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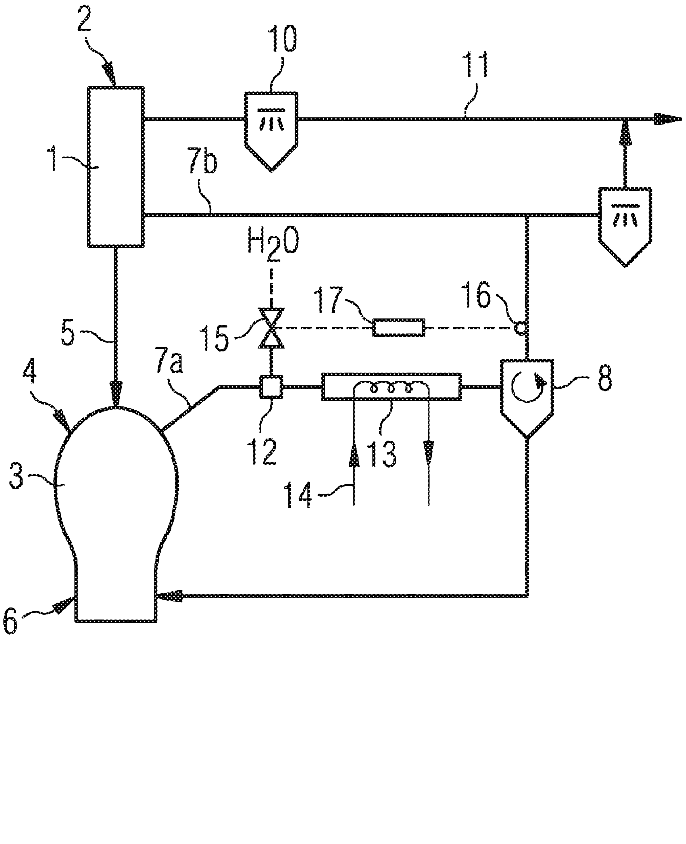
[Fortsetzung auf der nächsten Seite]

(54) Title: METHOD AND DEVICE FOR PROVIDING REDUCTION GAS FROM GENERATOR GAS

(54) Bezeichnung : VERFAHREN UND VORRICHTUNG ZUR BEREITSTELLUNG VON REDUKTIONSGAS AUS GENERATORGAS

FIG 2



(57) Abstract: The invention relates to a method for providing reduction gas for iron ore reduction by cooling and dry dust removal a generator gas (20) generated in a melting gasifier (3) for crude iron production, and to a device for carrying out said method. According to the invention, the generator gas (20) is cooled both by water injection and by heat exchange after discharge from the melting gasifier (3) and before dry dust removal thereof.

(57) Zusammenfassung: Die vorliegende Erfindung betrifft ein Verfahren zur Bereitstellung von Reduktionsgas zur Eisenerzreduktion durch Kühlung und Trockenentstaubung von in einem Einschmelzvergaser (3) zur Roheisenerzeugung erzeugtem Generatorgas (20), sowie eine Vorrichtung zur Durchführung des Verfahrens. Dabei wird das Generatorgas (20) nach seiner Ausleitung aus dem Einschmelzvergaser (3) und vor seiner Trockenentstaubung sowohl durch Wassereindüsung als auch durch Wärmetausch gekühlt.

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Description

Title of the invention

Method and device for providing reduction gas from generator gas

Technical field

The present invention relates to a method for providing reduction gas for iron ore reduction by cooling and dry dedusting generator gas produced in a melter gasifier for pig iron production, and also to a device for carrying out the method.

Prior art

In a number of melt reduction methods for iron ores, for example COREX® or FINEX®, the reduction gas required is provided from what is known as **generator gas** produced in a melter gasifier by gasifying carbon carriers in the presence of oxygen and pre-reduced iron carriers. The generator gas is excessively dust-laden for use as reduction gas in a reduction reactor, and is at a temperature which lies above a temperature range that is favorable for the use thereof for reducing iron ore. The temperature of the generator gas is not constant, but instead fluctuates on account of pressure shocks in the melter gasifier in a range of up to ±50°C about an average value of approximately 1030°C to 1070°C. So that it can be used as reduction gas in a reduction reactor, the generator gas therefore has to be dedusted and cooled. Within the context of this application, generator gas is designated as **reduction gas** only once dedusting and cooling have been effected. Here, cooling does not concomitantly encompass a reduction in temperature which arises in the form of heat loss upon passage through conduits.

