natural or crushed gravel are, however, preferred aggregates for use with portland cement binders with a suitable aggregate-to-cement ratio. Other binders which may be used with these or other aggregates include the rapid hardening cements, cement fondu, cements with plastics or other chemical additives, synthetic resins or bitumen.

The said layer or slab may conveniently be laid on top of a drainage beach. By the expression "drainage beach" is meant a base of granular material defining a drainage medium, which enables the filtrate to pass through it and acts as a foundation for the rigid no-fines concrete surface. To provide the requisite rigidity, a thickness of the layer or slab of approximately 3" to 9" is normally adequate. The said drainage medium of the drainage beach may include or consist of broken and crushed stone, hard clinker, blast furnace slag, natural or crushed gravel, precast concrete bodies or any other appropriate media having free draining characteristics and being sufficiently resistant to crushing to carry the load imposed upon it. The depth of the drainage beach may typically be between 3" and 24" approximately. It may, if desired, include drain pipes of clay, pitch fibre, plastics or other suitable material embedded in the drainage beach.

Alternatively, the drainage beach may be omitted and the said layer or slab simply laid or positioned above an air space with suitable means of structural support.

The said surface should preferably be not only of adequate rigidity but also level, even and devoid of any substantial surface irregularities, so as to avoid the danger of damage during sludge removal by mechanical or manual means.

The said surface may be that of a plurality of juxtaposed slabs which may be prefabricated and laid over a said drainage beach or over an *in situ* porous no-fines concrete support layer and may be held in position by suitable runners or bearers to form a continuous rigid surface structure. Such slabs could be removed periodically by the use of mechanical lifting aids and replaced

by fresh slabs, to allow routine cleaning and maintenance of the slabs to be effected without interfering unduly or at all with the operation of the drying-or dewatering bed.

A further modification envisaged is the laying of perforated small bore pipes at the base of the said no-fines concrete surface layer, slab or slabs, such pipes being connected to a pump drawing a suitable flushing liquid from a reservoir, storage tank or well to enable the said layer, slab or slabs to be cleaned periodically by back-washing. This flushing liquid may be water or sewage effluent in the case of sewage sludge drying beds, or, in the case of the other possible applications of such beds as above-mentioned, water or other liquid ingredient or ingredients of the sludge.

As is well known to those skilled in the art, the proportions of liquid drained off and solid left behind on the said surface respectively depends on a number of factors, such as the nature of the sludge (e.g. the particle size of the solid matter) and the time permitted for drainage, the latter having to be sufficient to enable the material retained on the surface to be handled as a solid, viz. for it to have an angle of repose.

One form of sludge drying bed embodying the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:—

Figure 1 is a sectional elevation of the bed on the line I-I in Figure 2; and

Figure 2 is a plan view of the bed and of portions of two beds adjacent the first-mentioned bed.

The drying bed shown in the drawings is designed as a dewatering bed for sewage sludge, but it would be equally suitable for any of the other applications heretofore mentioned.

Referring to the drawings, the bed comprises, contained within a boundary wall 1, a floor 2 supporting a drainage beach 3 on which is laid a rigid layer 4 of porous, no-fines concrete, and clay or tile drain pipes 5 embedded in the drainage beach 3 and leading to a collecting drain 6.

Alternatively, an air space may be provided instead of the drainage beach 3.

A sludge feed channel 7 is provided in one of the boundary walls 1.

In operation, sludge to be dried or dewatered is conveyed along the feed channel 7 whence it runs into the bed, where it is left deposited on the layer 4 for a sufficient period for the desired proportion of the liquid ingredient or ingredients of the sludge to drain away through the said layer and through the drainage beach into the drains 5 and thence to the collecting drain 6.

This period is found from experience and is sufficiently long for the material retained on the surface of the layer 4 to be handled

as a solid.

This solid may then be removed by manual labour using shovels, or preferably by mechanical means of known kind, before a further batch of sludge is admitted to the bed as aforesaid.

