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(54) Benævnelse: **FREMGANGSMÅDE OG APPARAT TIL BEHANDLING AF EN VANDHOLDIG CARBONDIOXIDRIG GAS**

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DESCRIPTION

The present invention relates to a process for treating a carbon dioxide-rich gas containing water. The gas may contain at least one acid gas other than carbon dioxide.
The carbon dioxide-rich gas contains at least 10 mol% of carbon dioxide or at least 50 mol% of carbon dioxide, or at least 80 mol% of carbon dioxide. The flue gases from the burners of a steam methane reformer (known by the acronym SMR) produce a gas containing 10 mol% of CO_2 and also about 70% of nitrogen.
The invention applies to the treatment, for example the compression, washing, cooling or drying, of any carbon dioxide-rich gas possibly containing at least one other acid gas, such as NO, NO_2, SO_2, SO_3.
The gas may be derived from a combustion, for example an oxycombustion, from fermentation, from a PSA for removing hydrogen, from a steel plant, from a cement plant, from the production of ammonia, lime or ethylene oxide.
It may consist of natural gas or biomethane also containing methane in both cases.
US4542114 describes the removal of the other acid gases present in a carbon dioxide-rich gas by compression, the acid gases being concentrated in the water condensates produced during the compression. The formed acidified water is not used.
"Industrial Gases Processing", by Häring ed. Wiley VCH 2008 describes the transfer of water condensed in a compressor of a carbon dioxide-rich gas as wastes (“waste water system”). This inevitably result in transferring acid into the sewers, which is hazardous to the environment.
US2002/0144506 describes the condensation of water in carbon dioxide compressed in a compressor after cooling, the water being sent afterwards to combustion.
FR2950925 discloses the treatment of a carbon dioxide-rich gas containing water and other acidic gases such as NO_2 and SO_2, wherein aqueous condensates with a high acidity level are recovered, which are used as a fluid for assisting in the extraction of a petroleum product.
Hydrogen is an energy carrier that is becoming increasingly important in decarbonisation in different sectors, in particular transport and industry. Hydrogen may be produced from the reforming reaction of natural gas (in SMR - "Steam Methane Reforming" furnaces) or by water electrolysis. Water electrolysis has the advantage of producing no greenhouse gases but consumes a lot of electricity (decarbonised where possible). In SMRs, hydrogen production is accompanied by a considerable CO_2 production. A CO_2 capture unit may be

added to an SMR in order to reduce the carbon footprint of the production of hydrogen by SMR. CO_2 capture (for example CO_2 treatment and liquefaction for food use or for sequestration) may be carried out cryogenically or non-cryogenically (for example, amine scrubbing).

The CO_2 produced during combustion (by treatment of combustion gases in air or in oxygen) contains some NO_x. The oxidation reaction of NO into NO_2 is slow, whereas the other reactions, and in particular the hydrolysis reactions of NO_2 and N_2O_3 in the presence of water are rapid and balanced:

$2\ NO + O2 \Leftrightarrow 2\ NO_2$

$3\ NO_2 + H_2O \Leftrightarrow 2\ HNO_3, + NO$

$NO + NO_2 \Leftrightarrow N_2O_3$

$N_2O_3 + H_2O \Leftrightarrow 2\ HNO_2$

Thus, when the CO_2 contains water and NO_x, acid condensates are formed in the process because of the formation of HNO_3 and HNO_2 in the condensed water (for example partial condensation between two compression stages of wet CO_2, partial condensation of the regeneration product of the TSA-type dryer, condensates from the water washing tower in the case where the pH has not risen too high to reduce the SO_x).

Moreover, even in the case where the carbon dioxide-rich gas does not contain any other acid gas (therefore no NOx), washing this gas with water and cooling or drying said gas could produce acidified water.

