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- (54) Title: METHOD AND SYSTEM FOR CONVEYING A FEED OF HIGH ADHESION SOLIDS

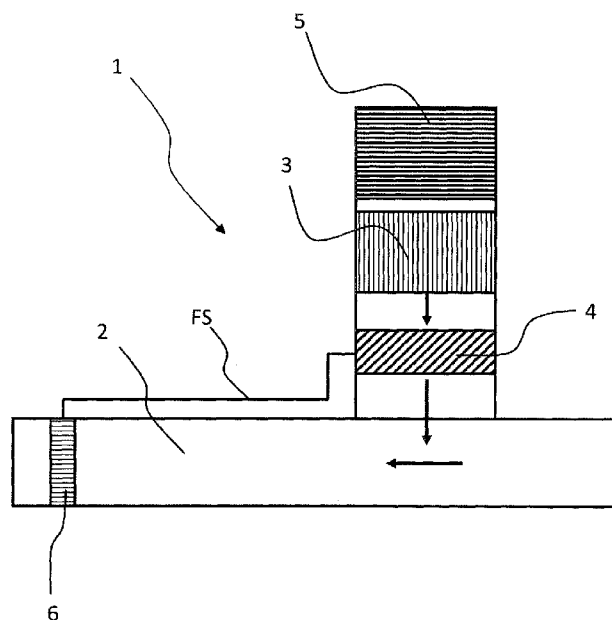


Fig. 2

(57) Abstract: A method of and a system for conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility. The method comprises the steps of conveying a stream of conveyable volumes of lumpy high adhesion solids; applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids, and thereafter conveying said conveyable volumes of high conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface.



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METHOD AND SYSTEM FOR CONVEYING A FEED OF HIGH ADHESION SOLIDS***Field of the invention***

The present invention relates to a method of conveying a feed of lumpy high adhesion solids in a solids refinement plant, such as a minerals processing plant, a cement plant or a materials handling facility. Furthermore, the present invention relates to a lumpy high adhesion solids handling conveyor system for conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility.

Background art

In solids refinement plants, such as minerals processing plants, cement plants or materials handling facilities, the performance of the plant or facility is very dependent on the nature of the solids. The present invention relates to solids handling problems encountered with high adhesion or “sticky” solids, such as clay in particular. High adhesion or “sticky” will be used throughout this document to describe solids typically having high water content which makes the high adhesion or sticky solids adhere or stick to surfaces they come into contact with in the conveying system of a refinement plant such as belt conveyors, chutes, hoppers, comminuters, etc. Problems related to adhesion or sticking effects during conveying of lumpy high adhesion solids are widespread and present at numerous refinement plants around the world, which lead to increased equipment costs and excessive downtime, all of which undermine efficiency and profitability of such plants. High adhesion materials are inherently difficult to store and reclaim due to their tendency to ‘fuse’ together, i.e. such materials lose their size distribution when stored. This typically necessitates the introduction of additional equipment like comminuters, etc., to handle such materials.

Furthermore, when such plants are situated in cold climate areas additional problems arise when handling lumpy high adhesion solids. Lumpy high adhesion solids are mainly characterized by a high water content, and therefore when working in cold climates with temperatures below freezing for long periods, handling of the lumpy high adhesion solids may present serious problems due to freezing of the materials both during conveying, stacking/reclaiming procedures, storing, etc.

In current plants when problems arise, such as clogging of chutes, build-up of materials in hoppers, on belts, in chutes, etc., the plant or conveying system is shut down and the lumpy high adhesion solids is typically mechanically removed from affected passages. Such cleaning procedures are tedious, costly and sometimes even impossible when
5 combined with severe frost conditions.

It is thus desirable to provide a solution, wherein the method and system for conveying lumpy high adhesion solids are improved so that at least conveying, stacking/reclaiming procedures and storing after conveying may be carried out at such plants with less
10 problems arising due to the adhesion or stickiness properties of lumpy high adhesion solids without having to stop the plant.

Summary of the invention

It is an object of the present invention to wholly or partly overcome the above
15 disadvantages and drawbacks of the prior art. More specifically, it is an object to provide an improved method and system for conveying a feed of lumpy high adhesion solids annular barrier solution which does not require frequent shut downs of the plant when conveying lumpy high adhesion solids.

20 The above objects, together with numerous other objects, advantages, and features, which will become evident from the below description, are accomplished by a solution in accordance with the present invention by a method of conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant or a cement plant comprising the steps of:

- 25
- providing a bulk volume of lumpy high adhesion solids ,
 - comminuting said bulk volume of lumpy high adhesion solids into a plurality of conveyable volumes,
 - applying a low adhesion solids onto the surface of the conveyable volumes of lumpy
30 high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids, and thereafter
 - conveying said conveyable volumes of high conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface.
- 35

By covering conveyable volumes of lumpy high adhesion solids with a layer of low adhesion solids, the conveyable volumes of lumpy high adhesion solids may be conveyed through a conveyor system without sticking or adhering to surfaces or neighboring volumes of lumpy high adhesion solids. The present invention thus suggests

