



159159

-1-

METHODS OF GATHERING UP AND TRANSPORTING PARTICULATE MATERIAL

FIELD OF THE INVENTION

The present invention relates to methods of gathering up and transporting particulate material particularly in conjunction with a grit or the like based blast cleaning activity, related apparatus and procedures and systems applicable thereto.

BACKGROUND

With blast cleaning reliant upon kinetic grit or the like (hereafter "grit") particles there is a generation of spent grit, whether largely of the same particle size or a reduced particle size, as well as particulate material that may be removed from the surface under the kinetic impingement action of the fluid carried grit (usually in water or air). See, for example, US Patent 6,273,154 (Laug).

Such systems require the removal of such grit and resultant particulate material whether for reuse, treatment for reuse or for disposal or treatment for disposal and, it is to that, and its preferred uses, that the present invention is directed.

The present invention recognises a prospect of harvesting from the zone of a blast cleaning activity of the resultant particulate material relying on a vacuum collection system.

Such a vacuum cleaning system reliant as it is on atmospheric pressure air being drawn into the system together with the particulate material is necessarily reliant upon a pressure differential between any collection vessel and atmospheric air of no greater than the atmospheric air pressure.

As the blasting grit is blasted through a nozzle onto the surface it will then settle on a surface. This settled and used grit is removed from such a surface via a hose under vacuum pressure. In existing systems such a vacuum hose will deliver the used blasting grit to a collection silo. However because a vacuum pressure is utilised, the distance between the silo and the end of the hose through which the grit enters the hose is limited. The use of a negative pressure to suck a material is much more limited than the use of the positive pressure to push the material.

In existing systems, the distance between the end of the hose and the silo has limited the positioning of the silo to for example being placed on a wharf adjacent to the ship. However as it is undesirable to establish a semi-permanent storage of the blasting grit at such



G00002

a location, blasting grit in existing system will be collected in a silo which is periodically emptied into a truck which would then transport the used blasting grit to a more permanent storage location.

The present invention recognises the prospect that pressurised air at pressures above atmospheric have an ability to transport particulate material a greater distance or at a greater mass density. Reference to past efforts is contained in US Patent 6,036,407 (Exxon), US Patent 6,368,028 (Exxon), EP 0692441 (Motan-Fuller), EP 1162140 (Xerox), JP 2001287701 (YMS:KK) and WO 02/36468 (Sotic Mecanique).

Accordingly it is an object of the present invention to provide methods and/or related apparatus of gathering up and transporting particulate materials, which addresses the abovementioned prospects or which would at least provide the public with a useful choice.

BRIEF DESCRIPTION OF THE INVENTION

In a first aspect the present invention consists in a method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting particulate material, said method comprising or including the steps of

- drawing the particulate material from a zone of the activity into a first air entrainment conduit,

- air entraining the material in said first air entrainment conduit to a first material collection chamber,

- allowing a quantity of the particulate material to accumulate in the first material collection chamber,

- diverting the flow of the first air entrainment conduit to a second material collection chamber whilst transferring the accumulated material of the first material collection chamber to an air pressurisable chamber,

- expelling, using air, the accumulated material from the air pressurisable chamber into a second air entrainment conduit, and

- air entraining the material in said second air entrainment conduit to a destination,

- subsequently diverting the flow of the first air entrainment conduit back to the first material collection chamber whilst transferring the accumulated material of the second material collection chamber to the same or a different air pressurisable chamber and then expelling, using air, the accumulated material from that air pressurisable chamber into an air

entrainment conduit and/or said second air entrainment conduit and air entraining that material to a destination or said destination.

Preferably wherein the or each transferal from a collection chamber to the or an air pressurisable chamber is a gravity transferal.

Preferably there are two air pressurisable chambers and each material collection chamber transfers to one or other of the air pressurisable chambers.

Preferably any one of the preceding claims wherein the diverting of the flows of the first air entrainment conduit, one way or the other, is controlled by one or more valves.

