

TITLE OF THE INVENTION

METHOD FOR SEPARATING OIL CONTENT AND APPARATUS FOR SEPARATING OIL CONTENT

FIELD OF THE INVENTION

[0001] This invention belongs to the technical field of separation of oil included in oil-containing material such as various types of sludge and so on for reuse purposes.

BACKGROUND ART

[0002] Recently, environmental contamination caused by disposal (dumping and incineration disposal) of oil-containing material has been recognized as a social problem. From a viewpoint of the efficient utilization of petroleum which is expected to be exhausted eventually, there have been the social needs to reuse the oil contained in the oil-containing material disposed of so far.

[0003] Generally, as the oil-containing material suitable on a commercial basis for reusing the oil contents, there may be enumerated crude oil sludge produced from crude oil, tanker sludge deposited on the ship bottom of a crude oil tanker, and tank sludge deposited on the bottom of an oil storage tank and so forth. This kind of sludge is featured to be much more easy to handle than the sludge containing metallic solid content produced by machining such as oil grinding and capable of being obtained concentratively in a quantitative manner.

[0004] To reuse the oil contained in the oil-containing material, it is necessary to separate the oil from the solid content in the oil-containing material without transform the oil content. A technology for performing separation of oil by vaporizing the oil content from the oil-containing material has been established. However, the oil separation technique has suffered a disadvantage such that the vaporized oil is flammable, and therefore, facilities and processing for preventing catching-fire are required, so it cannot easily be put into practice. Thus, the technological developments of eliminating the risks of igniting the oil when vaporizing the oil content from the oil-containing material have been called for.

[0005] The technique disclosed in Patent Literature 1 has been known as one example for eliminating the risks of igniting the oil when vaporizing the oil content from the oil-containing material.

[0006] Patent Literature 1 discloses the oil separating technique for separating the oil contained in the oil-containing material by jetting overheated steam of high temperature and high pressure onto the oil-containing material at supersonic speed to evaporate the oil content.

[0007] The oil separating technique of Patent Literature 1 serves to eliminate the risks of igniting the oil by instantaneously decomposing the oil-containing material with the

overheated steam to evaporate the oil content.

RELATED ART REFERENCE

PATENT LITERATURE

[0008]

Patent Literature 1: Japanese Unexamined Patent Application Publication No.
2001-149722

DISCLOSURE OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0009] In the oil separating technique of Patent Literature 1, due to the overheated steam which is jetted onto oil-containing material deposited in a treatment vessel, decomposition of the oil-containing material is proceeded unequally over a wide range of the interior of the treatment vessel. Hence, it has a problem that the oil content cannot be separated effectively.

[0010] The oil separating technique disclosed in Patent Literature 1 carries out supersonic jetting of the heated steam on the oil sludge, consequently to create the potential for collision of the sludge with the wall surface of the treatment vessel or damage to a jetting nozzle due to the collision.

[0011] The present invention was made in view of the problems described above and seeks to provide an oil separating method for effectively separating oil content from oil-containing material by jetting heated steam and an oil separating apparatus for putting the method into practice.

MEANS FOR SOLVING THE PROBLEMS

[0012] In order to solve the above problems according to the present invention, there is provided an oil separating method for separating oil content from oil-containing material by jetting overheated steam of high temperature and high pressure onto the oil-containing material to vaporize the oil content in the oil-containing material, which is characterized by supplying the oil-containing material of muddy state and the overheated steam each other in opposite directions to bring them into collision with each other.

[0013] In this invention, the easy-to-supply oil-containing material of muddy state and the heated steam are supplied in the opposite directions to have a collision with each other, so that concentrative decomposition of the oil-containing material can be progressed in an area narrowly limited near a point of collision between the oil-containing material and the heated steam.

[0014] The oil separating method of the present invention is further characterized in that a centrifugal force created centering on a straight line extending in the opposite directions of

supply of the oil-containing material and the heated steam is exerted on a collision product produced by the collision of the heated steam with the oil-containing material.