5 decreasing the level of adhesion or stickiness of the solids at an early stage in the method of conveying and thereby avoids adhesion or stickiness related problems later. Instead of covering surfaces of the conveyor system with "non-stick" materials, the present invention relates to a method, where the conveyed solids *per se* are encapsulated in low adhesion solids, which has a further advantage in addition to

10 protecting the surfaces of the conveyor system, namely that after conveying of lumpy high adhesion solids using the above described method, the solids may be stacked and reclaimed or stored in very cold environments. Typically, such lumpy high adhesion solids tend to freeze together in very large volumes. Such volumes can be very hard or even impossible to break apart with conventional machinery. However, after conveying

15 with the above mentioned method, the low adhesion solids layer surrounding the lumpy high adhesion solids volume represents a "separation" interface between two conveyable volumes, which may easily be separated even in severe frost conditions e.g. during reclaiming or after storing in a storage facility on the plant.

20 In one embodiment, the method of conveying a feed of lumpy high adhesion solids in a solids refinement plant may further comprise the steps of providing a bulk volume of lumpy high adhesion solids and then subsequently comminuting said bulk volume of lumpy high adhesion solids into a plurality of conveyable volumes.

25 Depending on the nature of the solids used in a specific plant, the solids may enter the plant in conveyable volumes or bulk volumes. If the solids enters in a bulk volume, the bulk volume is preferably comminuted to conveyable sizes before applying a low adhesion protection layer to the feed of lumpy high adhesion solids , such that the conveyable volumes are encapsulated or enclosed in a low adhesion solids. If the lumpy

30 high adhesion solids were encapsulated in bulk form and later comminuted the conveyor system would still be exposed to lumpy high adhesion solids with the affiliated problems.

Furthermore, the step of applying low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy

35 high adhesion solids having a low adhesion protecting layer on the surface from

adhesion of low adhesion solids to the surface of the lumpy high adhesion solids may further comprise the steps of:

- dispatching a first volume of low adhesion solids onto a conveyor,
 - 5 - dispatching the conveyable volumes of lumpy high adhesion solids onto the volume of low adhesion solids on the conveyor, and
 - dispatching a second volume of low adhesion solids onto the conveyable volumes of lumpy high adhesion solids.
- 10 In order to fully enclose or encapsulate the conveyable volumes of lumpy high adhesion solids in low adhesion solids, a volume of low adhesion solids may be dispatched onto a conveyor where after the conveyable volumes of lumpy high adhesion solids may be dispatched on the conveyor leaving the surfaces of the conveyable volumes of lumpy high adhesion solids facing the conveyor covered in low adhesion solids. Subsequently,
- 15 a second volume of low adhesion solids is dispatched onto the stream of conveyable volumes of lumpy high adhesion solids thereby covering the remaining surfaces of the conveyable volumes of lumpy high adhesion solids with low adhesion solids such that the entire surfaces are covered.
- 20 In the present invention several different steps of applying the low adhesion solids may fulfill the purpose of the step, namely to enclose the conveyable volumes of lumpy high adhesion solids in a protecting layer of low adhesion solids. In an embodiment of the invention the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy
- 25 high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids may further comprise the step of:
- passing the conveyable volumes of lumpy high adhesion solids through an air
 - 30 stream comprising low adhesion solids thereby covering the surface of the conveyable volumes of lumpy high adhesion solids with low adhesion solids.

Passing the conveyable volumes of lumpy high adhesion solids through an airstream comprising low adhesion solids has the advantage that highly homogeneous thin layers

35 of low adhesion solids may be applied to the conveyable volumes of lumpy high adhesion solids thus using only small amounts of low adhesion solids, which bears an

additional cost and therefore must be minimized. The airstream may be a closed loop ensuring that all excessive amounts of low adhesion solids is re-circulated.

In another embodiment of the invention, the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids may further comprise the step of:

- 10 - removing excessive amounts of low adhesion solids from the surface low adhesion protecting layer.

In order for instance to mitigate a possible problem of dust contamination of the surroundings, the lumpy high adhesion solids coated with a low adhesion solid layer may optionally enter a subsequent cleaning zone, where the excess low adhesion solids may be removed. In one embodiment of the system according to this invention, this might be practiced by having a clean air blowing zone downstream of the low adhesion solids protecting layer feeder, where the combined solids are subjected to an air stream without low adhesion solids. The resultant airstream comprising low adhesion solids may be de-dusted or cleaned subsequently by well-known means.

In another embodiment of the invention, the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids may further comprise the steps of:

- dispatching the conveyable volumes of lumpy high adhesion solids into a container with low adhesion solids, and
- 30 - separating the conveyable volumes of lumpy high adhesion solids from the low adhesion solids by means of a separating device.

If the conveyable volumes of lumpy high adhesion solids are dumped into a container with low adhesion solids, all sides of the conveyable volumes of lumpy high adhesion solids are covered. Subsequently, the conveyable volumes of lumpy high adhesion solids need to be separated from the low adhesion solids by means of a separating

device, e.g. a belt conveyor with a grated belt allowing only the conveyable volumes to be picked up leaving the low adhesion solids in the container or a reciprocating grate or screen discharging the conveyable volumes while leaving the low adhesion solids in the container.