It is known, for example from WO9801587, to free the generator gas of entrained dust by means of dry dedusting in a cyclone. The generator gas is cooled in that a partial quantity of the reduction gas emerging from the cyclone is wet dedusted and cooled in a washer and, following subsequent compression, is supplied to the generator gas as so-called cooling gas before the

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dry dedusting. A dedusted and cooled so-called reduction gas thus emerges from the cyclone. The cooling by means of the cooling gas circuit disclosed in WO9801587 has the disadvantage that it is very complex in terms of outlay on apparatus and required space. The plant parts required for realizing the cooling gas circuit, such as washers and compressors, shut-off valves and control valves, shut-off flaps and control flaps, noise protection and buildings including cranes, have to be provided, operated with a high energy consumption and maintained – the compressors in particular cause considerable maintenance costs in this case. In addition, the washers make a considerable contribution to the required design size of the wastewater system of a pig iron production plant as per WO9801587. The energy removed from the reduction gas by the washers in a cooling gas circuit is carried away unexploited with the washing water, and further discharged to the surroundings via cooling towers.

Object of the Invention

It is an object of the present invention to substantially overcome or at least ameliorate one or more of the above disadvantages.

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Summary of the invention

Accordingly, in a first aspect, the present invention provides a method for providing reduction gas for iron ore reduction by cooling and dry dedusting generator gas produced in a melter gasifier for pig iron production, wherein the generator gas is cooled both by water injection and by heat exchange after it has been discharged from the melter gasifier and before the dry dedusting thereof,

wherein the heat exchange is effected with at least one liquid heat exchange medium, and wherein the water injection is regulated in accordance with the temperature of the reduction gas produced by the dry dedusting.

In a second aspect, the present invention provides a device for carrying out the method defined in the first aspect, the device, comprising a reduction reactor for reducing iron ore by means of a reduction gas, and a melter gasifier for producing generator gas by gasifying carbon carriers in the presence of oxygen and pre-reduced iron carriers, wherein the melter gasifier and the reduction reactor are connected by a gas line, in which a dry dedusting device is present, wherein both a device for water injection and a device for heat exchange are present in the gas line between the melter gasifier and the dry dedusting device, wherein the device for heat exchange is provided with a feed line for liquid heat exchange medium, a valve and a temperature sensor are connected to one another on the gas line via a regulating device for regulating water injection.

Advantageous effects of the invention

The terms melter gasifier, generator gas and reduction gas are to be understood as defined above in the introduction. As is generally known, pre-reduced iron carriers are additionally completely reduced in the melter gasifier for producing generator gas, and the pig iron which forms is melted down. In order to provide a reduction gas, the generator gas, which - in addition to carbon dioxide CO_2, steam H_2O and nitrogen N_2 - consists primarily of reducing components such as carbon monoxide CO, hydrogen H_2 and methane CH_4, is subjected to dry dedusting and cooling, as in the prior art.
According to the invention, the generator gas is cooled here both by water injection and by heat exchange after it has been discharged from the melt reduction unit and before the dry dedusting thereof.
Since the cooling is no longer effected by introducing cooling gas produced from a partial quantity of the reduction gas, the complex cooling gas circuit according to the prior art is dispensed with here.
The cooling is effected already before the dry dedusting, in order to cool the particles of the dust and to keep the thermal loading of the device for dry dedusting as low as possible.

The combination of water injection and heat exchange makes it possible to ensure that the generator gas is cooled setting a degree of oxidation of the reduction gas which is favorable for the following iron ore reduction and setting a constant temperature of the reduction gas. The term constant temperature here is to be seen in connection with industrial iron ore reduction plants and the operation thereof, and therefore does not exclude small control deviations from a desired temperature value.

