

HOLD OFFLOADING SYSTEM

BACKGROUND

The typical material used for land reclamation is sand. As reclamation sand is a scarce commodity in many parts of the world, it often must be mined from elsewhere and transported long distances to the new location where reclamation is to occur. In such cases, it is often economically better to transport the sand or other reclamation material with bulk carriers instead of hopper dredgers which may have been used for dredging the material. However, unloading the bulk carriers is typically time consuming, and complex equipment is required, leading to high costs and high economical risks.

Hydraulic transport has proven to be a reliable and cost effective way to unload and transport sand or other material, but fluidization inside the cargo space of a bulk carrier is complex and challenging. WO2011/028129 shows dry bulk carrier with a fluidization system for unloading. The fluidization system consists of fluidizing pipes extending horizontally in the longitudinal direction of the hold along the bottom and on the walls of the hold. These fluidization pipes introduce liquid to the hold to fluidize the material in the hold, and then flow it toward an outlet.

A system for loading and unloading a holding space with a material and water is shown in WO 00/38975. This system includes a float and pump station that can move on the layer of liquid in the cargo hold. The pump station can have a suction head which can be elevated or lowered from the pump for suctioning the material in the cargo hold. In some embodiments, the pumping station can include nozzles at the float directing water jets outward from the float in case the material has settled too much. With use of the float, this system is applicable only to cargo holding spaces that include a large amount of liquid. Additionally, the nozzles being located on the float only act to generally fluidize material around the float, not necessarily close to the suction head or locally in a specific desired location.

U.S. Pat. No. 3,990,748 also discloses an apparatus for pumping a slurry with a liquid. The apparatus includes a housing suspended from a boom of a crane and nozzles which are also oriented to spray outward from below the end of the housing. The nozzles are fixed vertically, but can oscillate around the vertical axis. Just as in WO 00/38975, by having these nozzles oriented outwardly, they act to generally to form a slurry around the area, and are not directed or limited to a precise area.

Fluidization of an entire hold can lead to the maximum loading capacity of the vessel being exceeded and corrosion in the hull structure. Additionally, there are various regulations that must be adhered to, for example, with regard to stability and structural integrity. Most unloading systems invented up to now require conversion of the bulk carrier into a slurry for offloading and transport elsewhere, but this has not proven to be economically feasible.

SUMMARY

According to a first aspect of the invention, a hold offloading system comprises a holding space for containing a material; and a localized fluidization-suction-pump-drive system for locally fluidizing the material and transporting the fluidized material out of the holding space. The fluidization-suction-pump-drive system includes a fluidization portion and a suction head in proximity to the fluidization portion for suctioning the locally fluidized material, wherein nozzles of the fluidization portion are positioned at points around the suction head and directed toward the suction head.

Such a system allows for local fluidization within a holding space and removal of that locally fluidized material from the holding space with very few or no modifications required for a typical holding space (or a vessel if the holding space is located within a vessel). The proximity of the fluidization portion and the suction head promotes immediate removal of the fluidized material after fluidization, reducing the residual fluidized material and/or fluid that weighs on holding space and acts to corrode the holding space. Thus, such a system can allow for the cost-effective use and unloading of large holding spaces and/or vessels, such as bulk carriers.

According to an embodiment, the localized fluidization-suction-pump-drive system comprises a movable fluidization-suction-pump-drive system which can be moved around in the holding space for locally fluidizing the material and transporting the material out of the holding space. This can allow for removal of all material within a holding space no matter the size or shape. Additionally, the ability to move such a system around means that fewer or no modifications need to be made to the holding space to ensure full emptying of the space when desired.

According to an embodiment, the localized fluidization-suction-pump-drive system is removable from the holding space. This can be an advantage for various situations where the system is not desired or needed, for example, upon loading of the holding space. Additionally, the holding space will have more holding capacity when the localized fluidization-suction-pump-drive system is completely removed from the holding space.

