PATENT SPECIFICATION (11) 1 581 638

1 581 638

(21) Application No. 32368/76 (22) Filed 3 Aug. 1976 (19)

(23) Complete Specification filed 19 July 1977

(44) Complete Specification published 17 Dec. 1980

(51) INT. CL.³ B28C 1/10 C04B 7/48

(52) Index at acceptance

C1A 421 M11 PF5

(72) Inventor MARTIN TAYLOR

(54) STORING OR TRANSPORTING IN BULK A PARTICULATE SOLID MATERIAL

(71) We, ENGLISH CLAYS LOVERING POCHIN & COMPANY LIMITED, a British Company, of John Keay House, St. Austell, Cornwall, PL25 4DJ, do hereby declare the invention, for which we pray that a patent may be granted to us, 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 storing or transporting of clay or clay-derived materials.

Conventionally dry clay is handled in bulk in the form in which is issues from a dryer, i.e. as small rounded beads or pellets. Two problems arise when the clay is handled in this form. The first of these problems is that the pellets tend to break up to create a large amount of dust, which, as well as being a health hazard, is also an environmental inconvenience. The handling processes to which the dry clay may be subjected during the time it remains largely in pellet form and which causes the hitherto used pellets to break up and create dust include dropping the clay from a conveyor onto a stockpile (which may entrail a drop of, for example, 50 feet), loading the clay from the stockpile onto a lorry or railway truck using, for example, a mechanical shovel pouring the clay down a chute into a ship's hold, transferring the clay from the hold to another lorry or railway truck using a grab or bucket conveyor, and unloading the clay from the lorry or railway truck. It will be appreciated that each pellet will be subjected to a considerable amount of battering during which a great deal of dust will be created.

The second problem is that with clay in the hitherto used pellet form the pellets have a tendency to stick together when the clay is left in a stockpile or bulk container for even a short length of time, for example a few hours. This makes the clay difficult to handle, because it behaves more like a number of large lumps than a number of small pellets.

The present invention is based on the surprising discovery that if de-watered clay or clay-derived material with a moisture content lying within a specified range is extruded under certain conditions, the product of the extrusion is much more mechanically stable than would be expected, is dust-free, and does not tend to stick together in lumps.

According to the present invention there is provided a method of storing or transporting in bulk a clay or a clay-derived material, the method comprising:

(a) forming the material into pellets by extruding at a first location, a plastic mass of the material having a moisture content which is not less than 20% and not more than 35%, and, without subjecting it to a drying operation,

(b) either i) conveying at least some of the pellets to a bulk stockpile for storage, or

ii) transporting at least some of the pellets in bulk to a second location.

Where moisture contents are referred to in this specification and in the claims, these are given as percentages by weight.

The present invention has been developed for use with clay, but it will be appreciated that it is also suitable for use when transporting or storing, in bulk other clay-derived materials, for example cement.

It has been found that when clay is formed into extruded pellets in accordance with the present invention, the clay will not create as much dust as the hitherto used pellets when subjected to the handling processes mentioned above as causing the creation of dust with the hitherto used pellets. It is important that the particle size distribution is not changed during the extrusion process, or, if it is changed, that the change is controllable, since a clay producer will usually have to guarantee a specified particle size distribution to a customer; the particle size distribution will normally be determined before the clay is extruded and the resulting figure modified to take into account any change which is known to occur under the particular conditions under which the extrusion is effected. If changes in the particle size distribution are to be prevented, the extrusion should be effected at pressures which are less than 100 pounds per square inch.

For most clays, the moisture content before extrusion is preferably 23% to 25%. With some speciality grades of clay, the moisture

content can be even lower, for example as low as 20%, and it will still be possible to extrude the clay.

The plastic mass of clay to be extruded may be in the form of filter cake from a high pressure plate filter press. Filter cake can be obtained from such a filter press with a moisture content below 25%. Alternatively, the plastic mass may comprise filter cake from a conventional filter press, having, for example, a moisture content of 32%, mixed with dried clay having a moisture content of say, 10% in proportions which result in the required net moisture content.

The plastic mass is preferably worked in a pug mill before it is extruded, but this is not necessary with some grades of clay. The extrusion preferably takes place through an extrusion plate having a number of holes the size and shape of which will depend on the desired form of the extruded pellets. For example, the holes may be circular having a diameter of between 1/8 inch and 1 inch.