In addition, a cooling water network is generally used on the CO_2-rich gas treatment unit to cool the compressed fluid at the outlet of the compression stages and upstream of the dryer. This water tends to progressively scale heat exchangers, thereby making them less effective. Scaling of water exchangers could be limited by maintaining an acid pH ($pH < 7$) in the cooling water. A water treatment unit or an injection of an acid (for example H_2SO_4) allows maintaining the acid pH of the water and limiting scaling. As the case might be, in particular depending on the hardness of the water, a higher pH may be desired, for example a $pH<8.5$ or <8.

According to an object of the invention, a process is provided for the treatment of a gas rich in carbon dioxide containing water and optionally at least one other acid gas, in which:

a) the gas is compressed in at least one compression stage and cooled, and at least one condensate is separated from the cooled gas after at least one compression stage, preferably between two compression stages, the condensate consisting of water in which the CO_2 and/or the at least one other acid gas is dissolved, forming acidified water having a pH of at most 6.5, and/or

b) the gas rich in carbon dioxide is purified, optionally upstream of the compression of step a), in a unit for washing with water, so as to produce a purified gas, optionally to be sent to compression, and water containing impurities, and/or

c) the gas, optionally compressed in step a), is dried in a drying unit and water contained in the optionally compressed gas is recovered, forming recovered

water,

characterised in that:

i) at least a portion of the acidified water of step a), and/or

ii) at least a portion of the water containing impurities of step b), and/or

iii) at least a portion of the recovered water of step c)

is/are mixed with water circulating in a cooling circuit, so as to form a mixture with a desired degree of acidity, preferably having a pH of less than 8.5, indeed even of less than 7, preferably greater than -2. According to other optional aspects:

- the mixture serves to cool an indirect-contact heat exchanger.
- the heat exchanger is of brazed aluminium plate-fin type or of corrugated plate type or of shell-and-tube type.
- the heat exchanger serves to cool gas rich in carbon dioxide compressed in step a), downstream of at least one compression stage, and/or to be purified in step c).
- the dryer operates by water adsorption and is periodically regenerated by a dry regeneration gas which leaves the adsorption unit having recovered therein water accumulated in the drying unit.
- the heat exchanger serves to cool the regeneration gas which has recovered the water in the drying unit, the water thus condensed constituting the recovered water of step c).
- the dryer dries the gas by compressing it and/or by cooling it so as to condense the water contained therein.
- the desired degree of acidity is greater than a pH of 1 or greater than a pH of 3.
- the at least one other acid gas is chosen from the group: SO_2, SO_3, H_2S, HCl, NO, N_2O, NO_2, N_2O_4, HNO_3, HNO_2, H_2CO_3.
- an acid flow originating from storage is added to the water of the cooling circuit.
- the flow of water of the flow or flows i) and/or ii) and/or iii) is adjusted so as to obtain a desired pH in the cooling circuit.

- at least one flow i), ii) or iii) having a first pH is mixed with another one of these three flows having a second pH different from the first pH.
- the acid flow originating from storage and also at least one of the flows i) and/or ii) and/or iii) are adjusted so as to obtain a desired pH in the cooling circuit.
- the at least one amongst the flows i) and/or ii) and/or iii) has a first pH different from that of the acid flow.
- the at least one amongst the flows i) and/or ii) and/or iii) has a first pH higher than that of the acid flow.
- the at least one amongst the flows i) and/or ii) and/or iii) has a first pH lower than that of the acid flow.
- the gas rich in carbon dioxide is purified upstream of the compression in the unit for washing with water so as to produce a purified gas and water containing impurities, and the temperature and/or the flow rate of washing water sent to the cooling tower is/are adjusted in order to vary the flow rate and/or the acidity of the water containing impurities sent to the cooling circuit.
- the cooling circuit serves to cool a gas compressed in a compression stage, which can be that of step a) or a stage of compression of a gas produced by treating a gas treated in at least one of steps a) and/or b) and/or c).
- the addition of the water i) and/or ii) and/or iii) can increase or reduce the degree of acidity of the water circulating in the cooling circuit.
- the cooling circuit contains cooling water having a pH between 6 and 8, and possibly between 6.5 and 7.5, before being mixed with the at least one amongst the flows i), ii) or iii).