Preferably the drawing of the particulate material from the zone involves a vacuum pump directly or indirectly connected to draw a reduced pressure in the respective material collection chamber.

Preferably a valved supply of compressed air into the or an air pressurisable chamber and an opening of a valve to allow materials to be expelled from that chamber are used to control the air entrainment of the material in the air entrainment conduit.

Preferably the destinations are at least substantially the same and there is used a single air entrainment conduit for much of each mode of air entrainment from the air pressurisable chamber(s).

In a further aspect the present invention consists in apparatus for use, in conjunction with a grit or like based blast cleaning activity, in gathering up and transporting particulate material, said apparatus comprising or including,

a first material collection chamber,

a second material collection chamber,

a material harvesting conduit to selectively duct particulate material from the zone of the activity into a selected one of said first and second collection chambers,

a vacuum drawing system capable selectively of reducing the pressure in a selected one or other of the first and second collection chambers,

at least one air pressurisable chamber with a closable inlet capable of receiving particulate materials from an outlet of whichever of the two material collection chambers is not at a reduced pressure and still receiving particulate material from the material harvesting conduit,

a compressed air supply system for the or each air pressurisable chamber, and

an air entrainment conduit selectively adapted to receive air entrained material from

the air pressurisable chamber or, selectively, one of the air pressurisable chambers,

whereby, in use, said apparatus is operable to draw particulate material from a zone of the activity with the material harvesting conduit and to air entrain that material for accumulation in a said material collection chamber from which it can be transferred to an air pressurisable chamber for expelling therefrom to a destination via the air entrainment conduit under the action of the compressed air that has pressurised and/or is pressurising the air pressurisable chamber.

Preferably the outlet of each collection chamber is adapted to release under gravity accumulated material into the inlet of the or an air pressurisable chamber.

Preferably there are two air pressurisable chambers, each with a closable inlet, and each collection chamber is either dedicated to one of the air pressurisable chambers or can select either of the air pressurisable chambers to receive particulate material under transfer.

Preferably there is a single air entrainment conduit but that conduit is capable selectively of receiving the expelled output of whichever of the two air pressurisable chambers is in the process of expelling particulate material under the action of the compressed air.

Preferably the selection of air pressurisable chamber from which material is to be received by the air entrainment conduit is under at least the action of a valved release from the air pressurisable chamber.

Preferably a valved supply of compressed air is also adapted to be a factor in determining which air pressurisable chamber is to dispense any content into the air entrainment conduit.

Preferably there is a separately valved compressed air supply to each air pressurisable chamber.

Preferably there is a valved connection of the material harvesting conduit into each of the material collection chambers such that the selection of whichever valve is open and the selective reduction of pressure in a chamber is determinative of whichever collection chamber is to receive particulate material being harvested by the material harvesting conduit.

Preferably the material harvesting conduit has a vacuum head (optionally with an associated air sluicing outlet from an air supply) at its harvesting inlet distal from the collection chambers so as to best harvest materials from the activity zone.

In still a further aspect the present invention consists in a method, in conjunction with

a grit or the like based blast cleaning activity, of gathering up and transporting particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel,

transferring the accumulated material to an air pressurisable vessel,

expelling, using air, the accumulated material from the air pressurisable vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to a destination for immediate or subsequent treatment and/or disposal.

In still a further aspect the present invention consists in a method, in conjunction with a grit based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining at a pressure no higher than ambient air pressure the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel,

transferring the accumulated material to an air pressurisable vessel,

expelling, using air above ambient pressure, the accumulated material from the collection vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to an outlet of the second air entrainment conduit at a destination for immediate or subsequent treatment and/or disposal, said destination being further from said collection vessel than is the induction zone.