5

Further, the step of applying low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids may

10 comprise the steps of:

- applying a stream of low adhesion solids through a screen or a sieve from one direction, and
- dispatching the conveyable volumes of lumpy high adhesion solids onto the screen

15 or sieve from an opposite direction.

The present invention may further relate a lumpy high adhesion solids handling conveyor system for conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility, said conveyor system comprising:

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- a conveyor for conveying a stream of lumpy high adhesion solids ,
- a lumpy high adhesion solids feed inlet for supplying a feed of lumpy high adhesion solids to the conveyor, and
- a low adhesion solids protecting layer feeder for dispatching a volume of low adhesion solids onto the feed of lumpy high adhesion solids during operation for providing a protecting layer of low adhesion solids adhering to the feed of lumpy high adhesion solids, said low adhesion solids protecting layer feeder being arranged downstream of the lumpy high adhesion solids feed inlet in the lumpy high

30 adhesion solids handling conveyor system.

In a lumpy high adhesion solids handling conveyor system for conveying feeds of lumpy high adhesion solids according to the present invention, the system comprises a low adhesion solids protecting layer feeder for dispatching a volume of low adhesion solids onto the feed of lumpy high adhesion solids during operation. The low adhesion solids protecting layer feeder is able to dispatch a protecting layer of low adhesion solids

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adhering onto the feed of lumpy high adhesion solids. In order to dispatch the low adhesion solids according to the invention, the low adhesion solids protecting layer feeder is to be arranged downstream of the lumpy high adhesion solids feed inlet in the lumpy high adhesion solids handling conveyor system in order to dispatch the low adhesion solids onto the feed of conveyable volumes of lumpy high adhesion solids.

The lumpy high adhesion solids handling conveyor system may further comprise a lumpy high adhesion solids comminuter device arranged upstream in relation to the lumpy high adhesion solids feed inlet for providing the capability of comminuting the feed of lumpy high adhesion solids prior to dispatching the low adhesion solids onto the feed of lumpy high adhesion solids.

In lumpy high adhesion solids handling conveyor systems where the lumpy high adhesion solids enters as bulk material, the bulk material is comminuted using a solids comminuter device arranged upstream in relation to the lumpy high adhesion solids feed inlet to ensure that the low adhesion solids is applied to the conveyable volumes. Also comminuting of smaller volumes of lumpy high adhesion solids may be advantageous to obtain the most optimal volume for both conveying and application of a low adhesion solids protection layer.

Further, the low adhesion solids protecting layer feeder may comprise a low adhesion solids container and a low adhesion solids collecting device for collecting during operation excessive amounts of low adhesion solids not adhering to the feed of lumpy high adhesion solids and means for transporting the excessive amounts of low adhesion solids from the low adhesion solids collecting device to the low adhesion solids container in a closed cycle.

In order to keep the use of the low adhesion solids to a minimum in systems according to the invention, a closed loop between a low adhesion solids container, a low adhesion solids collecting device and means for transporting the excessive amounts of low adhesion solids from the low adhesion solids collecting device and back to the low adhesion solids container may advantageously be implemented in the system to save costs and to operate automatically.

Also, the lumpy high adhesion solids handling conveyor system may furthermore comprise means for determining the adhesive properties of the lumpy high adhesion

solids downstream of the low adhesion solids protecting layer feeder thus providing an adhesion feedback signal. The feedback may be used to continuously control the amounts of low adhesion solids adhering to the stream of lumpy high adhesion solids by changing settings of the low adhesion solids protecting layer feeder for instance by adding more or less low adhesion solids into the feeder or by changing the speed of the conveyor during constant feeder conditions. In this way, the properties of the conveyed lumpy high adhesion solids may continuously be changed by continuously changing the surface properties defined by the amount of low adhesion solids adhering to the surfaces of the conveyable volumes of lumpy high adhesion solids. The means for determining the adhesive properties of the feed may be advanced methods for analyzing the water content on the surfaces of the conveyable volumes of lumpy high adhesion solids covered with the low adhesion solids protecting layer, e.g. capacitance measurements, infrared (IR) sensor measurements monitoring the water content from solids passing by the sensors, e.g. IR or Raman sensor could be used provided the two materials contains different constituents, e.g. the low adhesion material being sand and the high adhesion material being chalk, then an algorithm based on the quartz and limestone signals could be worked out and used for regulation purpose. Also, more low-tech mechanical devices, such as a probe surface placed within the stream of lumpy high adhesion solids feed may be used to measure if any lumpy high adhesion solids adhere or stick to the surface by the probe surface being connected to a weight or spring measurement indicating the level of adhesion to the probe surface. Alternatively, the feedback signal may be provided by measuring the rate of the recycled low adhesion solids, i.e. during overdosing the recirculation rate will be high and vice versa during under-dosing the recirculation will be low (or zero). It shall be noted that optimal dosing is not necessarily obtained when the recirculation is zero.