According to an embodiment, the localized fluidization-suction-pump-drive system further comprises a shield to keep the fluidization near the system and ensure the locally

fluidized material is transported out of the holding space through the fluidization-suction-pump-drive system. Such a shield can help to further promote that fluid and localized material stay close to fluidization-suction-pump-drive system for removal through suction head and ensure that the holding space is affected with as little water as possible. The fluidization system can be connected to the shield in some embodiments and/or can be directed toward suction head. This can help to keep fluidization local and help direct the fluidized material toward the suction head for removal.

According to an embodiment, the localized fluidization-suction-pump-drive system works to locally fluidize and transport material from a top of the holding space first.

According to an embodiment, the localized fluidization-suction-pump-drive system is in a container and the material is transported to the container for fluidization. In such a system, the fluidized material is completely within the container, preventing the fluid or fluidized material from flowing to other parts of the holding container. This ensures that fluidization stays local and all fluidized material is directly fed to the suction head.

According to an embodiment, the material is transported to the container mechanically. Such a mechanical system can continuously transport material from the holding space to the container for fluidization and transport out of the holding tank.

According to an embodiment, the hold offloading system further comprises a pump-pipeline system to transport the material hydraulically after the material has been transported out of the holding space. Such a pump-pipeline system can be a reliable and cost effective way to transport a fluidized mixture.

According to an embodiment, a vessel can include the hold offloading system. Optionally, the vessel can be a bulk carrier. The hold offloading system allows for easy and cost-effective use and hydraulic unloading of a vessel while reducing or eliminating the risk of overloading the vessel with fluid.

According to a second aspect of the invention, a method of offloading a holding space comprises locally fluidizing material in a holding space; and transporting the fluidized material out of the holding space. Such a method allows for easy and cost effect unloading of a holding space without overloading the holding space by only locally fluidizing material and then immediately transporting that material out of the holding space, wherein the step of locally fluidizing material in a holding space comprises: introducing a fluid to the material with a fluidization-suction-pump-drive system with a fluidization portion; and removing the fluid and material mixture from the holding space through a suction head of the fluidization-suction- pump-drive system, wherein the fluidization portion and the suction head are located in proximity to each other and the nozzles are positioned at points around the suction head and directed toward the suction head.

According to an embodiment, the step of locally fluidizing material in a holding space comprises introducing a fluid to the material with a fluidization-suction-pump-drive system with a fluidization portion; and removing the fluid and material mixture from the holding space through a suction head of the fluidization-suction-pump-drive system, wherein the fluidization portion and the suction head are located in proximity to each other. By locating the fluidization portion and suction head in proximity to each other, most or all of the locally fluidized material can be directly suctioned through suction head and transported out of the holding space. This can help to prevent overloading of the holding space and/or corrosion in the holding space caused by excess or stagnant fluid.

According to an embodiment, the method further comprises moving the fluidization-suction-pump-drive system within the holding space to locally fluidize material in different parts of the holding space and remove the fluidized material. By making the fluidization-suction-pump-drive system movable to fluidize and remove material in all parts of holding space, the system can empty the holding space without the need for many or any additional changes or modifications of the holding space.

According to an embodiment, the material is fluidized and removed from a top of the holding space to a bottom of the holding space.

According to an embodiment, the method further comprises positioning a shield near the fluidization-suction-pump-drive system. Such a shield can further contain the fluid and fluidized material and encourage it to stay close for suctioning and transport out of the holding space. Optionally, the shield is connected to the fluidization-suction-pump-drive system to move with the fluidization-suction-pump-drive system. This can ensure that the shield is always positioned properly in relation to the fluidization-suction-pump-drive system.

According to an embodiment, the step of locally fluidizing the material with a holding space comprises transporting the material to a container; and fluidizing the material within the container. By using a container, and first transporting the material to the container before fluidizing, the container ensures that the fluidization stays local and does not cause an overloading of the holding space. Optionally, the material is transported to the container mechanically.

According to an embodiment, the method further comprises positioning the fluidization-suction-pump-drive system prior to loading the holding space with material. In such a system, the fluidization-suction-pump-drive system can be placed at any part of the holding space to be ready to remove material from any part of the holding space when desired.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1a is a cross-sectional view of a holding space with a first embodiment of a fluidization-suction-pump-drive system.

Fig. 1b is a perspective view of the fluidization-suction-pump-drive system of Fig. 1a.

