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(54) Title: METHOD FOR THE TREATMENT OF A RAW SYNTHESIS GAS AND A GAS CONDENSATE

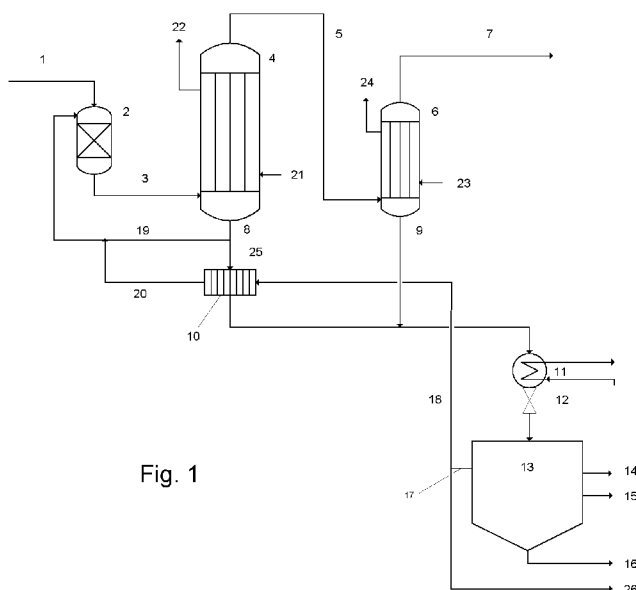


Fig. 1

(57) Abstract: A method for the treatment of a raw synthesis gas from the pressure gasification of coal, wherein the gas initially is cooled by direct cooling in a washer-cooler, then by indirect cooling in a waste heat boiler, and subsequently is cooled indirectly in at least one further cooler, and the gas condensate formed thereby is separated from the gas and cooled to a temperature below 100 °C and depressurized to atmospheric pressure and subjected to a separation of suspended matter, and wherein a part of the gas condensate liberated from suspended matter is recirculated into the washer-cooler, wherein the recirculated gas condensate, before being introduced into the washer-cooler, is heated by indirect heat exchange by the gas condensate produced in the washer-cooler and waste heat boiler and/or the further condensation stages.

Method for the Treatment of a Raw Synthesis Gas and a Gas Condensate

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Field of the Invention

This invention relates to a method for the treatment of a raw synthesis gas and a gas condensate from the gasification of carbonaceous feedstock carried out with oxygen and steam under elevated pressure and at elevated temperatures, wherein the raw synthesis gas initially is treated in a washer-cooler operated with gas condensate as washing and cooling medium, then in a waste heat boiler and then in at least one further cooler, wherein the gas condensate used in the washer-cooler is circulated via the waste heat boiler, wherein from this circuit a clarification stream is discharged and like the gas condensate formed in the at least one further cooler passed into a tar separator, and wherein a part of the gas condensate treated in the tar separator is recirculated as make-up stream into the gas condensate circuit of the washer-cooler.

Prior art

Such method is known from the German Patent Specification DE 25 42 055 C3. Its basic features will be described below.

The raw gas, more exactly a raw synthesis gas comprising hydrogen and carbon oxides from the fixed-bed coal gasification, is introduced directly into the washer-cooler after leaving the pressure gasifier. Said washer-cooler is operated with circulating gas condensate as washing and cooling medium. The raw synthesis gas is washed here, cooled and moistened. Subsequently, the raw synthesis gas is passed into the so-called waste heat boiler. Here, it is cooled further by indirect heat exchange, wherein moisture and other condensable substances are condensed out. Subsequent to the waste heat boiler, the raw synthesis gas is cooled further in at least one further heat exchanger, before it is handed over to further gas cleaning stages, which will not be discussed here in more detail.

- 2 -

In the following, the condensate formed in the washer-cooler, the waste heat boiler and the further heat exchangers will be referred to as gas condensate. The gas condensate used in the washer-cooler is circulated via the waste heat boiler. From this circuit a clarification stream is discharged, which like the gas condensate formed in the further heat exchangers is passed into a tar separator. From the tar separator, a purified make-up stream is fed back into the circuit of the washer-cooler.