In one embodiment, the low adhesion solids protecting layer feeder is a powder feeder.

The invention also relates to a lumpy high adhesion solids retrofit kit for a solids handling conveyor system comprising:

- a low adhesion solids protecting layer feeder for dispatching a volume of low adhesion solids onto the feed of lumpy high adhesion solids during operation thereby providing a protecting layer of low adhesion solids adhering to the feed of lumpy high adhesion solids after dispatch of the lumpy high adhesion solids onto the conveyor, said low adhesion solids protecting layer feeder being arranged

downstream of the lumpy high adhesion solids feed inlet in the lumpy high adhesion solids handling conveyor system, and

- means for attaching said low adhesion solids protecting layer feeder to a conveyor.

5 Further the retrofit kit may comprise:

- a conveyor low adhesion protecting layer feeder for feeding a layer of low adhesion solids onto the conveyor during operation thereby during operation providing a protecting layer of low adhesion solids between the conveyor and the feed of lumpy
10 high adhesion solids , and
- means for attaching said conveyor low adhesion protecting layer feeder to a conveyor.

Also the retrofit kit according to the above may comprise

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- a lumpy high adhesion solids comminuter device for comminuting the feed of lumpy high adhesion solids prior to dispatching the lumpy high adhesion solids onto a conveyor, and
- means for attaching said lumpy high adhesion solids comminuter device to a
20 conveyor.

The present invention may further relate to a method of conveying lumpy high adhesion solids according to the above, furthermore comprising the steps of:

- 25 - conveying a feed of lumpy high adhesion solids on a conveyor,
- dispatching a volume of low adhesion solids from a low adhesion solids container onto the feed of lumpy high adhesion solids thereby providing a protecting layer of low adhesion solids adhering to the feed of lumpy high adhesion solids.

30 Also, the present invention may further relate to a method of conveying lumpy high adhesion solids according to the above, furthermore comprising the step of:

- comminuting the feed of lumpy high adhesion solids prior to dispatching the volume of low adhesion solids onto the feed of lumpy high adhesion solids.

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The present invention may further relate to a method of conveying lumpy high adhesion solids according to the above, furthermore comprising the steps of:

- collecting an excessive amount of low adhesion solids, and
- 5 - feeding the excessive amount of low adhesion solids back to the low adhesion solids container.

Brief description of the drawings

Fig. 1 shows a schematic drawing of an embodiment of a lumpy high adhesion solids
10 handling conveyor system,

Fig. 2 shows a schematic drawing of another embodiment of a lumpy high adhesion solids handling conveyor system, and

15 Fig. 3 shows a cross-sectional drawing of a feed of conveyable lumpy high adhesion solids covered in low adhesion solids.

All the figures are highly schematic and not necessarily to scale, and they show only those parts which are necessary in order to elucidate the invention, other parts being
20 omitted or merely suggested.

Detailed description of the invention

Fig. 1 is a schematic drawing of an embodiment of a lumpy high adhesion solids handling conveyor system 1 for conveying a feed of lumpy high adhesion solids in a
25 solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility. The conveyor system 1 comprises a conveyor 2 for conveying a stream of lumpy high adhesion solids. The stream of lumpy high adhesion solids enters the system 1 via a lumpy high adhesion solids feed inlet 3. The system comprises a low adhesion solids protecting layer feeder 4 for dispatching a volume of low adhesion
30 solids onto the feed of lumpy high adhesion solids during operation for providing a protecting layer of low adhesion solids adhering to the feed of lumpy high adhesion solids, said low adhesion solids protecting layer feeder 3 being arranged downstream of the lumpy high adhesion solids feed inlet 4 in the lumpy high adhesion solids handling conveyor system 1.

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Fig. 2 is a schematic drawing of another embodiment of a lumpy high adhesion solids handling conveyor system 1, wherein the conveyable volumes of lumpy high adhesion solids are passed through a low adhesion solids protecting layer feeder 4 wherein the application of low adhesion solids may be performed by a single unit such as a device
5 for applying an air stream comprising low adhesion solids on the feed of lumpy high adhesion solids thereby covering the surface of the conveyable volumes of lumpy high adhesion solids with low adhesion solids. The step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids according to the invention may be carried out by passing the lumpy high adhesion solids through an
10 air stream to ensure the application of low adhesion solids on all sides of the lumpy high adhesion solids while remaining the amount of low adhesion solids needed to prevent sticking or adhesion relatively low and thereby lower costs. An airstream may be applied relatively easily with a closed loop of the air to prevent spillage and facilitate fully automatic operation.

15 Fig. 3 demonstrates a feed of lumpy high adhesion solids after being covered with a low adhesion solids layer conveyed on a typical belt conveyor 2. The conveyor 2 only "touches" or comes into contact with the low adhesion solids layer (L) on the surface of the lumpy high adhesion solids (H), and hence the lumpy high adhesion solids will not
20 adhere to the conveyor 2. Shown in Fig. 3 are three lumps of lumpy material as indicated in the figure, the volume of the lumpy high adhesion solids is very high compared to the very small volume of low adhesion solids covering it. In an embodiment of the invention the lumpy high adhesion solid is a feed of lumpy adhesive clay, whereas the low adhesion solid is applied to the high adhesion solid a very thin layer of powdery material
25 and thus the handling of large volumes of difficultly conveyable high adhesion solids are conveyable through use of a very small volume of low adhesion solids.