[0015] The method of the invention serves to allow the centrifugal force to act on collision products (vaporized oil content, powdery content, solid content, etc.) produced by the collision between the oil-containing material and the heated steam, causing a vortex flow of the vaporized oil content and powdery content, thereby to separate the solid content from the vaporized oil content and powdery content by centrifugation.

[0016] According to the invention, there is further provided an oil separating apparatus for separating oil content from oil-containing material by jetting overheated steam of high temperature and high pressure onto the oil-containing material to vaporize the oil content in the oil-containing material, which is characterized by comprising an oil-containing material supplying pipe for supplying the oil-containing material of muddy state and a heated steam supplying pipe for supplying the overheated steam, wherein the feed end port of the oil-containing material supplying pipe and the feed end port of the overheated steam supplying pipe are opposite each other.

[0017] In this invention, the easy-to-supply oil-containing material of muddy state is supplied from the oil-containing material supplying pipe, and the heated steam is supplied from the heated steam supplying pipe, so that the oil-containing material and the heated steam come into collision with each other in an area narrowly limited between the feed end port of the oil-containing material supplying pipe and the feed end port of the overheated steam supplying pipe by the structure in which the feed end port of the oil-containing material supplying pipe and the feed end port of the overheated steam supplying pipe to bring the oil-containing material are opposite each other, thereby to progress concentrative decomposition of the oil-containing material.

[0018] The oil separating apparatus of the present invention is further characterized by including a treatment vessel shaped in an inverted frustum of circular cone and a drive member for rotating the treatment vessel around its central axis, wherein the oil-containing material supplying pipe is arranged from the lower part of the central axis of the treatment vessel to the inside of the treatment vessel, and the heated steam supplying pipe is arranged from the upper part of the central axis of the treatment vessel to the inside of the treatment vessel.

[0019] In this invention, the treatment vessel rotated by the drive member encloses around the oil-containing material supplying pipe and heated steam supplying pipe to exert the centrifugal force on the collision products (vaporized oil content, powdery content, solid content, etc.) produced by the collision between the oil-containing material and the heated

steam, causing a vortex flow of the vaporized oil content and powdery content, thereby to separate the solid content from the vaporized oil content and powdery content by centrifugation.

[0020] The oil separating apparatus according to the present invention is characterized by further including a lid member for covering the upper part of the treatment vessel, which is connected at its center to an oil discharge port for discharging the vaporized oil content and has a dome sloping toward the oil discharge port.

[0021] The oil separating apparatus having the dome sloping toward the center of the lid member covering the upper part of the treatment vessel so as to cause a vortex flow serves to smoothly gather the vaporized oil content and powdery content to the oil discharge port connected to the center of the lid member.

[0022] The oil separating apparatus according to the present invention is characterized by further including a gutter-like solid content gathering part for gathering the solid content left after evaporating the oil content from the oil-containing material around the upper part of the treatment vessel.

[0023] According to this invention, the solid content gathering part disposed around the upper part of the treatment vessel serves to gather the solid content centrifuged from the vaporized oil content and powdery content.

EFFECT OF THE INVENTION

[0024] The oil separating method according to the present invention serves to supply the oil-containing material of muddy state and the overheated steam in the opposite directions to have a collision with each other to progress concentrative decomposition of the oil-containing material in an area narrowly limited near a point of collision between the oil-containing material and the heated steam, consequently to bring about an effect of effectively separating the oil content from the oil-containing material by jetting the heated steam.

[0025] The oil separating apparatus according to the present invention having a structure in which the feed end port of the oil-containing material supplying pipe for supplying the oil-containing material of muddy state and the feed end port of the overheated steam supplying pipe for supplying the heated steam are arranged in the opposite directions to bring the oil-containing material and the heated steam into collision with each other in an area narrowly limited between the feed end port of the oil-containing material and the feed end port of the overheated steam supplying pipe so as to progress concentrative decomposition of the oil-containing material, consequently to bring about an effect of effectively separating the oil content from the oil-containing material by jetting the heated steam merely by constituting the pipe arrangement of the oil-containing material supplying pipe and the heated steam supplying

pipe.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026]

FIG. 1 is a sectional view showing the device configuration of a first embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

FIG. 2 is a cross-sectional view of FIG. 1.

