METHOD AND INSTALLATION FOR THE UNINTERRUPTED SUPPLY OF A GASIFICATION PLANT WITH FUEL

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ABSTRACT

With a method and a system for interruption-free fuel supply to a gasification system for the production of crude synthesis gas, whereby the fuel is passed from a fuel reservoir to a grinding/drying system, subsequently the resulting fuel dust is passed to a fuel storage container, from there to a dust feed container, and finally, to the gasifier, by way of transport means, the system availability is supposed to be increased, and, at the same time, the storage capacities are supposed to be minimized, in order to thereby particularly achieve a cost reduction. This is achieved in that the fuel in the form of dust is passed to the storage container from at least two grinding/drying systems, by way of transport means, whereby at least one of the transport means, as a dust transport device, is acted on by at least two grinding/drying systems.
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[0001] The invention relates to a method and a system for interruption-free fuel supply to a gasification system for the production of crude synthesis gas, of the type indicated in the preamble of claim 1 and claim 4, respectively.

[0002] By means of a method of operation or a system of the type stated, finely disintegrated fuels, for example fuels in the form of dust (<0.5 mm), for example coal, petroleum coke, biological wastes, or fuels in suspension at a low particle charge (<50 kg/m³, not a fluidized bed) are reacted in a gasifier, with gasification agents that contain oxygen, under elevated pressure, at temperatures above the slag melting point. When carrying out pressurized gasification, a carbonaceous fuel is reacted with a gas that contains oxygen, whereby the gas that contains oxygen is fed in at a substoichiometric ratio, so that a product gas that contains carbon monoxide is obtained. In order to achieve as complete a conversion as possible under substoichiometric conditions, the fuel must be passed into the reactor in finely disintegrated form. The reaction usually takes place under elevated pressure.

[0003] Since gasification reactions can only be operated efficiently if the operation is carried out continuously over an extended period of time, the finely disintegrated fuel amount that flows in must be as constant as possible in terms of time units, in order to guarantee problem-free operation. In this connection, system components that conduct solids, particularly those that function mechanically, are, of course, subject to a greater likelihood of breakdown than that known for components that conduct gases or liquids, for example. In order to increase the availability of the overall system, it is therefore urgently necessary to increase the availability of the fuel supply. In this connection, it is the state of the art to prevent possible failures caused by the capacity of the storage devices. This means that the crude coal silos are dimensioned in such a manner that in the event of failure of the conveyor system that supplies the fuel, the stored crude coal is sufficient to guarantee operation of the gasification system during a repair. Analogous to this, the dust coal silo is dimensioned in such a manner that there is sufficient time for a repair of a grinding system. With the most modern gasification methods, which achieve very high system output values, the expense for providing corresponding buffer times in the storage devices is very great. In this connection, a large storage volume not only affects the costs for the actual large containers, but also for the related building systems and ancillary devices. The method of procedure described above is known from systems implemented by the applicant; DE 10 2006 029 595 A1 shows a supply to burners by way of multiple sluice systems.

[0004] It is the task of the invention to increase the system availability and, at the same time, to minimize the storage capacities, in order to thereby particularly achieve a cost reduction.

[0005] This task is accomplished, according to the invention, with a method of the type indicated initially, in that the fuel, in the form of dust, is supplied to the storage container from at least two grinding/drying systems, by way of transport means, whereby at least one of the transport means, as a dust transport device, is acted on by at least two grinding/drying systems.

[0006] With the method of procedure according to the invention, the result is achieved, in particular, that continuous charging of the gasification system with fuel is guaranteed, even if bottlenecks occur between the individual elements.

[0007] Embodiments of the invention are evident from the dependent claims. In this connection, it can be provided that each storage container that precedes the gasifier is acted on by at least two grinding/drying systems at the same time.

[0008] In an embodiment, it is provided that a further dust transport device is assigned to a dust transport device, and that at least two grinding/drying systems act on them at the same time and/or separately.

[0009] These embodiments according to the invention result in practically 100% redundancy, and thus in great reliability of the method of procedure according to the invention.

[0010] The task formulated further above is accomplished, by a system according to the invention, in that such a system is characterized in that at least two grinding/drying systems are assigned to the dust storage container, along with transport means to feed in the fuel in the form of dust, whereby at least one transport means is formed by two dust transport devices that are acted on by at least two grinding/drying systems.

[0011] Further embodiments of the system according to the invention are evident from the further dependent claims, whereby it can be seen that each gasifier has a storage container assigned to it, whereby the storage container is acted on by at least two grinding/drying systems, and/or that each dust transport device is formed by two dust transport devices to which grinding/drying systems are assigned, in each instance, which devices are acted on jointly and/or separately, to form 100% redundancy.