A preferred installation for producing extruded clay pellets for the method of the present invention comprises a high pressure plate filter press capable of producing filter cake having a moisture content of not more than 25%, a pug mill and an extruder, with respective conveyors for conveying filter cake from the filter press to the pug mill and worked clay from the pug mill to the extruder.

For a better understanding of the present invention and to show how the same may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings, in which:

Figure 1 is a plan view of an installation, including an extruder, for producing a dust-free clay product;

Figure 2 is a die view, in cross-section, of the extruder of Figure 1; and

Figure 3 is a front view of an extrusion plate for the extruder of Figure 2.

The installation shown in Figure 1 comprises two feed conveyors 1 and 2 which discharge onto a common third conveyor 4. The conveyor 4 supplies a pug mill 6 the outlet of which is connected, by a conveyor 8, to an extruder 10. Clay discharged by the extruder is conveyed away for transport or stockpiling, after any further processing which may be required, by a conveyor 12.

The pug mill 6 is driven by a motor 14 through a gearbox 16 and the extruder is driven by a motor 18 through a gearbox 28.

In operation of the installation of Figure 1, the conveyor 4 is supplied with clay either from the conveyor 1 or from the conveyor 2. The conveyor 1 feeds filter cake with a 25% moisture content supplied directly from a high pressure plate filter press. The conveyor 2 feeds filter cake with a 30% moisture content from a conventional filter press together with dry clay having a 10% moisture content, the proportion of the two being such as to give a net moisture content of 25%. The dry clay may consist of a feed-back from the output of the extruder 10 which has passed through a dryer.

The clay supplied from the conveyor 1 or the conveyor 2 is fed by the conveyor 4 to the pug mill 6. After the clay has been worked by the pug mill 6 it is discharged onto the conveyor 8. The moisture content is still 25% but the temperature is increased due to the work put into the clay by the pug mill.

The hot clay is fed into the extruder 10 by the conveyor 8, where it is forced through an extrusion plate 44 (see Figure 2) to be discharged onto the conveyor 12. From the conveyor 12, some of the clay may be transferred to a dryer, where the moisture content may be reduced to approximately 10%, this dry clay then being fed to the conveyor 2. The rest of the clay may be deposited on a stockpile, without drying, to await transport.

The clay pellets issuing from the extrusion plate are mechanically stable, i.e. they tend not to break or crumble, so that the formation of dust is prevented. Also they tend not to stick together to form lumps.

The extruder 10 is shown in more detail in Figure 2. It includes a feed screw 22 and an extruder screw 24 which are drivable by the motor 18 (Figure 1) through a pulley 26 and a gearbox 28.

The feed screw 22 is disposed in a feed duct 30 which connects an inlet opening 32 with a vacuum chamber 34. The vacuum chamber may be connected to a vacuum pump (not shown) at a connector 35. The feed duct 30 opens into the vacuum chamber through a convergent annular passage 36 which, in operation, creates a vacuum seal. A rotary cutting blade 38, which rotates with the feed screw 22, is arranged at the opening 36.

The extruder screw 24 is disposed in a duct 40 which connects the vacuum chamber 34 with an outlet 42 over which is fixed an extrusion plate 44 having, for example, 400 holes each with a diameter of $\frac{1}{2}''$. A further rotary cutting blade (not shown may be arranged on the outside of the extruder plate 44 if desired.

In operation, clay from the pug mill 6 (Figure 1), having a moisture content of 25%, is supplied by the conveyor 8 to the inlet opening 32. The clay is then fed along the duct 30 by the feed screw 22 and packed into the annular passage 36 thus forming a vacuum seal between the vacuum chamber 34 and the duct 30. As the clay is pressed through the opening 32, it is sliced off by the blade 38 and drops to the extruder screw 24.

The extruder screw packs the clay into the duct 40 where it forms another vacuum seal. The extruder screw forces the clay through the holes of the extrusion plate 44. As the clay, in the form of cylindrical strands, emerges from

the holes of the extrusion plate, it either breaks into pellets of its own accord or is cut off by the rotating cutter and the resulting cylindrical pellets are conveyed to, for example, a dryer or a stockpile by the conveyor 12 (Figure 1).