In an alternative embodiment of the invention, the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids is carried out
30 by dumping the lumpy high adhesion solids into a container with low adhesion solids, and then subsequently separated by extracting the conveyable volumes of lumpy high adhesion solids and leaving the low adhesion solids in the container by means of a separating device, e.g. a conveyor comprising a screen for catching the lumpy high adhesion solids while leaving a powdery low adhesion solids or alternatively a centrifugal
35 separator, a gravity separator grate.

In another alternative embodiment of the invention, the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids is carried out by applying a stream of low adhesion solids through a screen or a sieve from one direction, and subsequently separating the conveyable volumes of lumpy high adhesion solids from the low adhesion solids by means of a separating device. By having two counter current flows separated by a screen or a sieve, the lumpy high adhesion solids may also efficiently be covered in low adhesion solids where after the two flows are separated again.

- 10 The lumpy high adhesion solids feed inlet 4 for supplying a feed of lumpy high adhesion solids to the conveyor 2 may advantageously comprise a box feeder, since the box feeder is very efficient in feeding lumpy high adhesion solids.

15 An advantageous effect of the application of low adhesion solids to lumpy high adhesion solids during conveying is that the high adhesion materials may be stored after conveying in very cold climates below freezing due to the low adhesion solids layer between lumpy high adhesion solids volumes and still subsequently be broken apart with relatively small breaking forces. Normally storing of lumpy high adhesion solids is very problematic since storing below freezing results in large bulk frozen pieces which are impossible to convey or comminute with conventional comminution means maybe except from explosives. The application of low adhesion solids to lumpy high adhesion solids before handling/storing therefore facilitates easier reclaiming of the lumpy high adhesion solids from a frozen storage due to the effect of the low adhesion solids. The effect has been investigated by filling containers with a cubic meter of wet clay as lumpy high adhesion solids in a -30 degrees Celsius freezer with different levels of powdered surfaces using raw meal powder as low adhesion solid. Three containers were filled: One with pure un-powdered clay for reference, one with 3-4% of low adhesion solid of the total mass of lumpy high adhesion solids and one with 7%. In both cases of the powdered clay it was relatively easy to break off individual powder-covered lumps from the container by hand. The reference container with pure un-powdered clay was almost impossible to break up into smaller pieces.

35 Lumpy high adhesion solids may be high adhesion raw materials such as clays or wet chalk, wet coal, marl, pyrite ash. In this context the high adhesion materials will typically be geological or processed geological solids with characteristically high moisture content.

A minerals processing plant typically refers to a plant in the field of extractive metallurgy, mineral engineering, mineral processing, also known as mineral dressing or ore dressing, and concerns the process of separating commercially valuable minerals from their ores. Mineral processing typically involves four general types of unit operation: comminution, sizing, concentration and dewatering. In all of these processes, the most important considerations are the economics of the processes and this is dictated by the grade and recovery of the final product. To do this, the mineralogy of the ore needs to be considered as this dictates the amount of liberation required and the processes that can occur. The adhesion properties may greatly affect the value of the ore due to difficulties in handling. Especially in cold climates lumpy high adhesion solids may become critical during wintertime and cause long periods of downtime in such plants. Especially handling of gangue materials, overburden etc. may be problematic since handling of these materials might be a significant part of operating mines or minerals processing plants.

A cement plant is a facility for production of cement typically from the raw materials limestone, clay or shale. These raw materials are extracted from the quarry and then blended in the correct proportions. The handling of raw materials such as high adhesion clays may be very problematic in plants designed for low adhesion solids and cause severe downtime periods for the plant. Downtime in a cement plant is very costly, since many processes occur at very high temperatures well above 1000 degrees Celsius. Since the energy consumption in cement plants are extremely high the economy of the plant is very dependent on avoiding downtime. Lumpy high adhesion solids may cause delays in the raw materials handling or cause clogging or solids build ups in the conveyor systems. Also, improper or imprecise dosing of lumpy high adhesion solids in the plant process might compromise the quality of the ultimate product of the process, i.e. the clinker quality in cement plants.

Materials handling facilities such as stockyards with stacker/reclaimer systems or loading/unloading facilities in harbors etc. are likewise vulnerable when handling high adhesion materials especially in cold climates, when lumpy high adhesion solids with high water content may freeze to almost unbreakable structures of non-conveyable bulk solid material.

High adhesion solid may be defined by two different types of effects, high cohesion between particles e.g. by water bridges or high adhesion of particles adhering to walls/surfaces etc. by chemical bonds.

- 5 An example of low adhesion solids is silica sand, which may be used as low adhesion solid irrespective of the water content, since increased water content does not significantly alters the adhesion properties. This class of low adhesion solids might be described as solids with a Moh's hardness above 5 and includes granite, feldspars, quartz sand, etc..