According to another object of the invention, an apparatus is provided for the treatment of a gas rich in carbon dioxide containing water and optionally at least one other acid gas, comprising:

a) at least one compression stage, for compressing the gas, cooling means for cooling the compressed gas and at least partially condensing the water which it contains, and means for separating at least one condensate from the cooled gas, the separating means being placed after at least one compression stage, preferably between two compression stages, the condensate consisting of water in which the CO_2 and/or the at least one other acid gas is dissolved, forming acidified water having a pH of at most 6.5, and/or

b) a unit for washing with water so as to produce a purified gas, optionally to be sent to compression, and water containing impurities, and/or

c) a drying unit and also means for recovering the water removed by the drying.

characterised in that it comprises means for mixing:

i) at least a portion of the acidified water of option a) and/or

ii) at least a portion of the water containing impurities of option b), and/or

iii) at least a portion of the recovered water of option c)

with water circulating in a cooling circuit so as to form a mixture with a desired degree of acidity, preferably having a pH of less than 8.5, indeed even of less than 7, preferably greater than -2.

According to other optional features, the apparatus comprises:

- means for sending the mixture to cool an indirect-contact heat exchanger.
- the heat exchanger is of brazed aluminium plate-fin type or of corrugated plate type or of shell-and-tube type.
- the heat exchanger is arranged so as to cool carbon dioxide-rich gas compressed in step a), downstream of at least one compression stage, and/or to be purified in step c).
- the dryer comprises several water adsorption beds as well as means for periodically sending a dry regeneration gas to one amongst the beds and means for removing from the bed the regeneration gas having recovered water accumulated in the drying unit.
- the heat exchanger is arranged so as to cool the regeneration gas having recovered the water in the drying unit, the water thus condensed forming the recovered water of step c).
- the dryer comprises compression and/or cooling means for condensing the water contained in the gas to be dried.
- means for adding an acid flow originating from a storage to the water of the cooling circuit.
- a storage of an acid, connected to the cooling circuit
- means for adjusting the water flow from the flow(s) i) and/or ii) and/or iii) in order to obtain a desired pH in the cooling circuit.
- means for mixing at least one flow i), ii) or iii) having a first pH with another one amongst these three flows having a second pH different from the first pH.
- means for adjusting the acid flow originating from the storage as well as at least one amongst the flows i) and/or ii) and/or iii) to obtain a desired pH in the cooling circuit.
- means for sending the carbon dioxide-rich gas to be purified, possibly upstream of the compression, into the unit for washing with water to produce a purified gas and water containing impurities

- means for adjusting the temperature of the washing water sent to the cooling tower in order to vary the flow rate and/or the acidity of the water containing impurities sent to the cooling circuit.
- means for adjusting the flow rate of the washing water sent to the cooling tower in order to vary the flow rate and/or the acidity of the water containing impurities sent to the cooling circuit.
- the cooling circuit is arranged so as to cool a gas compressed in a compression stage, which could be that one of step a) or a stage for compression a gas produced by treating a gas treated in at least one amongst steps a) and/or b) and/or c).

The present invention consists in injecting at least one portion of the acid condensates generated by a process for treating the CO_2-rich gas and possibly including HNO_3 or HNO_2 in the cooling water network in order to maintain a pH lower than 8.5, or lower than 8, or lower than 7, instead of or complementarily with the injection of H_2SO_4 or another acid into the water network. This allows limiting the consumption of acid to be injected and/or reducing the investment and/or operational cost of the cooling water treatment unit.

Thus, one solution according to the invention consists in injecting the acidified water condensed downstream of at least one intermediate cooler and/or of the final cooler of a compressor of a carbon dioxide-rich gas into a cooling water network rather than into the tower for washing with water or the limiting battery of the client.

In many cases, the gas compressed in the compressor is dried afterwards in a dryer with several adsorption beds which should be regenerated on a regular basis in order to remove the water that has accumulated therein. The regeneration gas sent to the dryer comes out of the latter loaded with water vapour. By condensing this vapour, the produced water may also be sent to a water cooling circuit.

