THE SEPARATOR OF SOLID PARTICLES FROM STEAM-GAS MIXTURE

Abstract: The present invention is related to the separator for separating solid particles from vapour-gas mixture, particularly to the structure of the dust chamber belonging amongst installation of the plant processing the materials containing the fossil fuels or organic substances. The cage (1) for separating solid particles from vapour-gas mixture comprises main body (2), inner lining (7) arranged to the inner surface of the body, first and second stage cyclones (3, 4), lamella compensators (18, 19), dust removal conduits (5, 13) and inlet conduit (12) of the vapour-gas mixture into the first cyclone (3). The main body (2) of the dust chamber (1) is manufactured in all altitudinal extent from the cylinder of equal diameter and first and second stage cyclones (3, 4) are placed outward of the main body (2) of the dust chamber (1). For the lining of the main body (2) of the dust chamber (1) and first and second stage cyclones (3, 4) are used the non-porous and wear proof material, for example concrete.
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The separator of solid particles from steam-gas mixture

TECHNICAL FIELD

The present invention is related to the separator (cage) for separating solid particles from steam-gas mixture, particularly to the structure of the dust chamber belonging amongst installation of the plant processing the materials containing the fossil fuels or organic substances.

BACKGROUND ART

As regards to state of the art, the separator (cage) for separating solid particles from vapour-gas mixture known and used by patent applicant is described as follows with reference to fig 1. In order to get a clearer and better view of the device known from state of the art, and also to draw out differences with this invention, details of the separator of this invention has details that correspond to those known from the state of the art, marked with same position numbers, adding an apostrophe (') to position number in order to differentiate between the two.

The separator (cage) for separating solid particles from vapour-gas mixture known from state of the art 1 comprehends of cylindrical enclosures of various diameters with inner lining 2', 2", which are connected by conversion cylinder 20, fist and second stage cyclones 3', 4', dust removal conduits 5\ vapour-gas mixture from inlet vent 13' on first cyclone 3 and vapour-gas mixture containing semi-coke particles from inlet vent 9' to main body 2', 2".

This structure has several shortcomings that decrease the efficiency of cleaning and cause machine failures.

In this device, the physical deposition of semi-coke from vapour-gas mixture is performed by gravity, which, proceeding from the structure of device, causes:

- in the cylindrical part of the main body (for example, a decrease of diameter from about 6.5m to about 3.96m) gravitational deposition of semi-coke from vapour-gas mixture causes a heavy semi-coke sediment on the surface of conversion cylinder 20, which slowly decreases the diameter of conversion
cylinder 20. This in turn hinders the purposeful work of the dust chamber, i.e. the gravitational deposition of semi-coke decreases, because the speed of vapour-gas mixture going through main body accelerates so that semi-coke particles are carried through by steam mixture, i.e. the emission speed of semi-coke particles is higher than the deposition speed of particles affected by gravity. Decrease in gravitational deposition results in unwanted increase in semi-coke concentration for vapour-gas mixture passing from second cyclone 4'.

- internal two-layer lining T of dust chamber is made of firebricks with high porosity and cracks, and therefore has several shortcomings. The pores and cracks in firebricks cause vapour-gas mixture permeability and also the permeability of thermal insulation, e.g. bricks located behind firebricks, which cause hydrocarbon vapour in vapour-gas mixture to condense on the internal metal wall of dust chamber main body. This contravenes with the objective of lining and isolation, because the material used for lining loses its thermal insulation properties. Decrease in thermal insulation causes semi-coke to stick on internal walls of lining.

- structure of dust chamber for cleaning vapour-gas mixture from semi-coke particles involves inertial precipitants - cyclones 3', 4', which are placed inside dust chamber. Due to this kind of placement and the type of the second cyclone 4', the dust chamber known from state of the art has several deficiencies:
  • in treatment process, cyclones 3', 4', are filled with semi-coke depositions, which in turn causes the cyclones and the main metal bodies of their bins to heat up,
  • due to large parameters and rigid fixation and increase in linear parameters caused by temperature, the cyclones placed inside dust chamber need lamella compensators 17 with large diameter that are placed in the joint between bin and cyclone. Since this location is most subjected to semi-coke emersion, it will cause breakdown of lamella compensators and following permeability. This in turn causes the
stoppage of cyclone-operations during repairs. This deficiency is also in gas conduit between first and second cyclone.

• the inlet conduit 13’ of first cyclone 3’ is located horizontally and during the operation, starting and stopping of junction, it tends to collect semi-coke residue, which results in decrease in junction productivity.

• due to high speeds of vapour-gas mixture in cyclones, those cyclones are subject to high abrasive depreciation, which causes a decrease in the thickness of the walls of a cyclone's main body. Also, due to the fact that they are located inside a dust chamber, it is not possible to carry out cyclone wall thickness measurements at any given point, and an excessive depreciation of cyclone wall will incapacitate the whole machine.