[0012] It has proven to be practical if at least two solid feed silos as well as a mill are assigned to each grinding/drying system, for feed and mixing of different fuels or additives.

[0013] This embodiment has the particular advantage that the corresponding fuels can be combined in optimal manner; here, depending on the type of fuel, different fuels or a fuel and an additive can be mixed together, depending on the fuel composition.

[0014] The invention also provides that each dust storage container is connected with multiple grinding systems by way of dust transport devices, whereby it can be provided that the transport devices from the grinding/drying systems to the storage container, in each instance, are configured as horizontal conveyors, particularly as a fluidization channel, trough chain conveyor, screw conveyor, belt conveyor, pipe conveyor, or as a pipe/belt conveyor.

[0015] In order to ensure continuous redundancy of the overall system, the invention provides, in a further embodiment, that a separate transport device is provided from the fuel storage unit to a distribution device, for each type of solid, and that a distribution device to the silos of the grinding/drying systems is provided for each type of solid, whereby it can additionally be provided that the transport device and the distribution device for each type of solid are structured with 100% redundancy, in each instance.

[0016] Finally, the invention also provides that the distribution devices for the crude solid to the silos of the grinding/drying systems are connected with every grinding/drying system, whereby the dwell device provided in each instance can have different technical configurations, although this is not at all important.

[0017] Further advantages, details, and characteristics of the invention are evident from the following description and using the drawing. This shows, in:

[0018] FIG. 1 a system according to the invention, having a gasifier.
FIG. 2 in the same representation, without the gasifiers being reproduced separately, a system having two gasifiers.

FIG. 3 a modified exemplary embodiment having two gasifiers.

FIG. 1 shows, as an example, a gasification system to which two different solids can be applied. In the case of the two solids shown as examples, these can be, for example, a fuel and an additive that is needed for thermal gasification. The need for and the type of additives depends on the properties of the fuel used. If fuels that do not require any additives during thermal conversion are involved, then in the example in FIG. 1, two fuels can be applied. Fundamentally, numerous other fuels and, if necessary, additives can also be handled with the concept.

The crude fuel is applied, from the fuel storage unit 1, by way of transport devices 2 and 3, to a distribution device 4 and 5, which undertakes distribution to multiple (three, for example, in FIG. 3) grinding/drying systems.

The capacity of the most modern gasification methods is so great that the fuel supply cannot be guaranteed by one grinding/drying system alone. Even the largest mills commercially available at the present time are not large enough to reliably supply a gasifier. The reason is, on the one hand, that the capacity of a grinding system is not sufficient, and, on the other hand, that the grinding system demonstrates individual availability. If one takes into consideration the failure probabilities expressed in the availability, a certain excess capacity of the grinding systems must be made available, in order to be able to guarantee normal operation of the gasifier despite a failure of the grinding systems. The excess capacity of the grinding systems can be achieved, for example, with a standby grinding system, which is put into operation in the event of a failure. Or the excess capacities can be provided by means of increasing the output of the grinding systems that remain in operation.

In the example in FIG. 1, three grinding/drying systems 6a to 6c are provided, in order to be able to supply the gasification system with 100% fuel at all times. After two solids were received in the silos 7 and 8 of the grinding/drying system 6a-c, and subsequently ground and dried and pulverized together in the mill 9a-c, the mixture of the two ground solids, referred to as dust in the following, is conveyed out of the grinding/drying system by way of the mill filters, in each instance. In the case of the grinding system 6a that is disposed spatially closest to the gasification system, the transport 11 of the fuel dust can take place directly into the dust storage container 13. The other mills 6b, 6c: apply their dust to a jointly used dust transport device 12, which allows transport into the storage container 13. FIG. 4 shows only an exemplary case, so that in the case of a different spatial setup, it can also be the case that the grinding system 6a also uses the dust transport device 12 to supply the dust storage container 13.

The redundancy concept provides that at least the capacity of one grinding system is additionally made available in order to ensure a supply of fuel to the grinding system in the event of failure of a grinding system, either by way of the excess capacity of the remaining grinding systems or by means of an additional standby grinding system. For a reliable fuel supply, redundancy must also be provided in the conveying, transport, and distribution devices, in order to be able to make use of the redundancy of the grinding lines. These are components that carry solids and function mechanically, if applicable, which are therefore subject to great stress, of course, and therefore also to a tendency to break down.