The principal advantage of a drying bed constructed in accordance with the invention resides in the fact that the surface of the layer 4 is highly resistant to damage by the said mechanical sludge removal means. Such surface damage was hitherto the main reason for having to employ manual labour for the purpose, which is comparatively uneconomical and also becoming increasingly scarce because of the comparatively unpleasant nature of the work.

An example of a liquid waste which is intended to be encompassed by the expression "sludge" as used herein and which might be dried in a bed embodying the invention, is oil palm factory waste, resulting from the processing of the palm fruit bunches in a plant or factory designed for this purpose.

WHAT I CLAIM IS:—

1. A bed for drying a sludge and having a surface designed to permit a liquid ingredient or liquid ingredients of the sludge to drain therethrough whilst a solid ingredient or solid ingredients of the sludge remains or remain behind on the said surface, wherein the said surface is that of a layer or slab of porous, no-fines concrete as hereinbefore defined, contained within a boundary bank or wall.

2. A drying bed according to Claim 1, wherein the no-fines concrete comprises a single size aggregate of predetermined grade bonded together by a suitable binder which does not fill the interstices, thereby providing a honeycombed structure.

3. A drying bed according to Claim 2, wherein the single size aggregate has a nominal size of $\frac{1}{4}$ " to $1\frac{1}{2}$ ".

4. A drying bed according to Claim 2 or Claim 3, wherein the said aggregate consists of natural or crushed gravel and the binder includes or consists of portland cement.

5. A drying bed according to Claim 2 or Claim 3, wherein the binder includes or consists of a rapid hardening cement, cement fondu, a cement with a plastics or other chemical additive, a synthetic resin or bitumen.

6. A drying bed according to any one of the preceding claims, wherein a said layer or slab is laid on top of a drainage beach as hereinbefore defined.

7. A drying bed according to any one

of the preceding claims, wherein a said layer or slab is approximately 3" to 9" thick.

8. A drying bed according to any one of the preceding claims, wherein the said surface is that of a plurality of like juxtaposed said slabs.

9. A drying bed according to Claim 8, wherein the said slabs are laid over a drainage beach as hereinbefore defined and held in position by suitable runners or bearers to form a continuous rigid surface structure.

10. A drying bed according to Claim 8, wherein the said slabs are laid over an *in situ* no-fines concrete support layer and held in position by suitable runners or bearers to form a continuous rigid surface structure.

11. A drying bed according to any one of the preceding claims, wherein a plurality of perforated small bore pipes are laid at the base of the said no-fines concrete surface layer, slab or slabs and connected to a pump for drawing a flushing liquid from a reservoir, storage tank or well, the arrangement being such that the said layer, slab or slabs can be cleaned periodically by back-washing.

12. A drying bed according to Claim 1, constructed, arranged and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in the accompanying drawings.

13. A process for the treatment or purification of a water supply, wherein a sludge formed in the course of such treatment or purification is dewatered by depositing it in a dewatering bed defined by a drying bed according to any one of the preceding claims, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surface.

14. A process for the treatment, purification or refinement of a liquid other than water, in which a sludge is formed in the course of the industrial processing of agricultural produce, wherein the sludge is dried by depositing it in a drying bed according to any one of Claims 1 to 12, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surface.

15. A plant for treating and/or purifying water by a process according to Claim 13.

16. A plant or factory for treating purifying and/or refining a liquid other than water by a process according to Claim 14.

17. Water when treated or purified by a process according to Claim 13 or in a plant according to Claim 15.



as a solid.

This solid may then be removed by manual labour using shovels, or preferably by mechanical means of known kind, before a further batch of sludge is admitted to the bed as aforesaid.

The principal advantage of a drying bed constructed in accordance with the invention resides in the fact that the surface of the layer 4 is highly resistant to damage by the said mechanical sludge removal means. Such surface damage was hitherto the main reason for having to employ manual labour for the purpose, which is comparatively uneconomical and also becoming increasingly scarce because of the comparatively unpleasant nature of the work.