• Second cyclone has a very high hydraulic resistance.

- large amounts of deposited semi-coke (150 m³), proceeding from above listed deficiencies, cause a longer time spent on maintenance and repairs.

DISCLOSURE OF THE INVENTION

For increase in efficiency and reliability, as well as decrease in preparation time for repairs, this invention offers to:

- change dust chamber construction by removing the sloping cylinder between the various diameters of dust chamber's main body, i.e. dust chamber is fully built in the same diameter; this prevents semi-coke deposits on the cylindrical surfaces of dust chamber's main body. Which is the reason for the concentration of semi-coke particles in vapour-gas mixture from second level cyclone during the operation of dust chamber, and this ensures that the further product quality remains constant.

- porous material, used in the lining of dust chamber, is changed to non-porous, concrete for example. This prevents vapour-gas mixture from permeating through and the formation of unwanted condensate on the internal metal wall of dust chamber.

- the construction with internally placed cyclones is changed to external, adding also external thermal isolation to cyclones. This external design
prevents using lamella compensators between cyclone main body and dust collector. Also, such cyclone structure ensures a short repairs time and the opportunity to measure the thickness of cyclone main body walls constantly.

- to decrease cyclones' abrasive depreciation, wear-proof lining, e.g. concrete is pasted on the internal surfaces of cyclones.
- to increase the productivity of vapour-gas mixture without decreasing the efficiency of vapour-gas mixture cleaning, the second level cyclone is replaced by a cyclone with a lower hydraulic resistance, which enables to decrease the hydraulic resistance of the whole ash treatment facility.

BRIEF DESCRIPTION OF DRAWINGS

The cage for separating solid particles from vapour-gas mixture that corresponds to this invention, or dust chamber, is described extensively, but not resttctively, in following implementation example with references to annexed figures, where

Fig 1 shows the embodiment of dust chamber used as described state of the art;

Fig 2 shows the embodiment of the dust chamber according to the present invention;

Fig 3 shows the alternative embodiment of dust chamber according to the present invention.

DESCRIPTION OF EMBODIMENTS

The separator (cage) for separating solid particles from vapour-gas mixture pertains to composition of a device in which the pyrolysis of pulverized fossil fuel (e.g. oil shale) or material containing organic matter by solid heat-carrier is performed. The temperature of vapour-gas mixture entering into treatment junction is about 480 °C and its formulation contains particles of semi-coke up to 230g/m3, the rest is hydrocarbon vapours, water vapour and pyrolysis gas and other admixtures and gases.

Vapour-gas mixture is purified in this device by the deposition of particles through the force of gravity.
The separator for separating solid particles from vapour-gas mixture or dust chamber 1 according to the present invention illustrated in the fig 2 comprises the main body 2, which internal side surface is covered with internal lining 7. Internal lining 7 is made from wear-proof and non-porous material like concrete, so that vapour-gas mixture cannot leak through and the hydrocarbon vapours cannot condense between lining 7 and the internal metal surface of the main body 2 of dust chamber 1. The main body 2 of dust chamber 1 is cylindrical and its diameter is the same throughout its whole height, e.g. usually the main bodies of about 3 - 9 m in diameter are used. Inlet vent 9 for vapour-gas mixture containing semi-coke particles is located one side of the lower part of the main body 2 of dust chamber 1. Outlet vent 8 for semi-coke particles is on the lower end 11 of the main body 2 of dust chamber 1.

The cyclone centrifugal precipitants - first and second stage cyclones 3, 4 are set outside the main body 2 of dust chamber. The inlet conduit 13 of first stage cyclone 3 is connected to the upper end 10 of the main body 2 of dust chamber, whereas inlet conduit 13 is vertical and parallel to vertical axis of dust chamber 1. The outlet vent of 12 of the first stage cyclone 3 is connected to the inlet conduit 14 of second stage cyclone 4. To compensate for stress, lamella compensators 18 have been added to above listed connections, to the inlet conduit 13 of first stage cyclone 3 and on the conduit connecting first and second stage cyclones 3, 4 accordingly. Semi-coke outlet vents 15 are located on the lower part of first and second stage cyclones 3, 4, and are connected by dust channels 5 to the lower part of main body 2 of dust chamber so that dust channels 5 run to the semi-coke particles' outlet vent 8 located in main body of dust chamber 1. Additionally, small-sized lamella compensators 19 have been added to dust channels 5 in order to compensate for stress.