10

In the present application the terms conveying and conveyor are not limited to transporting materials from one place to another, but also comprise transport of materials in closed loops.

- 15 The term solids are used as a general term for solid materials of geological origin typically used unprocessed or partially processed in minerals processing plants, cement plants or at materials handling facilities. The term "raw materials" is widely used within these technical fields to describe such solids.

- 20 A separating device may comprise devices such as a screen, a centrifugal separator, a gravity separator grate etc..

The low adhesion solids protecting layer feeder 4 according to the invention may be a powder feeder.

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Although the invention has been described in the above in connection with preferred embodiments of the invention, it will be evident for a person skilled in the art that several modifications are conceivable without departing from the invention as defined by the following claims.

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Claims

1. A method of conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility comprising the steps of:
- 5
- conveying a stream of conveyable volumes of lumpy high adhesion solids,
 - applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids , and thereafter
 - conveying said conveyable volumes of high conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface.
- 10
2. A method of conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility comprising the steps of:
- 15
- providing a bulk volume of lumpy high adhesion solids ,
 - comminuting said bulk volume of lumpy high adhesion solids into a plurality of conveyable volumes,
 - applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids , and thereafter
 - conveying said conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface.
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- 25
3. A method according to claim 1 or 2 wherein the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids further comprises the steps of:
- 30
- 35
- dispatching a first volume of low adhesion solids onto a conveyor,

- dispatching the conveyable volumes of lumpy high adhesion solids onto the volume of low adhesion solids on the conveyor, and
- dispatching a second volume of low adhesion solids onto the conveyable volumes of lumpy high adhesion solids.

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4. A method according to claim 1 or 2 wherein the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids further comprises the step of:

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- passing the conveyable volumes of lumpy high adhesion solids through an air stream comprising low adhesion solids thereby covering the surface of the conveyable volumes of lumpy high adhesion solids with low adhesion solids.

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5. A method according to claim 1 or 2 wherein the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids further comprises the steps of:

20

- dispatching the conveyable volumes of lumpy high adhesion solids into a container with low adhesion solids, and
- separating the conveyable volumes of lumpy high adhesion solids from the low adhesion solids by means of a separating device.

25

6. A method according to claim 1 or 2 wherein the step of applying a low adhesion solids onto the surface of the conveyable volumes of lumpy high adhesion solids thereby forming conveyable volumes of lumpy high adhesion solids having a low adhesion protecting layer on the surface from adhesion of low adhesion solids to the surface of the lumpy high adhesion solids further comprises the steps of:

30

- applying a stream of low adhesion solids through a screen or a sieve from one direction, and
- dispatching the conveyable volumes of lumpy high adhesion solids onto the screen or sieve from an opposite direction.

35

7. A lumpy high adhesion solids handling conveyor system (1) for conveying a feed of lumpy high adhesion solids in a solids refinement plant such as a minerals processing plant, a cement plant or a materials handling facility, said conveyor system (1) comprising:

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- a conveyor (2) for conveying a stream of lumpy high adhesion solids ,
 - a lumpy high adhesion solids feed inlet (3) for supplying a feed of lumpy high adhesion solids to the conveyor (2), and
 - a low adhesion solids protecting layer feeder (4) for dispatching a volume of low
- 10 adhesion solids onto the feed of lumpy high adhesion solids during operation for providing a protecting layer of low adhesion solids adhering to the feed of lumpy high adhesion solids, said low adhesion solids protecting layer feeder (4) being arranged downstream of the lumpy high adhesion solids feed inlet (3) in the lumpy high adhesion solids handling conveyor system (1).

15

8. A lumpy high adhesion solids handling conveyor system (1) according to claim 7, furthermore comprising a lumpy high adhesion solids comminuter device (5) arranged upstream in relation to the lumpy high adhesion solids feed inlet for providing the capability of comminuting the feed of lumpy high adhesion solids prior to dispatching the

20 low adhesion solids onto the feed of lumpy high adhesion solids.

9. A lumpy high adhesion solids handling conveyor system (1) according to claim 7 or 8, wherein the low adhesion solids protecting layer feeder comprises a low adhesion solids container and a low adhesion solids collecting device for collecting during

25 operation excessive amounts of low adhesion solids not adhering to the feed of lumpy high adhesion solids and means for transporting the excessive amounts of low adhesion solids from the low adhesion solids collecting device to the low adhesion solids container in a closed cycle.

30 10. A lumpy high adhesion solids handling conveyor system (1) according to any of claims 7-9, furthermore comprising means (6) for determining the adhesive properties of the lumpy high adhesion solids downstream of the low adhesion solids protecting layer feeder thus providing an adhesion feedback signal, such that the amounts of low adhesion solids adhering to the stream of lumpy high adhesion solids may be

35 continuously controlled by changing settings of the low adhesion solids protecting layer feeder or changing the speed of the conveyor accordingly.