Cooling by water injection alone would provide a reduction gas, by water evaporation and the reaction of steam with carbon monoxide, which would have a considerably higher degree of oxidation compared to the procedure according to the invention - this is because the abandonment of cooling by heat exchange would mean that significantly more water would have to be injected to achieve a specific desired temperature for the reduction gas, which is why the degree of oxidation of the generator gas would be increased to a greater extent as a result.

Here, the degree of oxidation is defined by the relationship $(CO_2+H_2O)/(CO+CO_2+H_2+H_2O)$.

On account of the inertia of a heat exchanger system when it reacts to temperature fluctuations of a gas stream to be cooled, there is the problem that the reduction gas temperature would likewise fluctuate given a greatly fluctuating generator gas temperature. Reliable cooling at a maximum temperature by heat exchange alone would make it necessary to design the plant parts required for the maximum temperature peaks and volume throughputs of the generator gas which occur. This in turn would create the problem of reliably avoiding excessive cooling of the generator gas at temperatures of the generator gas which lie below the temperature peaks.

The combination according to the invention of water injection and heat exchange for cooling the generator gas avoids these disadvantages of the two individual cooling concepts. The inert reacting cooling by heat exchange is supplemented by the rapidly reacting water injection, and the negative influence of the water injection on the degree of oxidation of the reduction gas is reduced by the fact that not all of the cooling is effected by water injection, but instead heat exchange also removes some of the heat which is to be dissipated during the cooling.

According to an advantageous embodiment of the method according to the invention, the heat exchange is effected with at least one liquid heat exchange medium. A liquid heat exchange medium is used so that it is possible to reliably keep the surface temperature of the heat exchanger below 450°C. Cooling by gas or vapor, by contrast, has the disadvantage that the heat transfer coefficient would be lower, and therefore there would be an increased risk of higher surface temperatures of the heat exchanger. A surface temperature of the heat exchanger below 450°C is preferred, in order to avoid the risk of metal dusting corrosion of the heat exchanger by reaction with components of the generator gas.

The liquid heat exchange medium is, for example, water, which may be pressurized and may also have been specially treated - for example demineralized or desalinated water -, or thermal oil, produced for example from synthetic oils or organic oils.

In steel, petrochemical and ORC plants, use is made, for example, of the commercially available thermal oil THERMINOL® 66 for heat displacement or waste heat recovery.

The major advantage of thermal oil over water is the significantly higher boiling point, which can lie at temperatures above 300°C. Furthermore, the use of thermal oil is easier to manage in terms of apparatus, since it is generally used at atmospheric pressure and therefore, in contrast to water-carrying plants, the plants do not have to be designed for an excess pressure. Specifically, water is often used at an excess pressure, and therefore the plants have to be designed to be more stable. It is of course possible according to the invention for thermal oil to also be used at excess pressure, however.

The disadvantage compared to water is the need to couple the heat obtained via thermal oil into another product medium if the heat is to be utilized. Furthermore, thermal oil generally has a smaller heat capacity than water, and the heat of evaporation cannot be utilized in the case of saturated steam operation.

The water injection can be effected before, during or after the heat exchange. It is advantageous for the water injection to be effected before and/or during the heat exchange. In this way, it is possible to provide a sufficient evaporation distance for injected water and to achieve temperature equalization of the generator gas stream more easily before the dry dedusting.

Particularly if the water injection is effected before and/or during the heat exchange, it is advantageous
if the inlet temperature of the liquid heat exchange medium lies within a temperature range
with a minimum temperature of 70°C, preferably 100°C,
and

with a maximum temperature which is lower than the lowest temperature at which metal dusting corrosion occurs by reaction with generator gas on the material of the device for heat exchange, preferably lower than 450°C, particularly preferably 150°C.

It is preferable for the inlet temperature to lie within a temperature range of 100°C to 150°C.