For this reason, the transport device for each crude fuel 2a, 3a is structured with 100% redundancy, in other words double 2b, 3b. Likewise, the distribution device for each type of solid 4a, 5a, to the grinding devices 6a to 6c, is also structured with 100% redundancy. Analogously, the dust transport device 12a from the grinding systems to the dust storage container 13 is also structured in duplicate 12b. From the dust storage container 13, the fuel dust is brought to the required pressure by way of corresponding shuttle devices 15, to the dust feed container 16, from where continuous transport to the burners 19 of the gasification reactor 18 is ensured.

Analogous to the method described in FIG. 1, in FIGS. 2 and 3 there are two gasifiers, which are supplied with fuel in the form of dust, by means of an arrangement of grinding systems (four grinding systems in FIG. 2, five grinding systems in FIG. 3). Each gasifier has its own dust storage container 13a, 13b.

In FIG. 2, the redundancy in the grinding lines is provided in such a manner that the failure of a grinding system can be compensated by an increase in output of the remaining systems, so that both gasifiers can continue to function without a reduction in output. In the example in FIG. 2, two 6a, 6f of the four grinding systems are disposed in such a manner that they can place 11a, 11b the dust produced directly into the dust storage container 13a, 13b. In order to be able to supply the fuel for both gasifiers in the event of failure of any grinding system, a dust transport device 12a with redundancy 12b must be connected with the middle grinding systems 6f, 6c, in order to be able to convey into the first storage container 13a. At the same time, the two middle grinding systems 6b, 6c must convey to the dust storage container 13b, by way of another dust transport device 12c with redundancy 12d.

Example: During normal operation, all four mills function and provide 25% of the total system capacity (two gasifiers), in each instance. In this connection, the grinding systems 6a and 6b supply the dust storage container 13a and, analogously, 6c and 6f supply the container 13b. If grinding system 6c, for example, now fails, the output of the remaining grinding systems is increased to 33%. The grinding system 6b supplies half to the dust storage container 13a, by way of the dust transport device 12 (or a or b), and the other half to the dust storage container 13b, by way of the dust transport device 12 (c or d).

Analogous to the method described in FIG. 1, FIG. 3 involves two gasifiers that are supplied with fuel in the form of dust, by means of an arrangement of five grinding systems. Each gasifier has its own dust storage container 13a, 13b.

In FIG. 3, the redundancy in the grinding lines is provided in such a manner that failure of a grinding system can be compensated by means of turning on a standby grinding system, so that both gasifiers can continue to function without any reduction in output. In the example in FIG. 3, two 6a, 6c of the four grinding systems are disposed in such a manner that they can place 11a, 11b the dust produced directly into the dust storage container 13a, 13b. In order to be able to supply the fuel for both gasifiers in the event of failure of any grinding system, a dust transport device 12a with redundancy 12b must be connected with the grinding systems 6b and 6c, in order to be able to convey into the first storage container 13a. At the same time, the two grinding systems 6e and 6d must convey to the dust storage container 13b, by way of another dust transport device 12c with redundancy 12d.

Example: During normal operation, four of the five mills function and provide 25% of the total system capacity (two gasifiers), in each instance. In this connection, the grinding systems 6a and 6b supply the dust storage container 13a,
and, analogously, 6d and 6e supply the container 13b. The grinding system 6e is in standby mode. If grinding system 6b, for example, now fails, 6c is turned on and conveys into the dust storage container 13a by way of the dust transport device 12a, 12b. The failure of other grinding systems is compensated analogously.

1033] Fundamentally, all kinds of mechanical, pneumatic, and gravity-operated constant conveyors can be used as conveying and distribution devices 2, 3, 4, 5, 12. These include mechanical constant conveyors with pulling means, such as, for example, belt conveyors, which also include the so-called link conveyors, such as, for example, link belt conveyors, trough chain conveyors, scratch chain conveyors, circular conveyors, or the most varied forms of bucket conveyors (belt bucket conveyor, chain bucket conveyor, pendulum bucket conveyor, etc.).

1035] mechanical constant conveyors without pulling means, such as, for example, roller conveyors, screw conveyors, or vibration conveyors,

1036] gravity conveyors, such as, for example, chutes or drop lines,

1037] pneumatic conveyors, such as, for example, dense phase or lean phase conveying systems, fluidized bed conveying systems, or fluidization channels.

1038] The preferred embodiment provides a fluidization channel for the dust transport device 12, according to the invention. The fluidization channel offers the advantage of a low gradient of about 5 to 10° relative to the horizontal, causing the transport of the dust from multiple mills to the dust storage container to take place predominantly horizontally, so that only a slight loss in height has to be accepted. Inert gas can already be used for fluidization and for transport of the fuel dust, in advantageous manner. Another advantage is the complete elimination of moving parts, thereby making it possible to achieve a high level of maintenance-friendliness and a lower failure probability. Alternatively, the dust transport can also be carried out with mechanical conveyors, of course, such as, for example, trough chains or screws, but then, the disadvantage of lower availability must be taken into consideration.