Preferably, the regeneration gas, generally drawn in a separation unit downstream of the dryer, may be mixed with a gas originating from an intermediate or final stage of the compressor, so that the condensed water is a mixture of water present at the inlet of the compressor and of water originating from the regeneration gas. Alternatively, drying the gas may be carried out simply by cooling the carbon dioxide-rich gas so as to condense the water, the recovered water could be sent to the cooling circuit.

The cooling water circuit may also be supplied with water condensed in the tower for washing with water upstream of the compressor (if present). This water will be acidified because of the presence of acid gases in the gas to be washed. A portion of the NOx and/or SOx that the carbon dioxide-rich gas contains will be removed in the tower by washing with water, and the water accumulating in the tank of the tower contains the acids dissolved in the washing water.

Hence, it should be understood that the acidity of the water of the cooling circuit could be adjusted by adding water from at least one source, the water could originate from the tower for cooling the CO_2-rich gas and/or from the compression of the CO_2-rich gas and/or from the dryer, for example from the regeneration gas from the dryer of the compressed CO_2-rich gas.

These water sources may have different acidity levels and it therefore becomes possible, by metering the amount of water sent from one or more potential source(s), to regulate the acidity level in the cooling water circuit.

The alternative solution would be to add acid (for example sulphuric acid) to the water circuit in order to prevent the formation of limescale in the circuits, this solution requiring an acid to be supplied and stored on site.

Yet, in some cases, the present invention can avoid having to manage an acid source from outside the site, while at the same time solving the economic and above all environmental problem of management of acid wastes.

The present invention may also be applied to the use of condensates from purging of the tower for washing with water upstream of the compression, for example in the cooling water network of the unit if the composition and the pH of the condensates allow so; If the tower for washing with water or another dedicated column also allows reducing the SOx, then, depending on the amount of ions accumulated in the purge in case of reduction of the SOx with the addition of sodium hydroxide or another basic solution, the obtained purge water will be basic. In this case, the purge water could be added to the water of the refrigeration circuit to make it more basic or to correct an excessive acidity.

Preferably, the refrigeration circuit is used to cool a gas at the outlet of a compression stage of a compressor, which could be a compressor of the carbon dioxide-rich gas or a compressor of a product from an apparatus for separating the carbon dioxide-rich gas, located for example downstream of the dryer (if present) and/or downstream of the compressor of the carbon dioxide-rich gas, if present.

The invention will be described in more details with reference to the drawing. [FIG. 1] illustrates a process according to the invention.

In [FIG. 1], the carbon dioxide-rich gas may originate from any source capable of producing such a gas. In this case, two combustion gas flows FG 1 and FG 2 are mixed so as to form the carbon dioxide-rich gas 1 containing for example at least 10 mol% of CO_2, at least 40 mol% of CO_2, at least 80 mol% of CO_2 or at least 90 mol% of CO_2. This gas is sent to a tower for washing with water Q supplied at the top by pressurised water, W12, capable of absorbing at least one acid gas present in the carbon dioxide-rich gas, for example SO_2, SO_3, NO_2, NO, N_2O, HNO_3, HNO_2, CO_2, etc. The washing tower Q may also operate at atmospheric or sub-atmospheric pressure. The water flow W12 sent at the top of the tower may be varied to adjust the flow rate and/or the acidity of liquid formed in the tank of the tower Q.

The water in the tank of the tower Q is acidified and may be pumped by a pump P1. A portion W5 is possibly mixed with the water W12 and the remainder W7 may be sent according to the invention towards the cooling circuit to vary the acidity level thereof (not illustrated in the Figure).