This is because, if water injection is effected before and/or during the heat exchange, the steam content of the generator gas rises, and therefore the surfaces of the device for heat exchange should be at temperatures which make it possible to reliably avoid condensation of steam. Such a condensation entails the risk of the formation of undesirable caking of dust entrained in the generator gas. At a minimum temperature of 70°C, preferably 100°C, the risk of condensation is largely averted.
The maximum temperature should be lower than the lowest temperature at which metal dusting corrosion occurs by reaction with generator gas on the material of the device for heat exchange, preferably lower than 450°C, in order to avoid the risk of metal dusting corrosion, which typically occurs in the range of approximately 450°C - 900°C in the case of common materials for devices for heat exchange, as a result of excessively high surface temperatures in the device for heat exchange.

It is preferable for the water injection to be regulated in accordance with the temperature of the generator gas after the heat exchange. It is advantageous for the water injection to be regulated in accordance with the temperature of the reduction gas produced by the dry dedusting. In this way, it is possible to promptly react to changes in the temperature of the reduction gas.
In any event, the temperature used for regulating the water injection should be a temperature of the generator gas - or of the reduction gas - after water injection has been effected.

According to a preferred embodiment, this regulation is effected with the inclusion of information relating to the cooling power which can be provided by heat exchange - in addition to the cooling power by water injection.
If it is foreseeable, for example, that the cooling being effected given an adjustment A of the water injection leads to

a temperature of the generator gas subjected to the heat exchange which cannot be cooled down to a desired temperature for the reduction gas by the heat exchange, the adjustment of the water injection is regulated to an adjustment B, which makes it possible to set the desired temperature with the cooling power of the heat exchange.

According to one embodiment of the method according to the invention, the quantity of heat withdrawn from the generator gas per unit of time during the heat exchange, i.e. the cooling power, is regulated by changing the temperature of the heat exchange medium and/or the quantity of heat exchange medium supplied per unit of time. This regulation, too, can be effected in accordance with the temperature of the reduction gas produced by the dry dedusting. It is also possible to use the temperature of the generator gas downstream of the heat exchanger before the dry dedusting for regulation. In any event, the temperature used for regulation should be a temperature of the generator gas - or of the reduction gas - after heat exchange has been effected.

According to a preferred embodiment, a specific basic quantity of heat energy is withdrawn from the generator gas by means of heat exchange, and quantities of heat additionally to be withdrawn are withdrawn by water injection. On account of the fluctuations in the generator gas temperature, these additional quantities of heat vary over time. The water injection allows for easier and quicker adaptation of the cooling power to the fluctuations in the generator gas temperature than regulation of the cooling power by way of the heat exchange.

As opposed to a cooling gas circuit according to the prior art, a further advantage of the present invention consists in the fact that the water injection contributes, by a gasification reaction of coal dust entrained in the generator gas with the injected water, to the formation of reducing compounds such as CO and H_2, in accordance with the heterogeneous reaction

$$C+H_2O \rightarrow CO+H_2.$$

Correspondingly converted coal dust from the generator gas then does not have to be separated during the dry dedusting - which relieves the burden on the dry dedusting device - and contributes to the reduction capacity of the reduction gas.

The present invention also relates to a device for carrying out a method according to the invention, comprising

a reduction reactor for reducing iron ore by means of a reduction gas, and a melter gasifier for producing generator gas by gasifying carbon carriers in the presence of oxygen and pre-reduced iron carriers,

wherein the melter gasifier and the reduction reactor are connected by a gas line, in which a dry dedusting device is present, characterized in that both a device for water injection and a device for heat exchange are present in the gas line between the melter gasifier and the dry dedusting device.

The reduction reactor for reducing iron ore can be a fixed bed reactor or a fluidized bed reactor, for example. A plurality of such reduction reactors can also be present in series or connected in parallel. In the reduction reactor, iron ore is at least partially reduced by means of a reduction gas.
In a melter gasifier, as is known for example from COREX® or FINEX®, generator gas is produced. The melter gasifier and the reduction reactor are connected by a gas line. A dry dedusting device, for example a cyclone or a ceramic hot gas filter, is present in said gas line and dedusts the generator gas fed into the gas line from the melter gasifier.

Both a device for water injection and a device for heat exchange are present in the gas line between the melter gasifier and the dry dedusting device.

