

METHOD AND APPARATUS FOR TREATING OIL WASTE

BACKGROUND OF THE INVENTION:

The present invention relates to a method of treating oil waste material and an apparatus therefor, and more particularly to a method of high efficiently separating oil component, water component and solid matter component from oil waste material, for example, petroleum sludge, waste oil sludge, or waste oil per se and an apparatus therefor.

DESCRIPTION OF THE RELATED PRIOR ART:

When crude oil is left as it stands for a long period of time, its sediment (sludge) settles on account of its nature.

In the petroleum production countries in particular, a huge amount of crude oil sludge is produced at crude oil tanks or crude oil tankers.

Although crude oil tanks, crude oil tankers, and the like have the obligation to undergo repair and open inspection after the passage of each specified time period, no effective means for treating the sludge that is scraped out at that time has yet existed. Also the actual circumstance, therefore, is that such sludge is incinerated by a kiln, thrown away onto the mountains or into the sea, or otherwise left in land tanks as it stands. Since the sludge has high calory, the maintenance cost of an apparatus for the incineration thereof is high. In addition, a huge amount of expenditures is also needed for public nuisance

countermeasures against the stack gas. Further, the throw-away of such sludge must be withdrawn as much as possible in nowadays where the environment protection is being demanded to be attained. Further, leaving the sludge in land tanks as it stands is limited.

Further, even in a case where various kinds of petroleums including, for example, heavy oil, light oil, kerosine, naphtha, gasoline, residual oil, etc. which are fractional distillates of crude oil are left in land tanks as they stand, it often happens that sludge settles as the time lapses. The actual circumstance, however, is that treatment of such a sludge is also performed solely by incineration.

Further, when left as it is in an oil collection tank, the waste oil after oil has been used for operation or lubrication of an apparatus also produces sludge. This waste oil not only contains the above-mentioned various kinds of petroleum but also contains oil in a wider sense, namely, for example, natural or synthetic, vegetable oil or animal fat. Such a waste oil or such a waste oil sludge is also treated mainly by incineration.

[Problems to be Solved by the Invention]

However, the incineration of the above-mentioned sludge, waste oil sludge, or waste oil per se is very expensive and besides leads to warming of the earth. Furthermore, since the oil waste material still has an oil component, were

incineration thereof leads to waste use of the resources. In the present days where the environment protection and resources protection are being demanded, urgent request for clean treatment has been made with respect to the oil waste material as well.

[Summary of the Invention]

The present invention has been achieved in view of the above-mentioned circumstances and an object thereof is to provide a method of and an apparatus for effectively separating oil component, water component and solid matter component from oil waste material such as petroleum sludge or waste oil without burning it and without generating any smoke and any odor, in a short time and at a low cost.

[Measurement for Solving the Problem]

Namely, the method of treating oil waste material according to the present invention is characterized by comprising the step of:

:

(a) bringing an oil waste material into contact with a combustion gas of from 1000 to 2000 °C that is obtained by complete combustion thereof to perform the gasifying treatment of the oil waste material which includes gasification of oil and water components therein;

(b) holding the gasification treated oil waste material at a temperature of from 300 to 500 °C to separate it into a

gaseous mass portion and a solid matter portion; and

(c) cooling the gaseous mass to liquefy it to thereby recover the oil component and water component.

The oil waste material which is referred to in the present invention means the sediment that settles when oil is kept stored in, for example, a tank, a used oil, etc. It includes, for example, crude oil sludge that is a sludge settling in the bottom of crude oil tank or a other crude oil tanker. It also includes the other petroleum sludges that are sediments settling to the bottoms of petroleum vessels in which various kinds of petroleum are left stored as they stand, waste oil sludges that are sediments which settle as a result of storage of the waste oil after oil has been used for operation or lubrication or the like of an apparatus, waste oil per se etc. Note that the waste oil includes not only the above-mentioned crude oil sludges or petroleum sludges but also oil in a wider sense, namely natural or synthetic vegetable oil or animal fat.

Further, in the present invention, the combustion gas used for performing the gasifying treatment of oil waste material is not limited in particular only if it has a temperature of from 1000 to 2000°C after complete combustion of it is finished as mentioned above. Since such combustion gas is of a completely combusted type and therefore almost no oxygen is exist therein, it does not happen that the oil waste material is combusted. As^{as an example of} this type of combustion gas there is a high-temperature/high-pressure combustion gas

which is generated by performing complete combustion, within a combustion chamber in a jet burner, of a gaseous mixture of, for example, compressed air or high-pressure oxygen and high-pressure kerosine (or gasoline, heavy oil, natural gas, etc.). This combustion gas enables more higher efficient performance of the gasifying treatment of the oil waste material by being contacted therewith in the form of a jet stream from a nozzle.