5 Fig. 1c is a cross-sectional view of the holding space and the fluidization-suction-pump-drive system of Fig. 1a, with the fluidization-suction-pump-drive system having been placed in the holding space prior to filling the holding space with material.

Fig. 2 is a cross-sectional view of a holding space with a second embodiment of a fluidization-suction-pump-drive system.

10 Fig. 3 is a cross-sectional view of a holding space with a third embodiment of a fluidization-suction-pump-drive system.

DETAILED DESCRIPTION

Fig. 1a is a cross-sectional view of holding space 10 with a first embodiment of a fluidization-suction-pump-drive system 12, Fig. 1b is a perspective view of fluidization-suction-pump-drive system 12, and Fig. 1c is a cross-sectional view of holding space 10 and the fluidization-suction-pump-drive system 12, with the fluidization-suction-pump-drive system 12 having been placed in the holding space 10 prior to filling the holding space 10 with material. Holding space 10 can be within or part of a vessel, for example, a bulk carrier. Shown in holding space 10 is dry material 22 and fluidized material 24.

Fluidization-suction-pump-drive system 12 includes fluidization portion 14 with nozzles 15, suction head 16, pump 18 and transport pipe 20. Fluidization portion 14 is located in proximity to suction head 16. Fluidization portion 14 can be, for example, connected to suction head 16 or secured in proximity to suction head 16.

25 In operation, fluidization portion 14 can work to fluidize dry material 22 in holding space 10 by expelling liquid through nozzles 15. Fluidized material 24 is then sucked up through suction head 16 using the force provided by pump 18. Pump 18 works to flow the material to transport pipe 20, where it can be transported out of holding space 10 and further, for example, through a pump-pipeline system.

30 Fluidization-suction-pump-drive system 12 can be moveable within holding space 10, and can start the local fluidization and suction process from a top of holding space 10 and work towards the bottom as shown in Fig. 1a. Alternatively, fluidization-suction-pump-drive system 12 can be placed in holding space 10 prior to loading with dry material 22, as shown in Fig. 1c.

In such an embodiment, fluidization and suction can take place starting at whatever point fluidization-suction-pump-drive system 12 is positioned, for example, from a bottom or lower part of holding space 10. Fluidization-suction-pump-drive system 12 can also be removable from holding space 10 when desired, for example, when loading holding space 10.

5 By locating fluidization portion 14 in proximity to suction head 16, fluidization-suction-pump-drive system 12 is able to ensure that the fluidization stays localized. In past systems, when a bulk carrier created a slurry to unload the holding space, the entire holding space was typically flooded. This added significant weight to the vessel and could cause corrosion in the holding space interior.

10 By locally fluidizing only a portion of dry material 22 and then suctioning that with suction head 16, fluidization-suction-pump-drive system 12 can efficiently hydraulically unload holding space 10 without causing overloading of holding space 10. The local fluidization and then direct unloading through suction head 16 also reduces or eliminates corrosion to the interior of holding space 10 that can result from fluidizing the entire holding space 10. By using
15 fluidization-suction-pump-drive system 12 to only locally fluidize the material and then suction and transport the fluidized material out of holding space 10, large vessels, such as bulk carriers, can be used and unloaded in a cost effective manner.

Fig. 2 is a cross-sectional view of a holding space 10 with a second embodiment of a fluidization-suction-pump-drive system 12'. Similar parts are labelled similarly as in Figs. 1a-
20 1c. Fluidization-suction-pump-drive system 12' includes fluidization portion 14 with nozzles 15 and fluid line 17, suction head 16, pump 18, transport pipe 20, shield 26 and suspension system 28. Dry material 22 and fluidized material 24 are shown in holding space 10.

In this embodiment, fluidization-suction-pump-drive system 12' is suspended by a suspension system 28 connected to pump 18. Fluidization-suction-pump-drive system 12' also
25 includes shield 26 which works to keep fluidization local. Shield 26 can be connected to fluidization-suction-pump-drive system 12' to move with fluidization-suction-pump-drive system 12' or can be supported and controlled to move independently. In this embodiment, shield 26 is cylindrical in shape to surround suction head 16 and pump 18, though shield 26 can have other shapes in other embodiments.