The generator gas fed into the gas line from the melter gasifier flows in the direction of the reduction reactor. In this case, it passes through both the device for water injection and the device for heat exchange, by means of which it is cooled, and the dry dedusting device, by means of which the dust load thereof is reduced. The gas emerging from the dry dedusting device, which gas is cooled to a temperature favorable for carrying out the reduction in the reduction reactor and dedusted, is designated within the context of this application as reduction gas. The reduction gas is supplied to the reduction reactor via the gas line.

The device for water injection may consist, for example, of one to three water nozzles per generator gas line. The water nozzles are preferably two-fluid nozzles which atomize water with nitrogen or steam or process gas as atomization gas. As a result, the droplet size is minimized, which ensures a short evaporation distance for evaporation of the injected water in the generator gas stream, and a sufficient mixing distance for mixing the injected water in the generator gas stream. Evaporation within a short distance and mixing in this case help to exploit the cooling action of the injected water.

A device for heat exchange is to be understood to mean one or a plurality of indirect heat exchangers per generator gas line. A typical COREX® or FINEX® plant has 4 generator gas lines.
The heat exchangers can be operated as water preheaters or as water evaporators. Operation as superheaters would generally be disadvantageous, because in this case a poor transfer of heat from the heat exchanger to vapor, the heat exchange medium, would make metal dusting corrosion possible on account of high surface temperatures of the heat exchanger which are consequently present. If the material of the heat exchangers is resistant to metal dusting corrosion under the conditions of operation as superheaters, however, it is also possible for the heat exchangers to be operated as superheaters or as gas-gas heat exchangers.
The device for heat exchange advantageously has a plurality of heat exchangers which, with respect to feed lines and discharge lines for heat exchange medium, are connected in parallel or in series. This affords advantages in production and assembly, and has the effect that instances of thermal expansion in the installed state present fewer problems - here, the advantages are applicable if use is made, instead of a large heat exchanger with a specific surface area for heat exchange, of a plurality of smaller heat exchangers whose surface areas for heat exchange correspond in total to that of the large heat exchanger.

According to a preferred embodiment, the device for heat exchange is in the form of a cooling jacket heat exchanger. In this case, it preferably has a smooth surface on the inner side and has no fittings on the inner side. This serves for largely avoiding problems such as caking and abrasion resulting from dust.

It is advantageous for the cooling jacket heat exchanger to have a cooling jacket with a helical guide for heat exchange medium. This allows for particularly efficient cooling.

The device for heat exchange can be arranged, for example, within a pipeline for conducting generator gas. However, it can also itself form said pipeline.

Pipelines for conducting generator gas generally comprise a layer of anti-wear masonry, facing toward the generator gas, for protection against wear resulting from the hot generator gas and the dust load thereof, said layer of anti-wear masonry being surrounded toward the outside by a layer of insulating masonry for thermal insulation. If the device for heat exchange is arranged within a pipeline for conducting generator gas, it is fitted at the site of the anti-wear masonry. It is preferably fitted movably within the insulating masonry; by way of example, a spacing can be left free between the device for heat exchange and the insulating masonry and is sealed off against penetration by gases by means of a seal, for example silicone-sheathed ceramic sealing beads.

The feed lines and discharge lines for heat exchange medium are preferably provided with compensators in order to avoid stresses and instances of material fracture, caused by instances of thermal expansion, in the region of the inlet or of the outlet of the feed lines and discharge lines into that part of the device for heat exchange which provides the surface area for heat exchange.

According to various embodiments of the invention, the device for heat exchange can be operated as a preheater for heat exchange medium and/or as an evaporator for heat exchange medium.

According to one embodiment, the device for heat exchange is provided with a feed line for liquid heat exchange medium, preferably water or thermal oil.

The device for water injection can be arranged between the melter gasifier and the device for heat exchange, in the device for heat exchange or between the device for heat exchange and the dry dedusting device.

According to a preferred embodiment, the device for water injection is arranged between the melter gasifier and the end - as seen in the direction of flow of the generator gas - of the device for heat exchange.
According to a preferred embodiment, the device for water injection is arranged in the device for heat exchange.
It is particularly preferable for the device for water injection to be arranged between the melter gasifier and the start - as seen in the direction of flow of the generator gas - of the device for heat exchange.