Although the temperature of this combustion gas is appropriately selected, together with the pressure and speed thereof, according to the kind of oil waste material to be treated, it is preferably from 1100 to 1500 °C, or more particularly from 1200 to 1300°C.

In the oil waste material treating method of the present invention, the separation into a gaseous mass portion and a solid matter portion in the step (b) is preferably performed by a physical method which comprises at least two stages.

For example, the separation step in the step (b) comprises two stages, in first one of which relatively large solid-matter pieces that are contained in the gasified oil component and water component, are initially physically separated therefrom using a gravity settler or classifier, and in second one of which relatively small solid-matter pieces separated using, for example, a cyclone which uses a centrifugal force.

Note that the separation step (b) may of course, comprise three or more stages to perform finer

fractionalization of the solid matter or may be performed using only one stage, according to the amount of the solid matter contained in the oil waste material to be treated.

Further, in the oil waste material treating method of the present invention, the liquefaction in the step (c) is preferably performed by decreasing the temperature therefor down to at least two stages.

For example, the liquefaction process in this step (c) can be performed in two stages first by a first condenser for liquefying a heavy gravity oil portion and this by a second condenser for liquefying a medium gravity oil portion, light gravity oil portion, and water portion. The cooling temperature in each condenser may be also determined according to the proportion of oil component in the gasified mass portion.

In this case as well, the liquefaction may be also performed by performing three or more stages of cooling or only one stage of cooling.

The present invention also relates to an apparatus for treating oil waste material which is characterized by comprising an oil waste gasification section for performing the gasifying treatment of an oil waste material by contacting the oil waste material with a combustion gas of from 1000 to 2000 °C that is obtained by complete combustion thereof, a separator section connected to the oil waste gasification section, for holding the gasification treated oil waste material at a temperature of from 300 to 500°C and

thereby separating it into a gaseous mass portion and a solid matter portion, and a liquefying recovering section into which the gaseous mass portion is introduced from the separator section for cooling the gaseous mass portion to thereby liquefy an oil portion and a water portion therein for recovery thereof.

Treating the apparatus in a preferred mode of the present invention, the separation section includes at least a gravity settler performing separation of solid matter of relatively large pieces and a cyclone for performing separation of a solid matter of relatively small pieces. The gravity settler and the cyclone may be plurally included, respectively. The separator section may further include other separator such as a classifier or the like.

In the treating apparatus, the liquefying/recovering section preferably includes at least tow condensers in which plurally providing such condensers, fractional distillation of the oil that is to be recovered becomes possible to perform and the recycling thereof becomes easy to perform.

Other objects, features and advantages will become apparent from the following description taken in conjunction with the accompanying drawings in which:

Fig. 1 is a typical view illustrating an oil-waste material-treating apparatus according to an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

While an embodiment of the present invention will hereinafter be explained with reference to the accompanying drawing, the invention is not limited thereto.

Fig. 1 is a typical view showing an oil waste treating apparatus according to an embodiment of the present invention. The treatment of the oil waste material that is carried out with use of the oil waste treating apparatus 1 will first be explained, and the fractionalized materials of such oil waste material that have been obtained through actual operation of this treating apparatus will then be explained.

A. Treatment of oil waste material by the treating apparatus

The oil waste material desired to be treated, for example, petroleum sludge, waste oil sludge, waste oil, or the like is introduced into a sludge mixer tank 2 in which the contents thereof are mixed together. The resulting sludge mixture is introduced via a passageway 14 such as duct into a sludge hopper 3. The introduction of the sludge mixture from the sludge mixer tank 2 into the sludge hopper 3 may alternatively be performed by mere dropping. The oil waste sludge mixture is fed into a housing 6 of a gasification section by means of a screw conveyor 4 that is disposed beneath the sludge hopper 3. At a jet treatment portion a within the housing 6 the oil waste sludge mixture is contacted with a high-temperature/high-pressure jet stream, (approx. 1300 °C ; 6 to 7 kg/cm², 1200 m per second) that is guided from a top of the housing 6 thereinto and that

rushes from a nozzle at a tip end of a jet burner 5, and instantaneously subjected to gasifying treatment.

The above-mentioned high-temperature/high-pressure jet stream is a jet stream of the atomized gaseous mixture of compressed air and high-pressure kerosine which is completely combusted in a combustion chamber inside the jet burner 5 and which is jetted from the nozzle at the jet burner tip. Compressed oxygen may be also used in place of the compressed air while, on the other hand, gasoline, heavy oil, natural gas, or the like can also be used as the fuel in place of kerosine. By controlling the reacting conditions in the combustion chamber, the temperature, pressure and speed of the jet stream can be changed as desired within a range of, for example, the temperature from 1000 to 2000°C, the pressure of from 5 to 20 kg/cm² and the speed of the stream is from 500 to 2000 m/sec, respectively. Under any desired selected condition, it is necessary to perform complete combustion of the gaseous mixture. For this reason, almost no oxygen is exist in the jet stream so that no combustion takes place on the material desired to be treated in the jet treatment position a.