An example of a liquid waste which is intended to be encompassed by the expression "sludge" as used herein and which might be dried in a bed embodying the invention, is oil palm factory waste, resulting from the processing of the palm fruit bunches in a plant or factory designed for this purpose.

WHAT I CLAIM IS:—

1. A bed for drying a sludge and having a surface designed to permit a liquid ingredient or liquid ingredients of the sludge to drain therethrough whilst a solid ingredient or solid ingredients of the sludge remains or remain behind on the said surface, wherein the said surface is that of a layer or slab of porous, no-fines concrete as hereinbefore defined, contained within a boundary bank or wall.

2. A drying bed according to Claim 1, wherein the no-fines concrete comprises a single size aggregate of predetermined grade bonded together by a suitable binder which does not fill the interstices, thereby providing a honeycombed structure.

3. A drying bed according to Claim 2, wherein the single size aggregate has a nominal size of $\frac{1}{8}$ " to $1\frac{1}{2}$ ".

4. A drying bed according to Claim 2 or Claim 3, wherein the said aggregate consists of natural or crushed gravel and the binder includes or consists of portland cement.

5. A drying bed according to Claim 2 or Claim 3, wherein the binder includes or consists of a rapid hardening cement, cement fondu, a cement with a plastics or other chemical additive, a synthetic resin or bitumen.

6. A drying bed according to any one of the preceding claims, wherein a said layer or slab is laid on top of a drainage beach as hereinbefore defined.

7. A drying bed according to any one

of the preceding claims, wherein a said layer or slab is approximately 3" to 9" thick.

8. A drying bed according to any one of the preceding claims, wherein the said surface is that of a plurality of like juxtaposed said slabs.

9. A drying bed according to Claim 8, wherein the said slabs are laid over a drainage beach as hereinbefore defined and held in position by suitable runners or bearers to form a continuous rigid surface structure.

10. A drying bed according to Claim 8, wherein the said slabs are laid over an *in situ* no-fines concrete support layer and held in position by suitable runners or bearers to form a continuous rigid surface structure.

11. A drying bed according to any one of the preceding claims, wherein a plurality of perforated small bore pipes are laid at the base of the said no-fines concrete surface layer, slab or slabs and connected to a pump for drawing a flushing liquid from a reservoir, storage tank or well, the arrangement being such that the said layer, slab or slabs can be cleaned periodically by back-washing.

12. A drying bed according to Claim 1, constructed, arranged and adapted to operate substantially as hereinbefore described with reference to, and as illustrated in the accompanying drawings.

13. A process for the treatment or purification of a water supply, wherein a sludge formed in the course of such treatment or purification is dewatered by depositing it in a dewatering bed defined by a drying bed according to any one of the preceding claims, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surface.

14. A process for the treatment, purification or refinement of a liquid other than water, in which a sludge is formed in the course of the industrial processing of agricultural produce, wherein the sludge is dried by depositing it in a drying bed according to any one of Claims 1 to 12, and allowing a liquid ingredient or ingredients of the sludge to drain through the said surface whilst a solid ingredient or ingredients of the sludge remains or remain behind on the said surface.

15. A plant for treating and/or purifying water by a process according to Claim 13.

16. A plant or factory for treating purifying and/or refining a liquid other than water by a process according to Claim 14.

17. Water when treated or purified by a process according to Claim 13 or in a plant according to Claim 15.



18. A liquid other than water when treated, purified and/or refined by a process according to Claim 14 or in a plant according to Claim 15.

SAUNDERS & DOLLEYMORE
Chartered Patent Agents
2a Main Avenue, Moor Park
Northwood, Middx. HA6 2HJ
For The Applicant

Printed for Her Majesty's Stationery Office by The Tweeddale Press Ltd., Berwick-upon-Tweed, 1973.
Published at the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.