The actually selected site at which the device for water injection is arranged depends, for example, on where in a given device for carrying out a method according to the invention optimum turbulence of the injected water can be achieved.
The vapor which may be produced in the device for heat exchange can be used, for example, in a COREX® or FINEX® process for the substitution of smelter vapor for trace heating, or for vapor injection systems for oxygen nozzles. The exploitation of the energy withdrawn from the generator gas by heat exchange makes it possible for the method for iron ore reduction or for producing pig iron to be carried out more economically overall.

Brief description of the drawings

Embodiments of the present invention are explained hereinbelow by way of example with reference to schematic figures.

Figure 1 shows a device for iron ore reduction by means of a reduction gas obtained from a melter gasifier according to the prior art.
Figure 2 shows a device according to the invention analogous to figure 1.
Figure 3 is a schematic illustration of a section through a gas line portion which conducts generator gas and is provided with a cooling jacket heat exchanger.

Description of the embodiments

Figure 1 shows a device for carrying out a method for providing reduction gas for iron ore melt reduction by cooling and dry dedusting generator gas produced in a melter gasifier for pig iron production according to the prior art, in accordance with the COREX® method.
Iron ore 2 is introduced into a reduction reactor 1, in this case a fixed bed reactor, and reduced by a reduction gas. Carbon carriers 4, pre-reduced iron carriers 5 obtained in the

reduction reactor during the reduction of the iron ore and oxygen 6 are introduced into a melter gasifier 3. The pig iron obtained from the pre-reduced iron carriers 5 in the melter gasifier 3 as a result of the complete reduction thereof is melted down, and can be removed from the melter gasifier 3. The generator gas formed in the melter gasifier 3 by gasification reactions of the

carbon carriers 4 with the oxygen 6 in the presence of the pre-reduced iron carriers 5 is discharged from the melter gasifier 3 through the gas line which connects the melter gasifier 3 to the reduction reactor 1. The gas line portion 7a of the gas line conducts generator gas. The dust load of the generator gas is reduced in a dry dedusting device 8, here a cyclone, present in the gas line. Dust separated in the cyclone is returned into the melter gasifier 3. A partial quantity of the reduction gas emerging from the dry dedusting device 8 is subjected to wet washing in a washer 9 and in the process is largely freed of remaining dust and cooled. A partial quantity of the gas taken from the washer 9 is fed to the generator gas, after compression, before it enters the dry dedusting device 8. This reduces the temperature of the generator gas entering the dry dedusting device 8, i.e. the generator gas is cooled. Accordingly, reduction gas emerges from the dry dedusting device 8, in accordance with the definition of the present application. Accordingly, generator gas is conducted in the gas line portion 7a, and reduction gas is conducted in the gas line portion 7b. The gas line consists of the two gas line portions 7a and 7b. After washing in the washer 10, top gas emerging from the reduction reactor 1 is supplied, together with a partial quantity of the reduction gas treated in the washer 9, as export gas 11 to further consumers, for example power plants or pelletizing systems, as an energy provider.
The device parts which are utilized for the wet washing, for compression and for feeding wet-washed, compressed reduction gas into the generator gas are referred to as the cooling gas circuit.

Figure 2 shows a device according to the invention which is comparable to figure 1. Comparable parts of the device are provided with the same reference signs as in figure 1. In contrast to the device according to the prior art shown in figure 1, there is no cooling gas circuit with a washer 9 and a compressor. For cooling the generator gas, both a device for

water injection 12 and a device for heat exchange 13 are present in the gas line instead between the melter gasifier and the dry dedusting device 8, here a cyclone.
The device for heat exchange 13 is provided with a feed line for liquid heat exchange medium 14, in this case pressurized water. The

device for heat exchange 13 is in the form of a cooling jacket heat exchanger, with the cooling jacket heat exchanger having a helical guide for the heat exchange medium - the pressurized water.

The device for water injection 12 is arranged between the melter gasifier and the device for heat exchange 13. The water injection is regulated in accordance with the temperature of the reduction gas produced by the dry dedusting. To this end, a valve 15 and a temperature sensor 16 are connected to one another on the gas line portion 7b via a regulating device 17.