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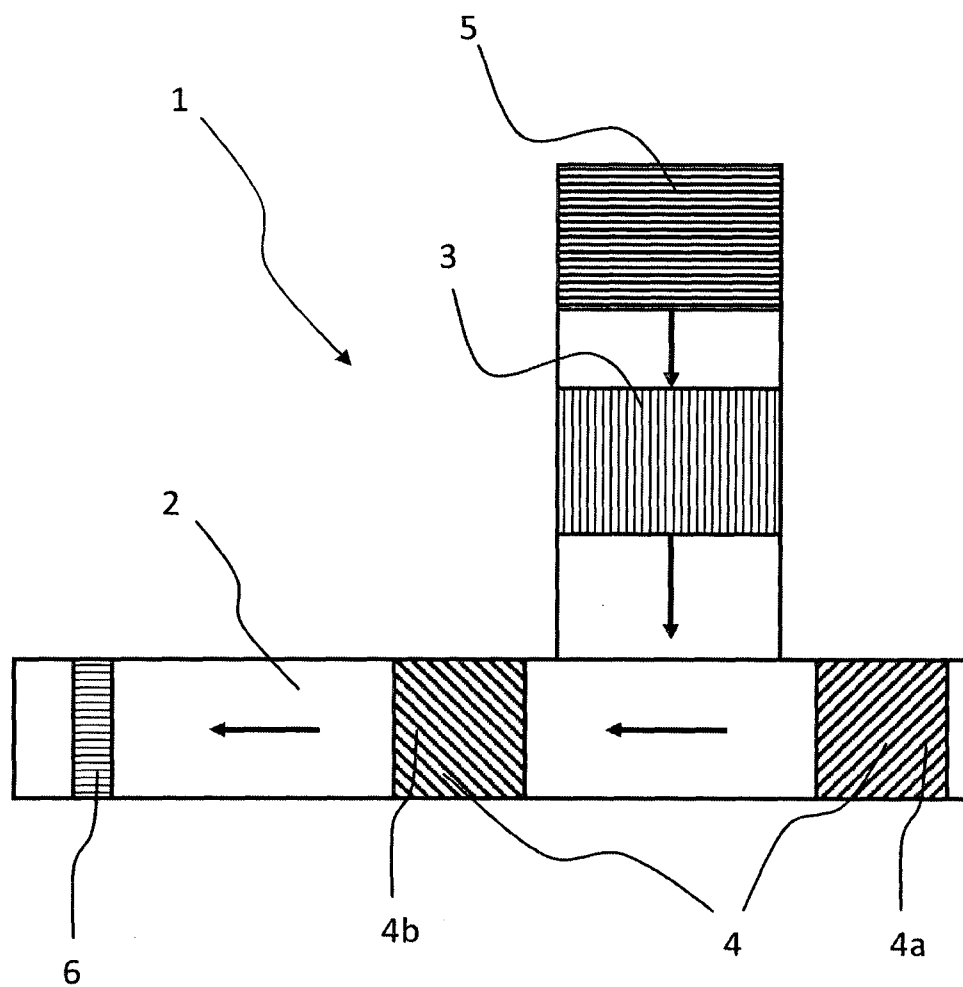


Fig. 1

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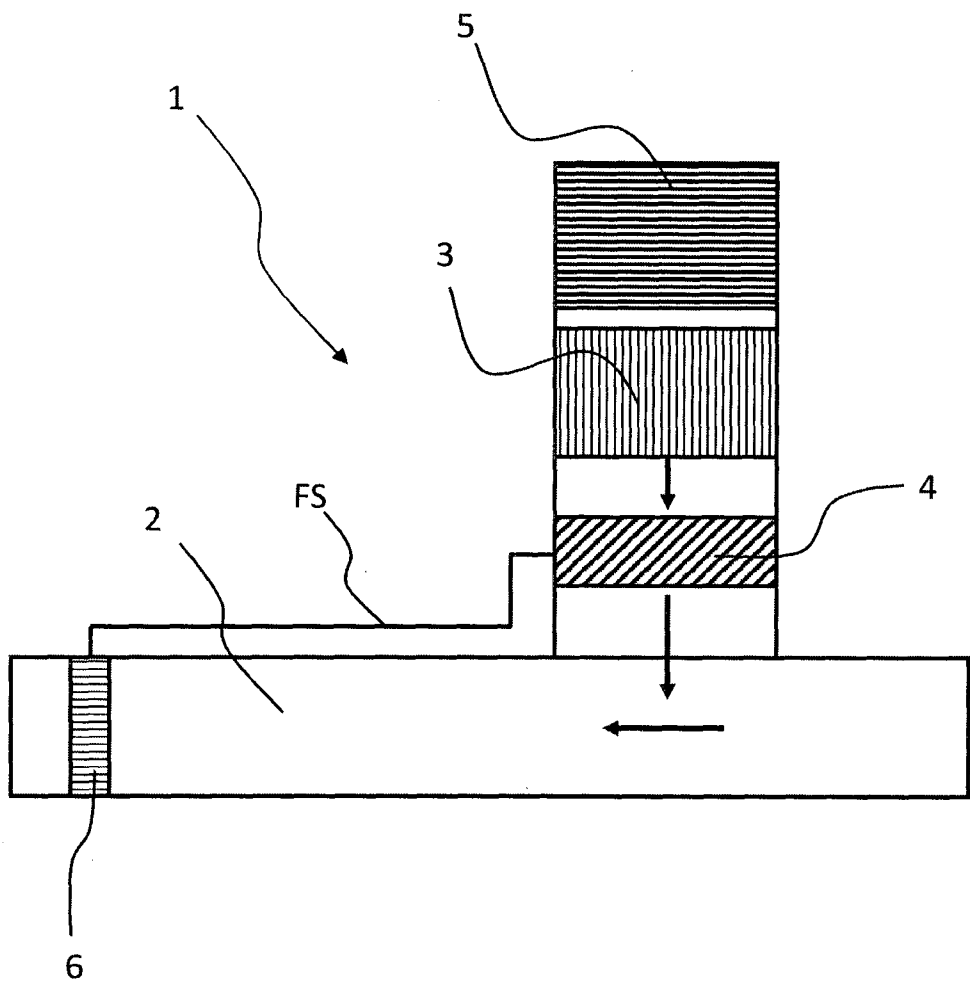