1039] For the transport 2, 3 and the distribution 4, 5 of the crude and therefore still course solid particles, mechanical constant conveyors, such as belt conveyors or the like, are a possibility.

REFERENCE SYMBOL LIST

[0040] 1 solid/fuel storage unit
[0041] 2a, 2b transport device
[0042] 3a, 3b transport device
[0043] 4a, 4b distribution device
[0044] 5a, 5b distribution device
[0045] 6a, . . . e grinding/drying system
[0046] 7a, . . . silo
[0047] 8a, . . . e silo
[0048] 9a, . . . e mill
[0049] 10a, . . . e mill filter
[0050] 11a, b connection line
[0051] 12a, . . . d dust transport device
[0052] 13a, b dust storage container
[0053] 14 silo device
[0054] 15 silo container
[0055] 16 dust feed container

[0056] 17 gasifier
[0057] 18 gasification reactor
[0058] 19 burner system

1. Method for interruption-free fuel supply to a gasification system for the production of crude synthesis gas, whereby the fuel is passed from a fuel reservoir to a grinding/drying system, subsequently the resulting fuel dust is passed to a fuel storage container, from there to a dust feed container, and finally, to the gasifier, by way of transport means, wherein the fuel in the form of dust is passed to the storage container from at least two grinding/drying systems, by way of transport means, whereby at least one of the transport means, as a dust transport device, is acted on by at least two grinding/drying systems.

2. Method according to claim 1, wherein each storage container that precedes the gasifier is acted on by at least two grinding/drying systems at the same time.

3. Method according to claim 1, wherein in order to achieve 100% redundancy, a further dust transport device is assigned to a dust transport device, and wherein these are acted on by at least two grinding/drying devices, simultaneously and/or separately.

4. System for interruption-free fuel supply to a gasification system (17) for the production of crude synthesis gas, whereby the fuel is passed from a fuel reservoir (1) or a fuel storage unit to a grinding/drying system (6), subsequently the fuel dust is passed to a fuel storage container (13), from there to a dust feed container (16), and finally, to the gasifier (17), by way of transport means (2, 4, 5, or 12), wherein at least two grinding/drying systems (6a, 6b) are assigned to the dust storage container (13), along with conveying means (11, 12) for feed of the fuel in the form of dust, whereby at least one conveying means is formed by two dust transport devices (12a, 12b) that are acted on by at least two grinding/drying systems (6b, 6c).

5. System according to claim 4, wherein each gasifier (17) has a storage container (13) assigned to it, whereby the storage container (13) is acted on by at least two grinding/drying systems (6a, 6b).

6. System according to claim 4, wherein in order to form 100% redundancy, each dust transport device (12) is formed by two dust transport devices (12a, 12b), which are acted on jointly and/or separately, to which devices two grinding/drying systems (6b, 6c) are assigned, in each instance.

7. System according to claim 6, wherein each grinding/drying system (6) has at least two solid feed silos (7, 8) and a mill (9) assigned to it, to supply and mix different fuels or additives.

8. System according to claim 7, having a plurality of gasifiers (17), with a dust storage container (13a, 13b) assigned to each gasifier (17), wherein each dust storage container (13a, 13b) is connected with multiple grinding systems (6b, 6c) by way of dust transport devices (12a, 12b).

9. System according to claim 8, wherein the transport devices (12) from the grinding/drying systems (6) to the storage container (13), in each instance, are formed as horizontal conveyors, particularly as a
fluidization channel, through chain conveyor, screw conveyor, belt conveyor, pipe conveyor, or as a pipe/belt conveyor.

10. System according to claim 4, wherein a separate transport device (2a, 3a) from the fuel storage unit (1) to a distribution device (4a, 5a) is provided for each type of solid, and a distribution device (4a, 5a) to the silos (7, 8) of the grinding/drying systems (6) is provided for each type of solid.

11. System according to claim 10, wherein the transport device (2a, 3a) and the distribution device (4a, 5a) for each type of fuel are structured with 100% redundancy (2b, 3b, and 4b, 5b), in each instance.

12. System according to claim 10, wherein the distribution devices (4a, 4b, 5a, 5b) for the crude solid to the silos (7, 8) of the grinding/drying systems (6) are connected with every grinding/drying system.

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