Figure 3 is a schematic illustration of a section through part of the gas line portion 7a, which is connected to a cooling jacket heat exchanger 18 as the device for heat exchange 13. The cooling jacket heat exchanger 18 is provided with a helical guide for the heat exchange medium, which is indicated by dashed lines within the cooling jacket heat exchanger 18. The cooling jacket heat exchanger is arranged within the pipeline for conducting generator gas 19 of the gas line portion 7a. In the portions without a cooling jacket heat exchanger, the pipeline for conducting generator gas 19 has a layer of anti-wear masonry 21, facing toward the generator gas 20, which is illustrated by wavy arrows in the direction of flow, for protection against wear resulting from the hot generator gas and the dust load thereof, said layer of anti-wear masonry being surrounded toward the outside by a layer of insulating masonry 22 for thermal insulation. Where the cooling jacket heat exchanger 18 is arranged within the pipeline for conducting generator gas 19, it is fitted at the site of the anti-wear masonry 21. An intermediate space 23 between the cooling jacket heat exchanger 18 and the insulating masonry 22 is left free, as a result of which the cooling jacket heat exchanger 18 is fitted movably within the insulating masonry 22. For reasons of clarity, seals which are present for the intermediate space 23 against the penetration of gases have not been illustrated.

The feed line 24 and discharge line 25 for heat exchange medium, in this case water - shown by dashed arrows -, are provided with compensators (not shown) in order to avoid stresses and instances of material fracture, caused by instances of thermal expansion, in the region of the inlet or of the outlet of the feed lines and discharge lines into that part of the cooling jacket heat exchanger 18 which provides the surface area for heat exchange.

List of reference signs

1 Reduction reactor
2 Iron ore
3 Melter gasifier
4 Carbon carriers
5 Iron carriers
6 Oxygen
7a Gas line portion
7b Gas line portion
8 Dry dedusting device
9 Washer
10 Washer
11 Export gas
12 Device for water injection
13 Device for heat exchange
14 Liquid heat exchange medium
15 Valve
16 Temperature sensor
17 Regulating device
18 Cooling jacket heat exchanger
19 Pipeline for conducting generator gas
20 Generator gas
21 Anti-wear masonry
22 Insulating masonry
23 Intermediate space
24 Feed line
25 Discharge line

List of citations

Patent literature

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CLAIMS

1. A method for providing reduction gas for iron ore reduction by cooling and dry dedusting generator gas produced in a melter gasifier for pig iron production, wherein the generator gas is cooled both by water injection and by heat exchange after it has been discharged from the melter gasifier and before the dry dedusting thereof,

wherein the heat exchange is effected with at least one liquid heat exchange medium, and

wherein the water injection is regulated in accordance with the temperature of the reduction gas produced by the dry dedusting.

2. The method as claimed in claim 1, wherein the liquid heat exchange medium is water.

3. The method as claimed in claim 1 or 2, wherein the liquid heat exchange medium is thermal oil.

4. The method as claimed in any one of the preceding claims, wherein the water injection is effected before and/or during the heat exchange.

5. The method as claimed in claim 4, wherein the inlet temperature of the liquid heat exchange medium lies within a temperature range with a minimum temperature of 70°C, preferably 100°C, and

with a maximum temperature which is lower than the lowest temperature at which metal dusting corrosion occurs by reaction with generator gas on the material of the device for heat exchange, preferably lower than 450°C, particularly preferably 150°C.

6. The method as claimed in any one of the preceding claims, wherein the water injection is regulated in accordance with the temperature of the generator gas after the heat exchange.

7. The method as claimed in any one of the preceding claims, wherein the quantity of heat withdrawn from the generator gas per unit of time during the heat exchange is regulated by changing the temperature of the heat exchange medium and/or the quantity of heat exchange medium supplied per unit of time.