Note that what is disclosed in, for example, Japanese Patent Laid-open No. 55-99527 can be used as the jet burner 5. However, the invention is not particularly limited thereto only if the jet burner 5 is one which can produce a combustion gas that satisfies the above-mentioned requirements.

Next, the oil waste sludge mixture that has been

subjected to gasifying treatment is supplied to a gravity treatment is supplied to a gravity settler 7 via duct 15 that is provided on a top of the housing 6. The duct 15 and gravity settler 7 are each kept at a temperature of from 350 to 400°C, and solid matter in the oil waste sludge mixture that has been subjected to gasifying treatment is received in an ash receiver 9 via a separated-powder receiving vessel 8. On the other hand, the gaseous mass is introduced into a cyclone 10 via a duct 16 that extends from a top of the gravity settler 7. The duct 16 and the cyclone 10 are each also kept at a temperature of from 350 to 400 °C. In the cyclone 10, fine solid matter pieces that have failed to be removed in the gravity settler 7 and are still contained in the gasified gaseous mass are separated by the centrifugal force and received in an ash receiver 12 via a separated-powder receiving vessel 11. The gravity settler 7 and the cyclone 10 constitute a separator section.

Further, the gasified mass that is still in a gaseous condition is next carried into a first condenser 13 via a duct 17 that extends from a top of the cyclone 10. In this first condenser 13, the gasified mass is cooled down to, for example, approx. 200°C whereby heavy oil therein is initially liquefied. The remainder of the gasified mass is carried into a second condenser 13' via a duct 18. In this second condenser 13', the gasified mass remainder is cooled down to 60°C whereby residual oil portion and residual water portion therein are liquefied. As a result, the remaining exhaust

gas which is composed of nitrogen gas (N_2), carbon dioxide (CO_2), vapor, etc. is exhausted from an exhaust duct 19 into outside the apparatus. The apparatus zone that is composed of the first and the second condenser constitutes a liquefying/recovering section of the apparatus.

B. Treated results of oil waste material obtained with the use of oil waste treating apparatus

Treatment of an oil waste material was actually carried out using the oil waste treating apparatus 1 shown in Fig. 1. The operating conditions and the results obtained thereunder are shown below.

A test sludge that is composed of 30 wt% of oil portion, 40 wt% of water portion and 30 wt% of solid-matter portion (iron oxide, sands, wood pieces, etc.) is supplied to the jet treatment portion inside the gasification section at a supplying speed of 800 kg/hour. The jet stream from the jet burner is caused by supplying kerosine (the value of the ratio of C to H₂ is 5.25:1), and air into the combustion chamber therein, at the rates of 47.5 kg/hour and 717.1 kg/hour, respectively, also by performing automatic fining of the resulting mixture. The temperature of 1300 °C, the pressure of from 6 to 7 kg/cm² and the speed of the jet stream is 1200 m/sec., respectively, at the time when it is jetted from the nozzle.

The oil portion, water portion, solid-matter portion, and exhaust as that have been recovered by causing the test

sludge, which has been gasified in the jet treatment portion, to pass through the separator section (the gravity settler and the cyclone kept at from 350 to 400 °C) and then through the liquefying/recovering section (the primary condenser cooled down to 200°C and the secondary condenser cooled down to 60 °C) are collectively shown in Table 1 in terms of their quantities each per hour.

Table 1

Recovered Components	Recovered Qualities (kg/hour)
Oil content ¹⁾	240
Water content ²⁾	381.2
Solid-matter content ³⁾	240
Exhaust gas content ⁴⁾	
N ₂	550.7
CO ₂	145.7
H ₂ O	6.9

Notes:

- 1) The quantity of the oil portion is a total of the heavy-gravity oil content recovered from the primary condenser and the remaining oil content (medium-gravity oil and light-gravity oil) recovered from the secondary condenser.
- 2) The quantity of the water portion is mainly a quantity thereof that has been discharged from the secondary condenser.

- 3) The quantity of the solid matter portion is a total quantity of the solid matter material that has been received in the ash receivers respectively installed beneath the gravity settler and the cyclone.
- 4) The quantity of the exhaust gas is a quantity thereof that is exhausted from the secondary condenser.