The internal surface of first and second stage cyclones 3, 4, is lined with wear-proof material 16, e.g. concrete, and since they are not inside of the main body 2 of dust chamber 1, it is possible to measure the wall thickness for cyclones 3, 4 and make repairs when necessary.
In the alternative embodiment of the dust chamber according to the present invention described in fig 3, the corresponding inlet conduits 13, 14 for cyclone centrifugal precipitants - for first and second stage cyclones 3, 4 are connected to the upper end 10 of the main body of dust chamber. The outlet conduit of second stage cyclone 4 is connected to the inlet conduit of the first stage cyclone 3 so that the vapour-gas mixture containing semi-coke particles is directed parallel to both cyclones 3, 4 and the vapour gas mixture exiting from second stage cyclone 4 is directed to the first stage cyclone 3. A lamella compensator 18 has also been installed between outlet pip of second stage cyclone 4 and the inlet conduit of first stage cyclone 3 to compensate for stress. The vapour-gas mixture purified from semi-coke particles is directed from first stage cyclone 3 through outlet vent 12 for further treatment. Such placement of centrifugal cyclones allows the parallel operation of cyclones 3, 4 and in case there are failures in one cyclones operation, the purification of vapour-gas mixture continues in another cyclone.

The operation of a plant for thermal treatment of fossil fuels and materials containing organic material, primarily in a device in which a pyrolysis of pulverised material with solid heat carrier creates vapour-gas mixture which has to be purified from semi-coke particles. To that end, a cage is included with device for the purpose of separating solid particles from vapour-gas mixture, or dust chamber 1, which main body 2 and centrifugal cyclones 3, 4 are used to purify vapour-gas mixture proceeding from the material of semi-coke particles. To achieve that, vapour-gas mixture containing semi-coke particles is directed to the main body 2 of dust chamber 1, where gravity forces heavier semi-coke particles to settle in the lower part 11 of main body 2 of dust chamber 1, vapour-gas mixture with lighter semi-coke particles is directed through the inlet conduit 13 located in the upper end of the main body 2 of dust chamber to first stage cyclone 3, where centrifugal forces help to deposit the remaining semi-coke particles. For complete purification of vapour-gas mixture, it is directed from the first stage cyclone 3 to the second stage cyclone 4, where the final purification of vapour-gas mixture from semi-coke particles occurs. After that the cleaned vapour-gas mixture is directed from the second stage cyclone 4 to further treatment.
Dust chamber design of separator (cage) for separating solid particles from vapour-gas mixture according to this invention allows performing repairs quickly and without stopping the whole production cycle for a longer period. It should be clear for experts of this field that the dust chamber corresponding to this invention is not restricted to implementation example as provided above, but the protection range of the invention should take into account that are described in annexed claims, features and also their combinations of the same nature.
Claims

1. A separator (cage) or dust chamber (1) for separating solid particles from vapour-gas mixture, the separator comprises the main body (2) with internal lining located on its internal side-surface (7), first stage cyclone (3), second stage cyclone (4), lamella compensators (18, 19), dust removal conduits (5, 15), inlet conduit for vapour-gas mixture (13) to first stage cyclone (3), inlet vent (9) for vapour-gas mixture containing semi-coke particles to the main body (2) of dust chamber (1), is characterized in that the uniform diameter of the cylinder in its full height located in the main body (2) of dust chamber, with its lower end (11) having an outlet vent (8) for the removal of semi-coke particles, whereas the inlet vent (9) is located above the outlet vent (8) on the side of the main body (2) of dust chamber (1).

2. The separator for separating solid particles from vapour-gas mixture according to claim 1, is characterized in that the first and second stage cyclones 3, 4 are located outside the main body (2) of dust chamber (1).

3. The separator for separating solid particles from vapour-gas mixture according to claim 1 and 2, is characterized in that the vapour-gas mixture inlet conduit (13) to first stage cyclone (3) is located vertically on the upper end (10) of the main body (2) of dust chamber (1), so that its axis is on the same direction and parallel to the vertical axis of the main body (2) of dust chamber.

4. The separator for separating solid particles from vapour-gas mixture according to claim 1, is characterized in that the material of internal lining (7) of main body (2) of dust chamber (1), is wear-proof and non-porous thermal insulation material.

5. The separator for separating solid particles from vapour-gas mixture according to claim 4, is characterized in that the material of internal lining (7) of main body (2) of dust chamber (1) is wear-proof and non-porous thermal insulation material is concrete.
6. The separator for separating solid particles from vapour-gas mixture according to claim 1, is characterized in that the first and second stage cyclones (3, 4) are connected by dust channels (5) with the lower end (11) of the main body (2) of dust chamber (1) whereas dust channels (5) flow to semi-coke outlet vent (8) in main body (2) of dust chamber (1).

7. The separator for separating solid particles from vapour-gas mixture according to any claim from 1 to 6, is characterized in that the internal surface of first and second stage cyclones (3, 4) which are lined by wear-proof material (16).

8. The separator for separating solid particles from vapour-gas mixture according to claim 7, characterized in that the wear-proof material (16) used for the internal surface of first and second stage cyclones (3, 4) is concrete.

9. The separator for separating solid particles from vapour-gas mixture according to any of the previous claims is characterized in that the second stage cyclone (4) has a lower hydraulic resistance.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

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

INV. B01J8/00 B01D45/00

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

BOIJ BOID

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Date of the actual completion of the international search

11 December 2008

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Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents

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