FIG. 3 is a structure diagram of the whole system incorporating the structure of FIG. 1 for collecting the oil content.

FIG. 4 is a flowchart showing the operation of separating the oil content of FIG. 1.

FIG. 5 is a sectional view showing the device configuration of a second embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

FIG. 6 is a sectional view showing the device configuration of a third embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

EXPLANATION OF REFERENCE LETTERS OR NUMERALS

[0027]

- 1 treatment vessel
- 2 Lid member
- 2a Solid content gathering part
- 2b Dome
- 3 Oil-containing material supplying pipe
- 3a Feed end port
- 30 Heater
- 4 Heated steam supplying pipe
- 4a Feed end port
- 5 Drive member
- A Oil-containing material
- B Heated steam
- a Oil content
- b Solid content
- L Central axis

BEST MODE FOR CARRYING OUT THE INVENTION

[0028] The embodiment for fulfilling the oil separating method and oil separating apparatus

according to the present invention will be described hereinafter with reference to the accompanying drawings.

[0029] FIG. 1 through FIG. 4 show the first embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

[0030] In the first embodiment, there is illustrated the oil-containing material "A" from which the oil content "a" can appropriately be separated, e.g. crude oil sludge, tanker sludge and tank sludge as described above.

[0031] The first embodiment has a treatment vessel 1, a lid member 2, an oil-containing material supplying pipe 3, and a heated steam supplying pipe 4 as principal parts as shown in FIGS. 1 and 2.

[0032] The treatment vessel 1 is shaped in an inverted frustum (mortar shape) and disposed on a not-shown support in a manner rotatable around the central axis "L". On the outer peripheral surface of the treatment vessel 1, there is disposed a gear 6 to which driving force is transmitted from the drive member 5 such as a motor via a chain. The driving force transmission from the drive member 5 via the gear 6 can be fulfilled by using relay gears in place of the chain or a belt pulley in place of the gear 6 and a belt in place of the chain.

[0033] The lid member 2 is formed in an inverted saucer shape and fixedly put on the treatment vessel 1 in a hermetically sealed state through a rotary support 7 offering sealing performance to the upper part of the treatment vessel 1. The lower part of the lid member 2 extends to the upper part of the outer peripheral surface of the treatment vessel 1 to define a gutter-shaped space with the outer peripheral surface of the treatment vessel 1. The space serves as a solid content gathering part 2a for gathering the solid content "b" separated from the oil-containing material "A". The solid content gathering part 2a is connected to a solid content discharge pipe 8 for discharging the solid content "b". On the upper part of the lid member 2, there is formed a dome 2b sloping toward the extension line of the central axis "L" of the treatment vessel 1 and bulging in a curved shape. To the dome 2b, an oil content discharge pipe 9 is connected for discharging the oil content "a" (including the powdery content) separated from the oil-containing material "A".

[0034] To the solid content discharge pipe 8, a solid content/powdery content collecting unit 100 is connected as shown in FIG. 3.

[0035] To the oil content discharge pipe 9, there is connected a oil content collecting unit 300 via cyclone separator 200 of a gravity type, collision type or the like for separating the oil content "a" and the powdery content as shown in FIG. 3. Further, the aforementioned solid content/powdery content collecting unit 100 is connected to the cyclone separator 200.

[0036] The oil-containing material supplying pipe 3 serves to supply the oil-containing

material "A" to the inside of the treatment vessel 1 and is arranged to penetrate the bottom wall of the treatment vessel 1 from below having its axis line in agreement with the central axis "L" of the treatment vessel 1 and protrude to a certain level of height within the treatment vessel 1. Thus, the feed end port 3a of the oil-containing material supplying pipe 3 is directed upward within the treatment vessel 1. Between the oil-containing material supplying pipe 3 and the bottom wall of the treatment vessel 1, a rotary support 10 having sealability is interposed.