In this example, the carbon dioxide-rich gas 3 purified in the tower Q is compressed in a compressor C1, then split in two and cooled in two heat exchangers E1, E2 by indirect heat exchange with different nitrogen flows W13 or with another refrigerant, such as water. Afterwards, the gas flows are combined and cooled in the heat exchanger E3 to condense a portion of the water contained in the gas. This water will contain carbonic acid in a dissolved form and/or sulphuric acid and/or sulphurous acid and/or nitric acid, and/or nitrous acid. It is separated from the gas in a separator S1 or by another equivalent means, the condensate W1 of which is drawn off into the separator tank S1. The gas is compressed again, in a compressor C2, and cooled in a heat exchanger E4 and the formed water is separated in a phase separator S2 or another equivalent means, the condensate W2 of which is drawn off into a tank. The gas from the separator S2 is compressed again, in a compressor C3, cooled in a heat exchanger E5 and the formed water is separated in a phase separator S3, the condensate W3 of which is drawn off into a tank. The gas from the separator S3 or another equivalent means is compressed by a compressor C4, then is cooled by a heat exchanger E6 and afterwards in an exchanger E7 to further condense water. This water in the gas 5 is removed in the separator S4 or another equivalent means to form a gas 7 and condensed water W4.

Afterwards, the gas 7 is dried in a dryer D which may consist of an adsorption unit. Afterwards, the dried gas 9 may be used as dry product or be purified by another means such as another adsorption unit and/or a membrane and/or a unit for separation at a temperature lower than 0°C, for example by partial condensation and/or distillation.

In the case where the dryer D operates by adsorption, it will be necessary to regenerate it by sending a dry regeneration gas thereto. This gas R comes out of the dryer loaded with water and may be mixed with the flow 5, in this case between the exchangers E6, E7, the mixing point depending on the contained amount of water and on the temperature of the gas R. It goes without saying that the composition of the gas R should be compatible with the ultimate use of the gas 9. For example, it may be rich in carbon dioxide.

It should be understood that the dryer does not necessarily operate by adsorption. The gas 7 may simply be cooled and/or pressurised to condense the water that it contains, this acidified water being recovered as a flow R for supplying the cooling cycle.

The water flows W1, W2, W3, W4 are mixed so as to form a flow of water containing at least one dissolved acid gas. Nevertheless, the mixture formed may contain only at least two of the flows mixed together. Alternatively, only one flow W1, W2, W3, W4 may be recovered. At least one portion of the recovered water (mixed or not) is sent to the water of a refrigeration cycle.

In the case of the example, the water is sent as a flow W6 to the heat exchanger E7, where the gas 5 cools downstream of the exchanger E6, in this case mixed with the regeneration gas R.

Thus, the water recovered at S4 originates partially from the regeneration gas R.

In this case, the water W6 is not cooled upstream of the exchanger E7. Nevertheless, it is possible to cool it down like, for example, in the cooling tower T.

The possibility of varying a flow sent to join the water circuit and/or of mixing at least two flows allows compensating for acidity levels that are excessively high or excessively low. For example, if one amongst the flows W1 to W4 or W7 has an exceptionally high acidity level, it could nevertheless be used to supply the cooling cycle, by reducing its flow rate and/or by mixing it with a less acidic flow.

A nitrogen circuit W is used to cool the exchanger E1 and the exchanger E2, possibly after expansion in a turbine. The nitrogen W15 expanded in the turbine supplies a tower T at the bottom. While rising up the tower, it cools the water W10 sent to the top of the tower, thereby producing a reheated nitrogen flow at the top of the tower, which is discharged into the atmosphere, and cooled water in a tank which supplies the cooling circuit. A nitrogen flow W11 may be sent into the air. For example, if the nitrogen W arrives too cold or if there is no need to cool very much the water flow W10 depending on how much heat is brought by the heat exchanger E7 into the cooling circuit, not all of the nitrogen is sent to the tower T, but the portion W11 may be sent directly into the atmosphere. This is one way to adjust the temperature of the water W8 originating from the tower T.

It should be understood that the specific type of nitrogen circuit is not important and, for this reason, it is not described in detail.