Since the tar separator is operated at atmospheric pressure, the gas condensate is cooled before introduction to a temperature of below 100 °C, in general to 80 °C, and depressurized from the pressure specified by the pressure gasification to atmospheric pressure. An operating temperature of 80 °C was found to be useful, as above 80 °C an unnecessary quantity of steam would be generated during the depressurization of the gas condensate. Below 80 °C, the separation in the tar separator is more difficult, since the density differences between the constituents of the gas condensate are reduced with decreasing temperature.

Unfavorably, however, the temperature of the make-up stream of likewise 80 °C resulting from this mode of operation leads to an undesired cooling of the gas condensate circuit of the washer-cooler. The reduced temperature leads to the fact that the gas absorbs less moisture. As a result, less condensate is formed in the waste heat boiler, which due to a washing effect counteracts the soiling of the heat exchanger surfaces of the waste heat boiler. In addition, due to the lower temperature of the gas and the lower amount of condensate, less heat is transferred in the waste heat boiler, i.e. the heat transfer capacity of the waste heat boiler is utilized less.

Another problem of the method according to the prior art consists in that the heat which must be withdrawn from the gas condensate before introduction into the tar separator cannot be used further in the method itself and also in the upstream and downstream methods and plants. Therefore, the heat must be dissipated to the surroundings as heat loss, e.g. by means of a cooling tower. This heat loss should therefore be kept as low as possible.

It is the object of the invention to provide a method which solves the above-described problems in an economic way.

Description of the Invention

- 5 The object underlying the invention is solved by a method with the features of claim 1.

By increasing the temperature of the gas condensate, which is used as washing, cooling and moistening medium in the washer-cooler, in accordance with the invention, less cooling of the raw synthesis gas in the washer-cooler and a higher moisture absorption
10 of the raw synthesis gas in the washer-cooler is achieved. The increased moisture of the raw synthesis gas leads to an improved washing effect in the waste heat boiler and due to increased condensation to a higher heat transfer in the waste heat boiler. In addition, the higher temperature of the raw synthesis gas and the resulting higher temperature difference to the boiler feed water used as cooling medium also leads to an increased
15 heat transfer and hence to an increased conversion of boiler feed water into low-pressure steam.

A particular aspect of the invention consists in that the heat exchange is carried out exclusively between the clarification stream and the make-up stream. Since the amount of
20 gas condensate which is formed in the cooler or coolers downstream of the waste heat boiler is not very large, it is not worthwhile in some cases to pass this amount of gas condensate over a heat exchanger. The additional expenditure for the guidance of the corresponding material streams then is not justified with regard to the amount of recoverable energy. Consequently, there is obtained a conceptually simple method with satis-
25 factory energy recovery.

Preferably, the heat exchange between the clarification stream and the make-up stream is effected indirectly. In this way, a make-up stream free from contamination is supplied to the washer-cooler.

30 A further particular aspect of the method consists in that the heat exchange is carried out by means of one or more heat exchangers constructed in the manner of a plate and/or spiral heat exchanger. Since the gas condensate coming from the raw synthesis

gas treatment is greatly loaded with suspended matter, such as tar, oil and dust, plate and/or spiral heat exchangers are particularly useful at this point, since they can be cleaned with little expenditure of work.

5 Exemplary embodiment

Further developments, advantages and possible applications of the invention can also be taken from the following description of exemplary embodiments and drawings. All features described and/or illustrated form the invention per se or in any combination, independent of their inclusion in the claims or their back-reference.

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The only Fig. 1 shows a preferred aspect of the method according to the invention. The raw synthesis gas (1) originating from the pressure gasification of coal as carbonaceous feedstock is introduced into the washer-cooler (2) directly after leaving the pressure gasifier. In said washer-cooler, the gas is cooled, moistened and dedusted by direct contact with aqueous gas condensate (19, 20). The raw synthesis gas and the gas condensate leave the washer-cooler (2) through a common conduit (3) and are introduced into the waste heat boiler (4). Here, gas and gas condensate are separated. In the waste heat boiler, the gas is cooled indirectly by boiler feed water (21), which is evaporated to low-pressure steam (22), wherein further gas condensate is formed. Via conduit (5), the gas is passed into the cooler (6) and further cooled down therein by indirect heat exchange, wherein boiler feed water (23) is converted into low-pressure steam (24). Subsequently, the gas is passed on via conduit (7) to further cooling and treatment steps, such as e.g. a gas cleaning by the Rectisol method (not shown).