It is not essential to the present invention that the vacuum chamber 34 is actually evacuated. However, evacuation of the vacuum chamber 34 tends to give stronger strands with a slightly reduced moisture content (for example, a reduction of between $\frac{1}{2}$–$\frac{3}{4}$% has been obtained). A result of the strands being stronger is that it becomes essential for some device, such as the rotating cutter, to be provided to cut the strands into pellets of manageable lengths. When the vacuum chamber 34 is not evacuated, the strands tend to break off from the extruder plate in lengths of about 3". It will be appreciated that the term "pellets is used in this specification, including the claims, to refer to these lengths, even where they are longer than 3".

WHAT WE CLAIM IS:—

1. A method of storing or transporting in bulk a clay or a clay-derived material, the method comprising:

(a) forming the material into pellets by extruding, at a first location, a plastic mass of the material having a moisture content which is not less than 20% and not more than 35%, and, without subjecting it to a drying operation,

(b) either i) conveying at least some of the pellets to a bulk stockpile for storage, or

ii) transporting at least some of the pellets in bulk to a second location.

2. A method as claimed in claim 1, in which the moisture content of the material during extrusion is not less than 23% and not more than 25%.

3. A method as claimed in claim 1 or claim 2, in which the material is extruded at a pressure of not more than 100 pounds per square inch.

4. A method as claimed in any one of the preceding claims, in which the material is subjected to mechanical working before it is extruded.

5. A method as claimed in any one of the preceding claims, in which the material is clay.

6. A method as claimed in any one of the preceding claims, in which the material to be extruded comprises a mixture of two feeds, one of which has a higher moisture content than the other, the relative proportions of the two feeds being such as to result in a nett moisture content of not less than 20% and not more than 35%.

7. A method as claimed in claim 6, in which the said one feed has a moisture content of about 32% and the said other feed has a moisture content of about 10%.

8. A method as claimed in claim 7, in which the said other feed comprises some of the extruded material which has been subjected to a drying operation.

9. A method as claimed in any one of the preceding claims, in which the material is extruded through an extrusion plate having a plurality of holes with a diameter of not less than 1/8 inch and not more than 1 inch.

10. A method as claimed in claim 9, in which 400 holes are provided in the extrusion plate, each with a diameter of about $\frac{1}{2}$ inch.

11. A method as claimed in claim 9 or 10, in which the material is passed through an evacuated chamber before it is extruded.

12. A method as claimed in any one of the preceding claims in which the extruded material is cut into lengths after extrusion.

13. A method of transporting or storing in bulk a clay or a clay-derived material, substantially as specifically described herein with reference to the accompanying drawings.

14. A stockpile of clay or clay-derived material which is in the form of pellets produced by extrusion, without subsequent drying, of a plastic mass of the material having a moisture content of not less than 20% and not more than 35%.

15. A bulk transport container containing clay or clay-derived material which is in the form of pellets produced by extrusion, without subsequent drying, of a plastic mass of the material having a moisture content of not less than 20% and not more than 35%.

HASELTINE LAKE & CO.,
Chartered Patent Agents,
28 Southampton Buildings,
Chancery Lane, London WC2A 1AT,
and
Temple Gate House,
Temple Gate,
Bristol BS1 6PT,
9 Park Square,
Leeds LS1 2LH,

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1581638 COMPLETE SPECIFICATION
2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