30 Nozzles 15 for fluidization system are also connected to shield 26 to fluidize material 22 in proximity to suction head 16 and fluidization-suction-pump-drive system 12. Fluid line 17 connects to nozzles 15 to supply nozzles 15 with fluid for disbursement. Optionally, system 12' can include nozzles 15 pointing outward from shield 26 to enable easier movement of shield

26 through material 22. Shield 26 can also, in some embodiments, include one or more openings 27 to enable movement of material 22 into shield 26 for fluidization and then suction through suction head 16.

Fluidization-suction-pump-drive system 12' works similarly to fluidization-suction-pump-drive system 12 shown and described in Figs. 1a-1c. Fluidization portion 14 is used to locally fluidize dry material 22, which is then suctioned into fluidization-suction-pump-drive system 12' through suction head 16. The fluidized material can then be transported out of holding space through transport pipe 20, using pump 18. Fluidization-suction-pump-drive system 12' and shield 26 can be moved around within holding space 10 to fluidize and transport all material 22 from holding space 10. Shield 26 acts as a barrier to keep fluidization from spreading far beyond fluidization-suction-pump-drive system 12'. Additionally, directing nozzles 15 inward from shield 26 ensures that fluidization and flow of fluidized material is toward suction head 16. This further promotes only local fluidization and subsequent removal of locally fluidized material 24, thereby allowing for easy removal of material from holding space without overloading holding space 10 by allowing too much fluidization.

Fig. 3 is a cross-sectional view of a holding space 10 with a third embodiment of a fluidization-suction-pump-drive system 12'', and includes fluidization portion 14, suction head 16, pump 18, transport pipe 20, suspension system 28, container 30 and transport system 32. Dry material 22 and fluidized material 24 are also shown. In this embodiment, fluidization portion 14 consists of container 30 and nozzles (not shown in this embodiment) which introduce fluid to container 30. Fluid can be supplied by a fluid line, which can, for example, be delivered to container 30 in combination with power lines for pump 18 and/or connected at least in part to transport pipe 20 and/or suspension system 28.

Container 30 is connected to suspension system 28, which can be attached to a crane or other support system or feature. In other embodiments, container 30 can be supported by other means and/or could be positioned at a different location.

Transport system 32 is a mechanical transport system which connects between dry material 22 in holding space 10 and container 30, and can be, for example, a count wheel or a scraper conveyor. Transport system 32 can be a different type of transport system in other embodiments.

Transport system 32 works to transport dry material 22 from holding space 10 to container 30, and can continuously transport material 22 to container 30 until holding space 10 is empty. Once in container 30, dry material is fluidized and sucked up through suction head

16 and into transport pipe 20 (with pump 18), where it can be transported to a pump-pipeline system. Container 30 acts as the fluidization space, ensuring that only a set amount of dry material 22 is fluidized at a time before transporting away.

By using container 30 to fluidize material 22, fluidization remains local, thereby avoiding adding a lot of additional weight (in the form of liquid for fluidization) to holding space 10. Such a system which uses container 30 to keep fluidization local also avoids adding liquid directly to holding space 10 which helps prevent deterioration of the interior of holding space 10 that can occur from the addition of liquid for fluidization and transport. The use of container 30 also can ensure that pump 18 is always under liquid, thereby making start-up and subsequent operation of pump 18 easier.

In summary, fluidization-suction-pump-drive systems 12, 12' and 12'' allow for the local fluidization and transport of material from holding space 10 with few or no modifications required of holding space 10 or a vessel in which holding space 10 sits. By locating fluidization system 14 and suction head 16 in proximity to each other in fluidization-suction-pump-drive systems 12, 12' and 12'', dry material 22 can be locally fluidized and then immediately transported out of holding space 10. This ensures that most or all of fluidized material 24 is flowed out of holding space 10 soon after fluidization, thereby reducing or eliminating the chances of overloading holding space 10 with too much fluid. This can also reduce or eliminate corrosion in holding space 10 from the introduction of liquid, particularly in system 12'' which encloses fluidized material within container 30. Fluidization-suction-pump-drive systems 12, 12' and 12'' are moveable, allowing for movement around holding space 10 to entirely empty holding space 10, and can be completely removed from holding space 10 if desired, for example when filling holding space 10. Shield 26 can help to further enclose and promote only local fluidization, and the addition of fluidization system 14 on shield 26 promotes the flow of fluidized material directly to suction head 16 for removal. By only locally fluidizing and then removing material, fluidization-suction-pump-drive systems 12, 12' and 12'' can provide a cost-effective and efficient way of emptying holding space 10, allowing for the cost-effective use and unloading of large vessels, such as dry bulk carriers.