It should be noted that the cooling water circuit is optionally supplied with an acid flow W9, which could be sulphuric acid and/or have a pH lower than 7. This acid transfer may be eliminated or reduced since the water circuit is acidified by water originating from at least one amongst three sources, namely:

- the washing tower Q, when present, the condensate W7 of which may be mixed with the water circuit.
- the regeneration gas R, when present, the water of which may be separated, or not, by mixing it with the gas to be dried.
- at least one amongst the compression stages C1, C2, C3, C4 after cooling and partial condensation.

It should be noted that each of the compressors C1, C2, C3, C4 may consist of at least one stage of a compressor.

The tower Q may be supplied with water originating from at least one amongst the compressors C1 to C4 so as to form the flow W12. Alternatively, this flow W12 may be completely independent.

It is possible to regulate the flow rate and/or the acidity of the flow W12 by varying the flow rate and/or the acidity of the flow W12. The flow rate may be varied by a valve on the flow W12. Alternatively, at least one amongst the flows W1, W2, W3 may be regulated by means of a valve. Since the flows W1, W2, W3 could have different acidity levels, this may be sufficient to vary the acidity of the purge water removed at the column tank.

The water having been used to cool the heat exchanger E7 may be sent to a washing tower T at the top thereof in order to cool a nitrogen flow W15.

Preferably, the acid W9, if present, is mixed with the liquid from the tank of the tower T and afterwards the formed water is mixed with the flow W6.

The water in the gas R is ingeniously recovered by mixing the gas R with the gas compressed between the exchangers E6 and E7, so that the exchanger E7 cools the gas R and the separator S4 recovers the water originating from the compressor and from the regeneration gas R.

The cooling cycle supplied with water from at least one amongst the sources a), b), c) may be that one of the compressor of the source a) or any other compressor, for example a compressor of a product from a separation device supplied with the carbon dioxide-rich gas.

In the example of the figure, water is drawn from the washing tower, the washed gas compressor and the dryer of the gas originating from the compressor to supply the cooling circuit.

Nevertheless, it should be understood that not all of the washing tower, the compressor and the dryer are necessarily present.

For example, the process may just consist of a washing process (and the apparatus is a washing tower with associated means) producing acidified water to acidify water from a cooling circuit. In this case, the compressor and/or the dryer is/are not present. Hence, the washing tower may produce a gas to be treated by compression and/or drying.

Similarly, the process may just consist of a drying process (and the apparatus is a dryer with associated means) producing acidified water to acidify water from a cooling circuit. In this case, the compressor and/or the washing tower is not present. Hence, the dryer can dry a gas originating from compression of the gas to be dried and/or from washing in a washing tower, so as to produce the gas to be treated by drying.

The cooling circuit may cool gas derived from a compression stage, which could be the gas that has been purified in the washing tower and/or gas to be dried in the dryer. Alternatively, it may cool a cooling circuit independent of steps a), b) and c).

Patentkrav

1. Fremgangsmåde til behandling af en carbondioxidrig gas (1,3,7), der indeholder vand og eventuelt mindst en anden sur gas, ved hvilken:

a) gassen komprimeres i mindst et kompressionstrin (C1, C2, C3, C4) og afkøles, og mindst et kondensat (W1, W2, W3, W4) skilles fra den afkølede gas (5) efter mindst et kompressionstrin, fortrinsvis mellem to kompressionstrin, idet kondensatet består af vand, i hvilket CO_2'et og/eller den mindst ene anden sure gas er opløst, hvorved der dannes syrnet vand med en pH-værdi på højst 6,5, og/eller

b) den carbondioxidrige gas renses, eventuelt opstrøms for kompressionen i trin a), i en vandvaskeenhed (Q) til at frembringe en renset gas (3), der eventuelt skal sendes til kompressionen, og vand (W7), der indeholder urenheder, og/eller

c) gassen (7), der eventuelt er komprimeret i trin a), tørres i en tørreenhed (D), og i den eventuelt komprimerede gas indeholdt vand genvindes og danner genvundet vand (W4),

kendetegnet ved, at

i) mindst en del af det syrnede vand (W1, W2, W3, W4) fra trin a) og/eller

ii) mindst en del af det vand (W7), der indeholder urenhederne, fra trin b) og/eller

iii) mindst en del af det genvundne vand (W4) fra trin c)

blandes med vand, der cirkulerer i et kølekredsløb (W8, W10) til dannelse af en blanding (W8) med en ønsket surhedsgrad, fortrinsvis med en pH-værdi lavere end 8,5 eller endog lavere end 7.