In still a further aspect the present invention consists in a method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining at a pressure no higher than ambient air pressure the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel,

transferring the accumulated material to an air pressurisable vessel,

expelling, using air above ambient pressure, the accumulated material from the air pressurisable vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to an outlet of the second air entrainment conduit at a destination for immediate or subsequent treatment and/or disposal, said destination being further from said collection vessel than is the induction zone.

In still a further aspect the present invention consists in a method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining the material in said first air entrainment conduit to a first material collection chamber,

allowing a quantity of the particulate material to accumulate in the first material collection chamber,

diverting the flow of the first air entrainment conduit to a second material collection chamber,

expelling, using air, the accumulated material from the first material collection chamber into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to a destination for immediate or subsequent treatment and/or disposal,

subsequently diverting the flow of the first air entrainment conduit back to the first material collection chamber whilst expelling, using air, the accumulated material of the second material collection chamber into said second air entrainment conduit and air entraining that material to said destination.

The present invention recognises an advantage in conjunction with grit based blast cleaning activities in drawing the particulate material into a vacuum collection system and then to express the accumulated particulate material as collected from that collection vessel or some vessel to which the materials is easily transferred (for example, by auger, gravity, or the like)

to then be transported using pressurised air to a destination that preferably is itself at atmospheric pressure and need not be at a reduced pressure with respect to atmospheric pressure.

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

BRIEF DESCRIPTION OF THE DRAWING

A preferred form will now be described with reference to the accompanying drawing Figure 1 which shows a silo forming two chambers above two existing blasting pots modified to perform methods of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The preferred system has been developed in order to aid in the transfer of used blasting grit from an area (the zone) where the blasting grit has settled to a storage area. Blasting grit such as sand or copper oxide is often used for the blasting of a surface to prepare the surface for painting old layers of paint or rust from the surface. This particular system was developed for use in a shipyard.

The current development preferably utilises a wharf based silo (ie; material collection chambers 1 and 2) which, through a negative pressure (applied to the chambers 1 and 2 by a vacuum device), will collect blasting grit via a suction hose 3 (the material harvesting conduit). However instead of being discharged into a truck, the collected blasting grit (in chambers 1 and 2) is discharged into a blasting pot (air pressurisable chamber, eg; preferably one or other of existing blasting pots 4 and 5) which is subjected to a positive pressure (compressed air) from valved conduits 6 and 7. Valves 20 control the deliver of compressed air to the pots 4, 5 and to the deliver line 21. This is a second stage of the delivery of the used blasting grit from a shipping vessel and utilises a positive pressure to deliver the grit to a more permanent storage area (eg; about 100 m away).

Furthermore the system has been designed to more or less operate continuously. The

collection silo is provided with two grit delivery inlets 7 and 8, each able to receive delivery of grit into compartments 1 and 2 respectively of a two-compartment silo. The silo is split substantially down the middle to provide the two compartments.

When one compartment is being discharged into one or the other of the blasting pot 4, 5 through the lower outlet 9, the other compartment is sealed at the lower outlet and is in a collection mode. Once the first collection chamber has been discharged the lower outlet can be moved to seal the emptied compartment and open the previously closed compartment for discharge into the second blasting pot. Selective filling of the blasting pots by the lower outlet 9, can allow for the blasting pots to operate substantially continuously. One blasting pot 4 is being filled for example by material from one or the other of the collection chamber 1, 2 whilst the other blasting pot 5 is being discharged to have its previously collected material discharged therefrom via the delivery line 21 to the storage area. Appropriate control of the valves 20 and 24 can allow for the blasting pots to also operate to have a substantially continuous delivery of grit to the storage area.

The valves (eg; 4 inch Ø ball valves) to the vacuum source and the valves (eg; 3 inch Ø valves) to the suction hose are appropriately controlled to control the delivery of grit therethrough to the appropriate compartments of the silo. Likewise the valves (eg; 1.5 inch Ø compressed air inlet valves 2 inch Ø sump outlet valves) on the blasting pots are controlled for appropriate delivery of the blasting grit to the storage area, via the delivery line 21.