While reference is made to pump 18, pump 18 can be a pumping system, including, for example, a pump drive.

While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In

addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiments disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

Claims

1. A hold offloading system comprising:
 - a holding space (10) for containing a material; and
 - 5 a localized fluidization-suction-pump-drive system (12, 12', 12'') for locally fluidizing the material and transporting the fluidized material out of the holding space (10), the fluidization-suction-pump-drive system (12, 12', 12'') with a fluidization portion (14) and a suction head (16) in proximity to the fluidization portion for suctioning the locally fluidized material, wherein nozzles of the fluidization portion (14) are positioned at points around the
 - 10 suction head (16) and directed toward the suction head (16).
2. The hold offloading system of claim 1, wherein the localized fluidization-suction-pump-drive system (12, 12', 12'') comprises:
 - a movable fluidization-suction-pump-drive system which can be moved around in the
 - 15 holding space (10) for locally fluidizing the material and transporting the material out of the holding space (10).
3. The hold offloading system of any of the preceding claims, wherein the localized fluidization-suction-pump-drive system (12') further comprises:
 - 20 a shield (26) to keep the fluidization near the system and ensure the locally fluidized material is transported out of the holding space (10) through the fluidization-suction-pump-drive system (12').
4. The hold offloading system of any of the preceding claims, wherein the localized
- 25 fluidization-suction-pump-drive system (12, 12', 12'') works to locally fluidize and transport material from a top of the holding space (10) first.
5. The hold offloading system of any of the preceding claims, wherein the localized fluidization-suction-pump-drive system (12'') is in a container (30) and the material is
- 30 transported to the container for fluidization.
6. The hold offloading system of claim 5, wherein the material is transported to the container mechanically.

7. The hold offloading system of any of the preceding claims, and further comprising:
a pump-pipeline system (18, 20) to transport the material hydraulically after the
material has been transported out of the holding space.

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8. A vessel comprising the hold offloading system of any of the preceding claims,
preferably wherein the vessel is a bulk carrier.

10 9. A method of offloading a holding space (10) comprising:
locally fluidizing material in a holding space (10); and
transporting the fluidized material out of the holding space (10), wherein the step of
locally fluidizing material in a holding space (10) comprises:
introducing a fluid to the material with a fluidization-suction-pump-drive system (12,
15 12', 12'') with a fluidization portion; and
removing the fluid and material mixture from the holding space (10) through a suction
head (16) of the fluidization-suction-pump-drive system (12, 12', 12''), wherein the
fluidization portion and the suction head (16) are located in proximity to each other and the
nozzles are positioned at points around the suction head (16) and directed toward the suction
20 head (16).

10. The method of any of claim 9, and further comprising:
moving the fluidization-suction-pump-drive system (12, 12', 12'') within the holding
space to locally fluidize material in different parts of the holding space (10) and remove the
25 fluidized material, preferably wherein the material is fluidized and removed from a top of the
holding space (10) to a bottom of the holding space.

11. The method of any of claims 9-10, and further comprising:
positioning a shield (26) near the fluidization-suction-pump-drive system (12, 12',
30 12''), preferably wherein the shield (26) is connected to the fluidization-suction-pump-drive
system (12, 12', 12'') to move with the fluidization-suction-pump-drive system.

12. The method of claim 9, wherein the step of locally fluidizing the material with a holding space (10) comprises:

transporting the material to a container (30); and
fluidizing the material within the container (30).

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13. The method of claim 12, wherein the material is transported to the container (30) mechanically.

14. The method of any of claims 9-13, and further comprising

10 positioning the fluidization-suction-pump-drive system (12, 12', 12'') prior to loading the holding space with material.