It is understood from Table 1 that the oil portion and solid matter portion that were contained in the test sludge each have been recovered in total quantity whereupon highly efficient treatment of the oil waste material sludge have been performed. Further, as regards the oil portion, the heavy-gravity oil and the other medium-gravity and light-gravity oils are sorted from each other through the performance of one recovering operation. Therefore, the recycling thereof can be readily performed and finer sorting or fractionalization thereof is also possible to perform. Note that the reason why the quantity of the recovered water portion is increased as compared with that of the water portion in the test sludge is that the vapor generated by combustion of the kerosine is condensed liquefied.

As has been explained above in detail, the method of treating oil waste material and the apparatus therefor in accordance with the present invention has enabled the treatment of oil waste material such as petroleum sludge,

waste oil sludge, waste oil per se, or the like without burning it out, which oil waste material conventionally had no choice but to be incinerated or to be thrown away or merely left as it stands, and has in addition enabled highly efficient fractionalization and recovery of the oil portion, water portion, solid matter portion, etc. that are contained in the oil waste material.

Further, by carrying out the solid-matter portion separation process in plurality of stages, it is possible to perform finer fractionalization and recovery of the solid matter portion. Also, by carrying out the liquefying/recovering process in a plurality of stages, it is possible to finer fractionalization and recovery of the oil portion such as heavy-gravity oil, medium-gravity oil, light-gravity oil, and the like and the water portion.

As mentioned above, the present invention enables recycling of the oil waste material which as hitherto been left out of recycling, and enables finer fractionalization thereof to made the recycling easy to perform.

Furthermore, the above-mentioned apparatus of the present invention enables treatment in a short time without generating any smoke nor odor during the treatment of the oil waste material and having any adverse effect upon the working environment or areal environment, and yet the apparatus can be operated at low cost.



CLAIMS

1. A method of treating oil waste material comprising the steps of:
 - (a) bringing an oil waste material into contact with a combustion gas at 1000 to 2000°C that has been completely combusted, to perform gasifying treatment of the oil waste material which includes gasification of oil and water components therein;
 - (b) holding the oil waste material containing the gasified oil and water components at a temperature of from 300 to 500°C to separate it into a gaseous mass portion and a solid matter portion; and
 - (c) cooling the gaseous mass portion to liquefy the oil and water components for the recovery thereof.
2. A method according to claim 1, wherein the separation into the gaseous mass portion and the solid matter portion in the step (b) is carried out by a physical method which comprises at least two stages.
3. A method according to claim 1 or 2, wherein the liquefaction in the step (c) is carried out by decreasing the temperature in at least two stages.
4. An apparatus for treating oil waste material comprising an oil waste gasification section for performing gasifying treatment of an oil waste material, which includes gasification of the oil and water components therein by contacting the oil waste material with a combustion gas at 1000 to 2000°C that has been completely combusted, a separator section connected to the oil waste gasification section, for holding the gasification treated oil waste material at a temperature of from 300 to 500°C and thereby separating it into a gaseous mass portion



and a solid matter portion, and a liquefying/recovering section into which the gaseous mass portion is introduced from the separator section, for cooling the gaseous mass portion thereby to liquefy an oil portion and a water portion therein for recovery thereof.

5. An apparatus according to claim 4, wherein the separator section includes at least a gravity settler for performing separation of solid matter of relatively large pieces and a cyclone for performing separation of solid matter of relatively small pieces of solid matter.
6. An apparatus according to claim 4 or 5, wherein the liquefying/recovering section includes at least two condensers in which the cooling temperature is stepwise decreased.
7. A method as claimed in claim 1, substantially as hereinbefore described with reference to the accompanying drawing.
8. An apparatus as claimed in claim 4, substantially as hereinbefore described with reference to the accompanying drawing.
9. An oil component which is a product of the process as claimed in claim 1, 2, 3 or 7.
10. A water component which is a product of the process as claimed in claim 1, 2, 3 or 7.
11. Solid matter which is a product of the process as claimed in claim 1, 2, 3 or 7.

METHOD AND APPARATUS FOR TREATING OIL WASTE

ABSTRACT

An oil waste material, for example, petroleum sludge, waste oil, or the like is contacted with a combustion gas of from 1000 to 2000 °C that is obtained by complete combustion thereof and that is supplied from a jet burner 5, thereby performing gasifying treatment thereof (jet treating portion a). The gasification treated oil waste material is held at a temperature of from 300 to 500°C to be physically separated into a gaseous mass portion and a solid matter portion (gravity settler 7, cyclone 10). This gaseous mass portion is cooled down to liquefy an oil portion and a water portion therein for recovery thereof (condensers 13, 13'). Thus, the oil component, water component and solid matter component are separated with high efficiency from the oil waste material without combusting it and without causing generation of any smoke or odor and in a short time and at a low cost. (Fig 1)

Fig. 1 to accompany abstract when published

FIG. 1