A filter plate 25 is provided at the upper regions of the material collection chambers 1 and 2 which ensures that no or little grit is able to enter into the vacuum lines to the vacuum machine. Further filtration apparatus may be provided at or more proximate to the vacuum machine.

Whilst compressed air only may be provided to the chambers 4 and 5, further eduction apparatus may also be provided along the delivery line 21 should it be required where for example the material is to be transferred over greater distance. Indeed a venturi effect can be established at the outlet of the blasting pots by the use of compressed air perhaps derived from the same source as that which compresses the chambers of the blasting pots, for the suction of blasting grit from the pots.

In one trial that we have conducted the following parameters and approximate statistics were collected.

(a)	the vacuum being drawn,	About 0.55 to 0.67 bar
(b)	the diameter of the harvesting conduit	About 4"
(c)	the rate of particle transfer into the material collection chamber,	About 3000 kg/hour
(d)	the compressed air pressure into the air pressurisable chamber,	About 7 bars
(e)	the rate of air flow of the compressed air into the compressed air chamber,	About 30 m ³ /min
(f)	the diameter of the air entrainment conduit to the destination,	About 4"
(g)	the mass density in that air entrainment conduit, and	Bulk density of blasting grit approximately 2450 kg/ m ³
(h)	the flow rate in that air entrainment conduit.	Conveying Capacity: about 5000 kg/hour

WHAT WE CLAIMS IS:

1. A method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining the material in said first air entrainment conduit to a first material collection chamber,

allowing a quantity of the particulate material to accumulate in the first material collection chamber,

diverting the flow of the first air entrainment conduit to a second material collection chamber whilst transferring the accumulated material of the first material collection chamber to an air pressurisable chamber,

expelling, using air, the accumulated material from the air pressurisable chamber into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to a destination,

subsequently diverting the flow of the first air entrainment conduit back to the first material collection chamber whilst transferring the accumulated material of the second material collection chamber to the same or a different air pressurisable chamber and then expelling, using air, the accumulated material from that air pressurisable chamber into an air entrainment conduit and/or said second air entrainment conduit and air entraining that material to a destination or said destination.

2. A method of claim 1 wherein the or each transferal from a collection chamber to the or an air pressurisable chamber is a gravity transferal.

3. A method of claims 1 or 2 wherein there are two air pressurisable chambers and each material collection chamber transfers to one or other of the air pressurisable chambers.

4. A method of any one of the preceding claims wherein the diverting of the flows of the first air entrainment conduit, one way or the other, is controlled by one or more valves.

5. A method as claimed in any one of the preceding claims wherein the drawing of the particulate material from the zone involves a vacuum pump directly or indirectly connected to draw a reduced pressure in the respective material collection chamber.

6. A method of any one of the preceding claims wherein a valved supply of compressed

air into the or an air pressurisable chamber and an opening of a valve to allow materials to be expelled from that chamber are used to control the air entrainment of the material in the air entrainment conduit.

7. A method of any one of the preceding claims wherein the destinations are at least substantially the same and there is used a single air entrainment conduit for much of each mode of air entrainment from the air pressurisable chamber(s).

8. Apparatus for use, in conjunction with a grit or like based blast cleaning activity, in gathering up and transporting particulate material, said apparatus comprising or including,
a first material collection chamber,
a second material collection chamber,
a material harvesting conduit to selectively duct particulate material from the zone of the activity into a selected one of said first and second collection chambers,
a vacuum drawing system capable selectively of reducing the pressure in a selected one or other of the first and second collection chambers,
at least one air pressurisable chamber with a closable inlet capable of receiving particulate materials from an outlet of whichever of the two material collection chambers is not at a reduced pressure and still receiving particulate material from the material harvesting conduit,
a compressed air supply system for the or each air pressurisable chamber, and
an air entrainment conduit selectively adapted to receive air entrained material from the air pressurisable chamber or, selectively, one of the air pressurisable chambers,
whereby, in use, said apparatus is operable to draw particulate material from a zone of the activity with the material harvesting conduit and to air entrain that material for accumulation in a said material collection chamber from which it can be transferred to an air pressurisable chamber for expelling therefrom to a destination via the air entrainment conduit under the action of the compressed air that has pressurised and/or is pressurising the air pressurisable chamber.