[0037] To the oil-containing material supplying pipe 3, a sludge tank 500 for reserving the oil-containing material "A" is connected via a sludge pump 400 as shown in FIG. 3. The sludge pump 400 serves to eject the oil-containing material "A" from the feed end port 3a of the oil-containing material supplying pipe 3 and may be provided with a stirring device and/or a heating device for making the oil-containing material into an ejectable muddy state according to need.

Further, the oil-containing material supplying pipe 3 may be covered with warming means 30 over the outer periphery from the sludge pump 400 to the treatment vessel 1. The warming means 30 utilizes a heater or hot water capable of heating to the temperature at around 60°C to 90°C, so that the oil-containing material can be fed in their low-viscosity state.

[0038] The heated steam supplying pipe 4 serves to supply the heated steam "B" to the inside of the treatment vessel 1 and is arranged to penetrate the oil content discharge pipe 9 connected to the lid member 2 from the top of the treatment vessel 1 having its axis line in agreement with the central axis "L" of the treatment vessel 1 and protrude to a certain level of depth within the treatment vessel 1. Thus, the feed end port 4a of the heated steam supplying pipe 4 is directed downward within the treatment vessel 1 in opposition to the feed end port 3a of the oil-containing material supplying pipe 3 with a small distance. The feed end port 4a of the heated steam supplying pipe 4 may be provided with a nozzle as necessary.

[0039] To the heated steam supplying pipe 4, a boiler 700 for producing the heated steam "B" is connected via a heat exchanger 600 for heating the heated steam "B" as shown in FIG. 3. The overheated steam "B" is heated to 200°C to 500°C with the heat exchanger 600.

[0040] According to the device of the first embodiment, the operation of separating the oil contents is fulfilled by supplying the oil-containing material "A" from the oil-containing material supplying pipe 3 and the heated steam "B" from the heated steam supplying pipe 4 while rotating the treatment vessel 1. FIG. 4 shows a flowchart of the operation of separating the oil content.

[0041] That is, the oil-containing material "A" made into muddy is ejected from the feed end port 3a of the oil-containing material supplying pipe 3 as the overheated steam "B" of high

temperature and high pressure is ejected from the feed end port 4a of the overheated steam supplying pipe 4. The ejected oil-containing material "A" and the heated steam "B" come into collision with each other in opposite directions within the treatment vessel 1.

[0042] As a result, the oil-containing material "A" is instantaneously decomposed with the overheated steam "B" to vaporize and separate the oil content "a" (including the powdery content) from the solid content "b". During the decomposition of the oil-containing material "A" in this instant of time, the vaporized oil content "a" is effectively prevented from igniting as with the oil separating technique disclosed in Patent Literature 1 as noted above. In case where the interior of the treatment vessel 1 becomes high in temperature and pressure, an explosion-proof means such as a cooling means may be provided as may be necessary.

[0043] At this time, concentrative decomposition of the oil-containing material "A" is progressed in an area narrowly limited near a point of collision between the oil-containing material "A" and the heated steam "B". Namely, decomposition of the oil-containing material "A" is prevented from being progressed nonuniformly in a broad area within the treatment vessel 1 unlike the oil separating technique disclosed in Patent Literature 1 as noted above. Consequently, the separation of the oil content "a" can be carried out effectively.

[0044] Collision products (oil content "a" and solid content "b") produced by the collision of the oil-containing material "A" with the heated steam "B" are subjected to the centrifugal force created by rotating the treatment vessel 1.

[0045] The oil content "a" moves upward causing a vortex flow within the treatment vessel 1, consequently to be discharged from the oil content discharge pipe 9 with the guidance of the oil content discharge pipe 9 and the slope of the dome 2b of the lid member 2.

[0046] The solid content "b" subjected to the centrifugal force ascends in a spiral manner along the side wall inside the treatment vessel 1 and then is discharged from the solid content discharge pipe 8 with being gathered with the solid content gathering part 2a of the lid member 2.

[0047] Thus, the separation of the oil content "a" and solid content "b" can be carried out assuredly and effectively.

[0048] FIG 5 shows the second embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

[0049] The second embodiment includes a spreading member 11 having a punching plate on the leading end side of the feed end port 4a of the steam supplying pipe 4.