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25 Via the conduits (8) and (9), the gas condensate formed upon cooling the raw synthesis gas is discharged from the waste heat boiler and the downstream cooler, respectively. Via conduit (19), the larger part of the gas condensate exiting from the waste heat boiler via conduit (8) is recirculated into the washer-cooler (2). From this circuit, a clarification stream is withdrawn via conduit (25), in order to keep the content of tar, oil and solid particles constant. The clarification stream (25) is passed over a plate heat exchanger (10), cooled in the process and joined with the gas condensate (9) discharged from the downstream cooler (6), cooled to 80 °C by means of a heat exchanger (11), depressur-

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- 5 -

ized to atmospheric pressure by means of a depressurizing device (12) and passed into a settling device, the so-called tar separator (13). Here, suspended matter such as oil (14), tar (15) and a sludge (16) containing solid particles are separated from the gas condensate and discharged from the tar separator. Via conduit (17), the gas condensate
5 cleaned in this way is withdrawn from the tar separator (13). A part of this gas condensate is passed to the plate heat exchanger (10) via conduit (18), heated in the process, and via conduit (20) fed into the gas condensate circuit of the washer-cooler (2) as make-up stream. The other part of the cleaned gas condensate withdrawn from the tar separator is supplied to the succeeding treatment stages (not shown) via conduit (26).

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Industrial Applicability

With the invention, an economic method is provided for the treatment of raw synthesis gas produced by pressure gasification of solid, carbonaceous feedstocks, which provides for a higher yield of the thermal energy contained in the raw synthesis gas and in
15 the gas condensate.

List of Reference Numerals

- | | | |
|----|----------|---|
| 5 | (1) | raw synthesis gas from pressure gasifier |
| | (2) | washer-cooler |
| | (3) | raw synthesis gas and gas condensate |
| | (4) | waste heat boiler |
| | (5) | raw synthesis gas |
| 10 | (6) | cooler |
| | (7) | raw synthesis gas for the further treatment |
| | (8) | gas condensate |
| | (9) | gas condensate |
| | (10) | heat exchanger |
| 15 | (11) | cooler |
| | (12) | depressurizing device |
| | (13) | tar separator |
| | (14) | oil draw |
| | (15) | tar draw |
| 20 | (16) | solids draw |
| | (17) | gas condensate, cleaned |
| | (18) | gas condensate, cleaned, as make-up stream to the washer-cooler |
| | (19) | gas condensate, uncleaned to the washer-cooler |
| | (20) | gas condensate to the washer-cooler |
| 25 | (21, 23) | boiler feed water |
| | (22, 24) | low-pressure steam |
| | (25) | clarification stream |
| | (26) | gas condensate, cleaned, for the further treatment |

Claims

- 5 1. A method for the treatment of a raw synthesis gas and a gas condensate from the
gasification of carbonaceous feedstock carried out with oxygen and steam under
elevated pressure and at elevated temperatures, wherein the raw synthesis gas
initially is treated in a washer-cooler operated with gas condensate as washing
and cooling medium, then in a waste heat boiler and then in at least one further
10 cooler, wherein the gas condensate used in the washer-cooler is circulated via
the waste heat boiler, wherein from this circuit a clarification stream is discharged
and like the gas condensate formed in the at least one further cooler passed into
a tar separator, and wherein a part of the gas condensate treated in the tar sepa-
rator is recirculated as make-up stream into the gas condensate circuit of the
15 washer-cooler, **characterized in** that between the make-up stream and the clari-
fication stream and/or the gas condensate originating from at least one further
cooler a heat exchange is carried out.
- 20 2. The method according to claim 1, **characterized in** that the heat exchange is car-
ried out exclusively between the clarification stream and the make-up stream.
3. The method according to claim 1 or 2, **characterized in** that the heat exchange
between the clarification stream and the make-up stream is effected indirectly.
- 25 4. The method according to claim 3, **characterized in** that the heat exchange is car-
ried out by means of one or more plate or spiral heat exchangers.
5. The method according to any of the preceding claims, **characterized in** that coal
is used as carbonaceous feedstock.