2. Fremgangsmåde ifølge krav 1, ved hvilken blandingen (W8) tjener til at afkøle en varmeveksler med indirekte kontakt (E7).

3. Fremgangsmåde ifølge krav 2, ved hvilken varmeveksleren (E7) er af typen med plader og ribber af loddet aluminium eller med bølgede plader eller med skal og rør.

4. Fremgangsmåde ifølge krav 2 eller 3, ved hvilken varmeveksleren (E7) tjener til at afkøle den i trin a) komprimerede (5) carbondioxidrige gas nedstrøms for mindst et kompressionstrin og/eller at rense (7) den i trin c).

5. Fremgangsmåde ifølge et af kravene 2 til 4, ved hvilken tørreenheden (D) fungerer ved adsorption af vand og regenereres periodisk af en tør regenereringsgas (R), som forlader adsorptionsenheden, idet den der har genvundet i tørreenheden opsamlet vand.

6. Fremgangsmåde ifølge krav 2 og 5, ved hvilken varmeveksleren (E7) tjener til at afkøle regenereringsgassen (R), der har genvundet vandet i tørreenheden (D), idet det således fortættede vand (W4) udgør det i trin c) genvundne vand.

7. Fremgangsmåde ifølge et af de foregående krav, ved hvilken den mindst ene anden sure gas er valgt fra gruppen: SO_2, SO_3, H_2S, HCl, NO, N_2O, NO_2, N_2O_4, HNO_3, HNO_2, H_2CO_3.

8. Fremgangsmåde ifølge et af de foregående krav, ved hvilken man til vandet i kølekredsløbet tilsætter en syrestrømning (W9), der stammer fra et lager.

9. Fremgangsmåde ifølge foregående krav, ved hvilken strømningen af vand i strømningen eller strømningerne i) og/eller ii) og/eller iii) (W1, W2, W3, W4, W7) reguleres til at opnå en ønsket pH-værdi i kølekredsløbet.

10. Fremgangsmåde ifølge krav 8 og 9, ved hvilken syrestrømningen (W9), der stammer fra lageret, samt mindst en af strømmene i) og/eller ii) og/eller iii) (W1, W2, W3, W4, W7) reguleres til at opnå en ønsket pH-værdi i kølekredsløbet.

11. Fremgangsmåde ifølge et af de foregående krav, ved hvilken den carbondioxidrige gas (3) renses opstrøms for kompressionen i vandvaskeenheden (Q) for at frembringe en renset gas (3) og vand, der indeholder urenheder (W7), og temperaturen og/eller strømningen af vaskevand (W12) sendt til køletårnet indstilles for at ændre strømningen og/eller surheden af det vand, der indeholder de til kølekredsløb sendte urenheder.

12. Fremgangsmåde ifølge et af de foregående krav, ved hvilken kølekredsløbet (W8, W10) tjener til at afkøle en i et kompressionstrin (C1, C2, C3, C4) komprimeret gas (5), som kan være den i trin a) eller et kompressionstrin for en gas, der er fremstillet ved behandling af en i mindst et af trinnene a) og/eller b) og/eller c) behandlet gas.