8. A device for carrying out a method as claimed in any one of claims 1 to 6, comprising a reduction reactor for reducing iron ore by means of a reduction gas, and a melter gasifier for

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producing generator gas by gasifying carbon carriers in the presence of oxygen and pre-reduced iron carriers, wherein the melter gasifier and the reduction reactor are connected by a gas line, in which a dry dedusting device is present, wherein both a device for water injection and a device for heat exchange are present in the gas line between the melter gasifier and the dry dedusting device, wherein the device for heat exchange is provided with a feed line for liquid heat exchange medium, a valve and a temperature sensor are connected to one another on the gas line via a regulating device for regulating water injection.

9. The device as claimed in claim 8, wherein the device for water injection is arranged between the melter gasifier and the end, as seen in the direction of flow of the generator gas, of the device for heat exchange preferably in the device for heat exchange.

10. The device as claimed in claim 9, wherein the device for water injection is in the device for heat exchange.

11. The device as claimed in claim 8, 9 or 10, wherein the device for heat exchange is in the form of a cooling jacket heat exchanger.

12. The device as claimed in claim 11, wherein the cooling jacket heat exchanger has a cooling jacket with a helical guide for heat exchange medium.

13. The device as claimed in any one of claims 8 to 12 wherein the liquid heat exchange medium is water or thermal oil.

14. A method for providing reduction gas for iron ore reduction, the method substantially as hereinbefore described with reference to the accompanying drawings.

15. A device for for providing reduction gas for iron ore reduction, the device substantially as hereinbefore described with reference to the accompanying drawings.

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2009P23466WO

FIG 1

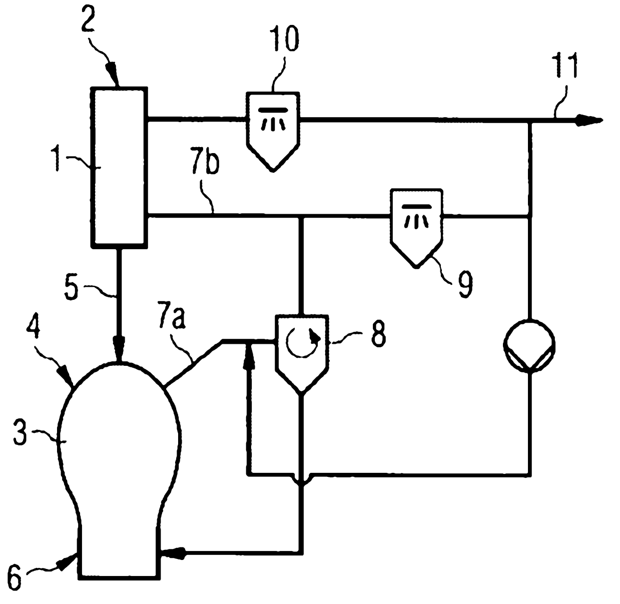

FIG 2

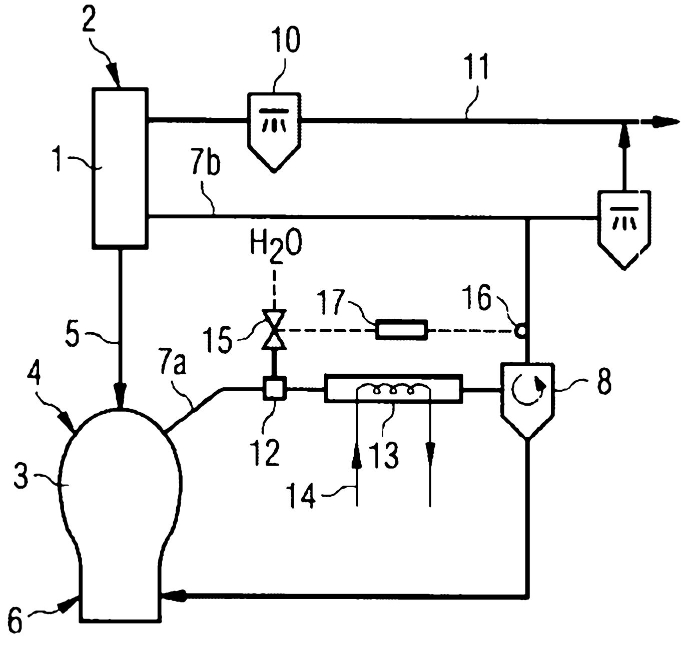

FIG 3