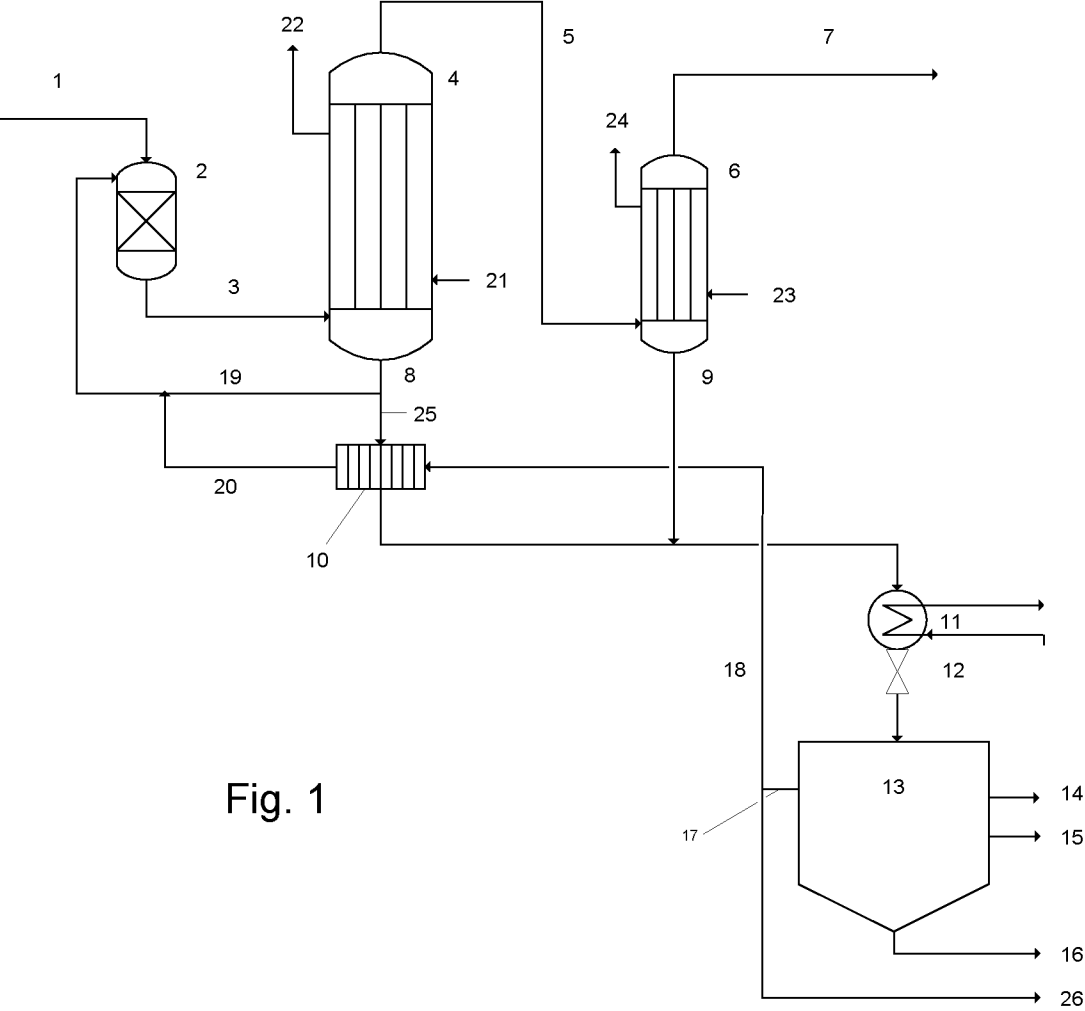


Fig. 1

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/067690

A. CLASSIFICATION OF SUBJECT MATTER

INV. C10K1/04 C10K1/08 C10K1/10
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C10K

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 practicable, search terms used)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	DE 25 42 055 C3 (METALLGESELLSCHAFT AG) 22 August 1985 (1985-08-22) cited in the application claims 1,2,5-7; figure 1 -----	1-5
A	WO 2010/149173 A2 (DALL ENERGY HOLDING APS [DK]; BENTZEN JENS DALL [DK]) 29 December 2010 (2010-12-29) the whole document -----	1-5
A	DE 28 53 989 B1 (METALLGESELLSCHAFT AG) 22 November 1979 (1979-11-22) the whole document -----	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"E" earlier application or patent but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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