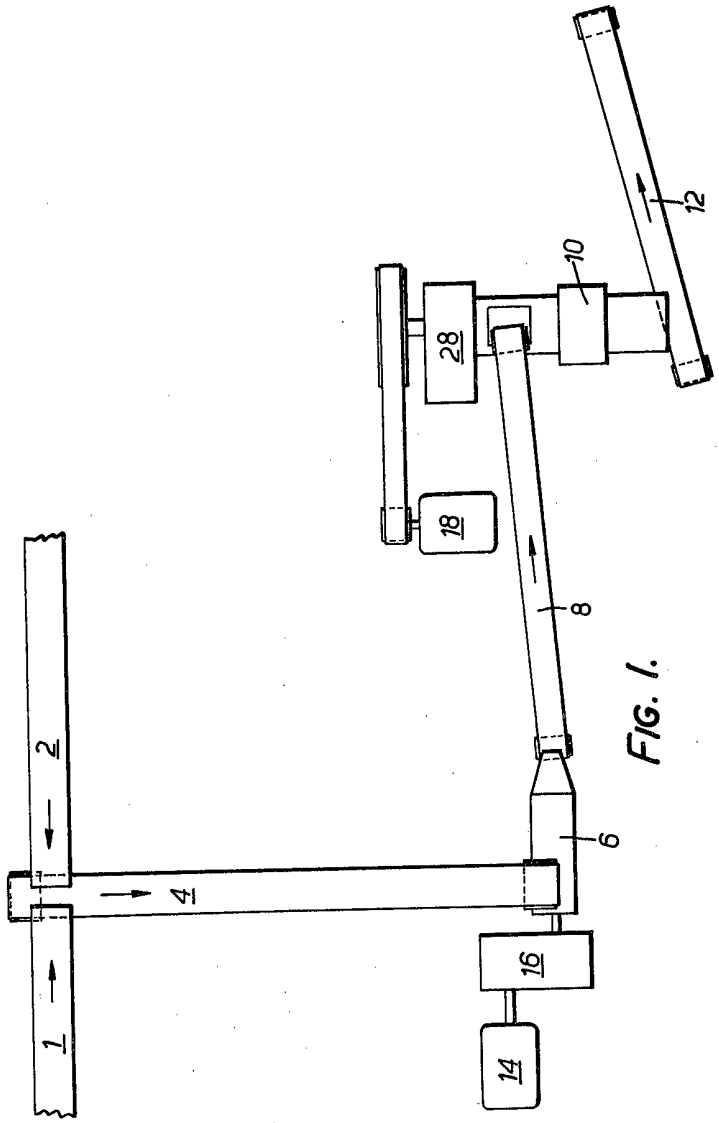

FIG. 1.

1581638 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

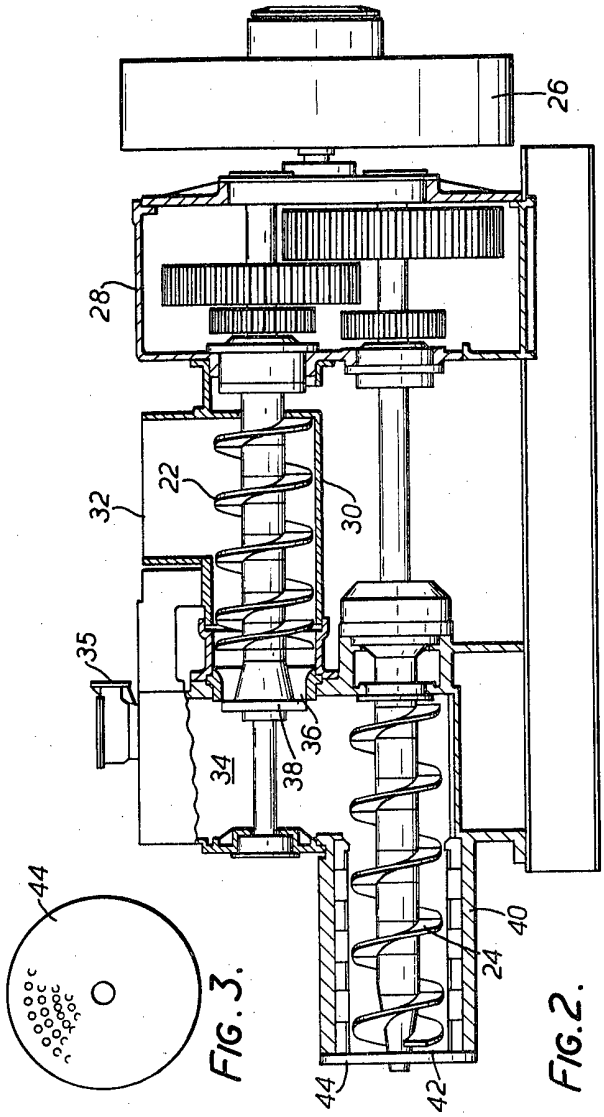

FIG. 2.

FIG. 3.