9. Apparatus of claim 8 wherein the outlet of each collection chamber is adapted to release under gravity accumulated material into the inlet of the or an air pressurisable chamber.

10. Apparatus as claimed in claim 8 or claim 9 wherein there are two air pressurisable chambers, each with a closable inlet, and each collection chamber is either dedicated to one of the air pressurisable chambers or can select either of the air pressurisable chambers to

receive particulate material under transfer.

11. Apparatus as claimed in claim 10 wherein there is a single air entrainment conduit but that conduit is capable selectively of receiving the expelled output of whichever of the two air pressurisable chambers is in the process of expelling particulate material under the action of the compressed air.

12. Apparatus as claimed in claim 11 wherein the selection of air pressurisable chamber from which material is to be received by the air entrainment conduit is under at least the action of a valved release from the air pressurisable chamber.

13. Apparatus as claimed in claim 12 wherein a valved supply of compressed air is also adapted to be a factor in determining which air pressurisable chamber is to dispense any content into the air entrainment conduit.

14. Apparatus as claimed in any one of claims 10 to 13 wherein there is a separately valved compressed air supply to each air pressurisable chamber.

15. Apparatus as claimed in any one of claims 8 to 14 wherein there is a valved connection of the material harvesting conduit into each of the material collection chambers such that the selection of whichever valve is open and the selective reduction of pressure in a chamber is determinative of whichever collection chamber is to receive particulate material being harvested by the material harvesting conduit.

16. Apparatus as claimed in any one of claims 8 to 15 wherein the material harvesting conduit has a vacuum head (optionally with an associated air sluicing outlet from an air supply) at its harvesting inlet distal from the collection chambers so as to best harvest materials from the activity zone.

17. A method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel, transferring the accumulated material to an air pressurisable vessel,

expelling, using air, the accumulated material from the air pressurisable vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to a destination for immediate or subsequent treatment and/or disposal.

18. A method, in conjunction with a grit based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining at a pressure no higher than ambient air pressure the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel,

transferring the accumulated material to an air pressurisable vessel,

expelling, using air above ambient pressure, the accumulated material from the collection vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to an outlet of the second air entrainment conduit at a destination for immediate or subsequent treatment and/or disposal, said destination being further from said collection vessel than is the induction zone.

19. A method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining at a pressure no higher than ambient air pressure the material in said first air entrainment conduit to a material collection vessel,

allowing a quantity of the particulate material to accumulate in the collection vessel,

transferring the accumulated material to an air pressurisable vessel,

expelling, using air above ambient pressure, the accumulated material from the air pressurisable vessel into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to an outlet of the second air entrainment conduit at a destination for immediate or subsequent treatment and/or disposal, said destination being further from said collection vessel than is the induction zone.

20. A method, in conjunction with a grit or the like based blast cleaning activity, of gathering up and transporting resultant particulate material, said method comprising or including the steps of

drawing the particulate material from a zone of the activity into a first air entrainment conduit,

air entraining the material in said first air entrainment conduit to a first material collection chamber,

allowing a quantity of the particulate material to accumulate in the first material collection chamber,

diverting the flow of the first air entrainment conduit to a second material collection chamber,

expelling, using air, the accumulated material from the first material collection chamber into a second air entrainment conduit, and

air entraining the material in said second air entrainment conduit to a destination for immediate or subsequent treatment and/or disposal,

subsequently diverting the flow of the first air entrainment conduit back to the first material collection chamber whilst expelling, using air, the accumulated material of the second material collection chamber into said second air entrainment conduit and air entraining that material to said destination.