Fig. 2

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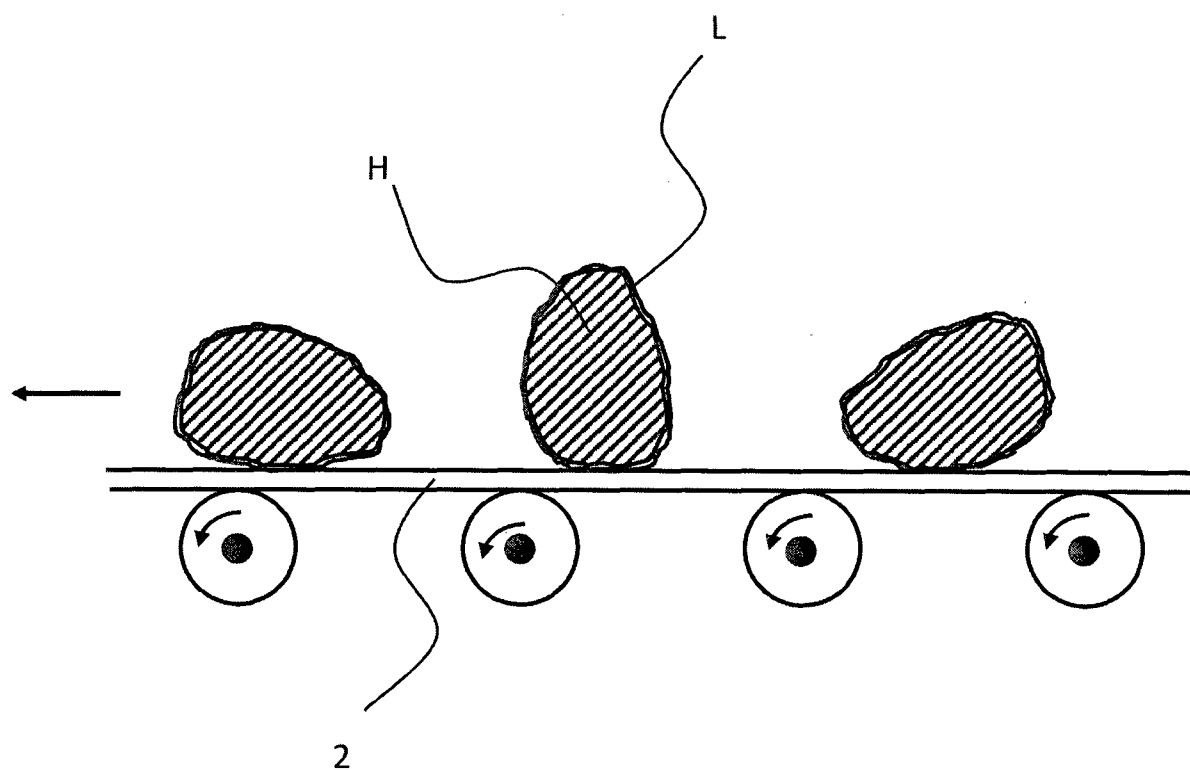


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2014/050438

A. CLASSIFICATION OF SUBJECT MATTER

INV. B65G45/02 B01J2/00 B28C1/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B65G B01J B28C C04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 628 738 A (MITCHELL DENNIS ET AL) 21 December 1971 (1971-12-21)	1-4,7,8
Y	column 1, line 17 - column 2, line 19 figure 1	10
X	EP 1 338 392 A2 (OREGON CERAMICS SERVICES S R L [IT]) 27 August 2003 (2003-08-27) paragraphs [0015] - [0029] figure 1	1-4,7,8
X	EP 0 052 681 A1 (OCCIDENTAL RES CORP [US]) 2 June 1982 (1982-06-02) the whole document	7-9
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

1 April 2015

Date of mailing of the international search report

13/04/2015

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INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2014/050438

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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International application No
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