[0050] According to the second embodiment, the heated steam "B" ejected from the feed end port 4a of the heated steam supplying pipe 4 can be spread with the spreading member 11. Depending on the ejection quantity and ejection pressure of the heated steam "B",

concentrative decomposition of the oil-containing material which is progressed in an area narrowly limited near a point of collision between the oil-containing material "A" and the heated steam "B" is not hampered even by spreading the heated steam "B" in some measure.

[0051] FIG. 6 shows the third embodiment for fulfilling the oil separating method and oil separating apparatus according to the present invention.

[0052] The third embodiment includes a guide plate 12 having a punching plate disposed along the side wall of the treatment vessel 1 with a distance to the side wall.

[0053] According to the third embodiment, even if the centrifugal brought about depending on the size of the solid content "b" is nonuniform, the entire solid content "b" can unfailingly ascend in a spiral manner along the side wall of the treatment vessel 1 by inhibiting stagnation and dropout of the solid content "b" with the guide plate 12.

PRACTICAL EXAMPLE

[0054] The desirable results regarding the first embodiment for fulfilling the oil separating method and oil separating apparatus according to the aforementioned present invention have been obtained on the basis of the following dimensional and numeric setting.

[0055] The treatment vessel 1 having a upper diameter of 1.5 meters, lower diameter of 0.3 meters, height of 1 meter to provide the performance of a disposal amount of 1 cubic meter was used. The treatment vessel 1 was driven to rotate at 500 rpm to 5000 rpm.

[0056] The feed end port 4a of the heated steam supplying pipe 4 was 2 mm to 16 mm in diameter.

[0057] The distance between the feed end port 3a of the oil-containing material supplying pipe 3 and the feed end port 4a of the heated steam supplying pipe 4 was 30 mm to 150 mm.

[0058] The oil-containing material "A" was supplied at 70°C to 80°C in the form of tank sludge.

INDUSTRIAL APPLICABILITY

[0059] The oil separating method and oil separating apparatus according to the present invention can be applied for dealing with the oil-containing material such as crude oil sludge, tanker sludge, tank sludge or the like as well as various types of sludge.

CLAIMS

1. An oil separating method for separating oil content from oil-containing material by jetting overheated steam of high temperature and high pressure onto said oil-containing material to vaporize said oil content in said oil-containing material, characterized by supplying said oil-containing material of muddy state and said overheated steam each other in opposite directions to bring them into collision with each other.
2. The oil separating method set forth in Claim 1, characterized in that centrifugal force centering on a straight line extending in the opposite directions of supply of the oil-containing material and the heated steam is exerted on a collision product produced by the collision of the heated steam with the oil-containing material.
3. An oil separating apparatus for separating oil content from oil-containing material by jetting overheated steam of high temperature and high pressure onto said oil-containing material to vaporize said oil content in said oil-containing material, characterized by comprising an oil-containing material supplying pipe for supplying said oil-containing material of muddy state and a heated steam supplying pipe for supplying said overheated steam, wherein a feed end port of said oil-containing material supplying pipe and a feed end port of the overheated steam supplying pipe are opposite each other.
4. The oil separating apparatus set forth in Claim 3, characterized by further including a treatment vessel shaped in an inverted frustum of circular cone and a drive member for rotating said treatment vessel around its central axis, wherein said oil-containing material supplying pipe is arranged from the lower part of the central axis of said treatment vessel to the inside of said treatment vessel, and said heated steam supplying pipe is arranged from the upper part of the central axis of said treatment vessel to the inside of said treatment vessel.
5. The oil separating apparatus set forth in Claim 4, characterized by further including a lid member for covering the upper part of said treatment vessel, which is connected at its center to an oil discharge pipe for discharging the vaporized oil content and has a dome sloping toward said oil discharge pipe.
6. The oil separating apparatus set forth in Claim 4 or Claim 5, characterized by further including a gutter-like solid content gathering part for gathering said solid content left after

evaporating said oil content from said oil-containing material around the upper part of said treatment vessel.