13. Apparat til behandling af en carbondioxidrig gas (1,3,7), der indeholder vand og eventuelt mindst en anden sur gas omfattende:

a) mindst et kompressionstrin (C1, C2, C3, C4) til at komprimere gassen, kølemidler (E1, E2, E3, E4, E5, E6, E7) til at afkøle den komprimerede gas og i det mindste delvis fortætte det vand, den indeholder, og midler til at adskille mindst et kondensat fra den afkølede gas (S1, S2, S3, S4, S4), idet skillemidlerne er anbragt efter mindst et kompressionstrin, fortrinsvis mellem to kompressionstrin, idet kondensatet består af vand (W1, W2, W3, W4), i hvilket CO_2'et og/eller den mindst ene anden sure gas er opløst og danner syrnet vand med en pH-værdi på højst 6,5 og/eller

b) en vandvaskeenhed (Q) til at frembringe en renset gas (3), der eventuelt skal sendes til kompressionen, og vand, der indeholder urenheder (W7), og/eller

c) en tørreenhed (D) samt midler til at genvinde det ved tørringen fjernede vand (W4),

kendetegnet ved, at det omfatter midler til at blande

i) mindst en del af det syrnede vand fra option a) og/eller

ii) mindst en del af det vand, der indeholder urenheder, fra option b), og/eller

iii) mindst en del af det fra option c) genvundne vand

med vand (W8), der cirkulerer i et kølekredsløb, til dannelse af en blanding med en ønsket surhedsgrad, fortrinsvis med en pH-værdi lavere end 8,5, endog lavere end 7.

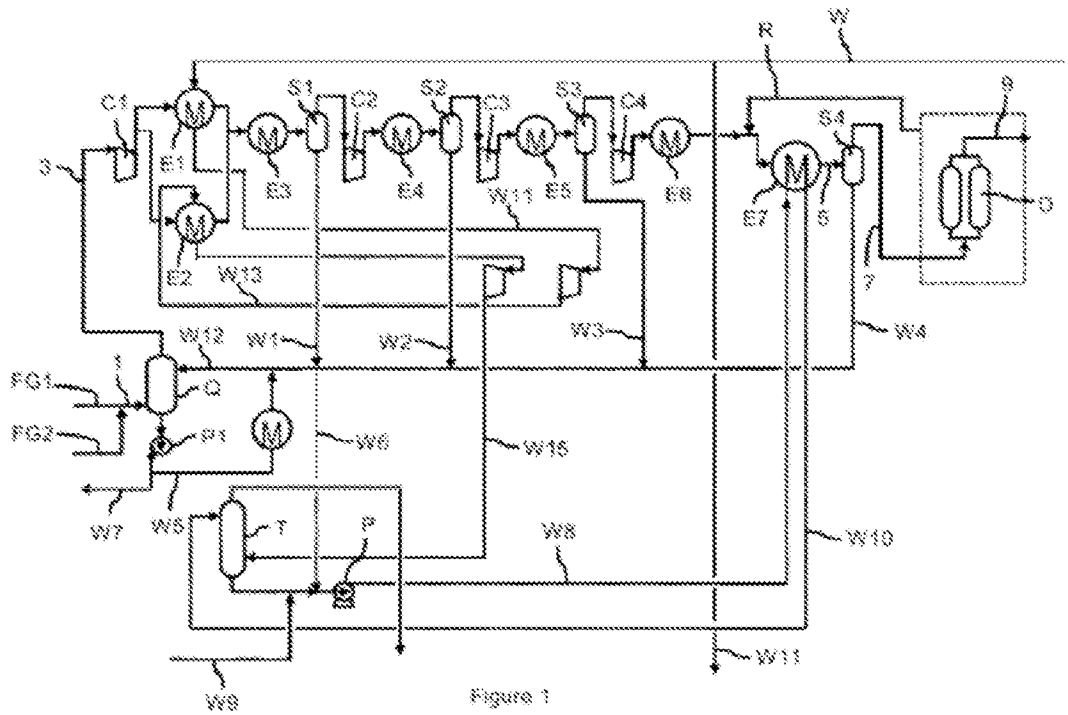
W
R
9
C1
S1
C2
S2
C3
S3
C4
S4
E1
E3
E4
E5
E6
E7
5
D
3
E2
W13
W11
7
W12
W1
W2
W3
W4
FG1
1
Q
FG2
P1
W6
W15
W7
W5
T
P
W8
W10
W9
W11

Figure 1