

Description

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The present invention relates to a process for removing CO_2 and/or H_2S from gases by means of an aqueous alkanolamine-containing absorption liquid.

5 It has been disclosed, for example by A. Kohl and F. Riesenfeld in Gas Purification, 3rd edition, 1979, in particular on pages 28, 33 and 34, that aqueous solutions of primary amines, such as monoethanolamine, can be used for removing CO_2 and/or H_2S from gases. However, a
10 disadvantage of using aqueous solutions of monoethanolamine is that they have a very corrosive action, particularly at fairly high concentrations. In order to avoid corrosion damage in the gas washers, or to reduce it to an acceptable level, expensive systems of corrosion inhibitors
15 therefore have to be employed in such washers; however, in the case of H_2S -containing gases, these corrosion inhibitors cannot be used at all. The conventional processes for removing CO_2 and/or H_2S with the use of primary alkanolamines, such as monoethanolamine, are
20 therefore unsatisfactory.

There is therefore a need for a process for removing CO_2 and/or H_2S from gases by which the disadvantages of the conventional processes can be avoided.

We have now found an advantageous process for removing
25 CO_2 and/or H_2S from a gas containing CO_2 and/or H_2S by washing the gas with an aqueous alkanolamine-containing absorption liquid and subsequently regenerating the latter, wherein the aqueous absorption liquid used contains from 3 to 60% by weight of methyldiethanolamine and from 1 to 50% by weight of
30 monoethanolamine. No claim is made to processes using two series-connected absorption stages in which the regeneration of the laden absorption liquid is carried out using two decompression stages and a stripping zone and which use an absorption liquid containing from 0.05 to 1 mol/l of monoethanolamine. The processes which are not claimed are known from EP-A-0159495 (priority:
35 10.03.84; filing date: 01.03.85; publication date: 30.10.85).

In the novel process, the energy consumption and the capital costs can be substantially reduced compared with the conventional processes. Corrosion damage can be substantially avoided without there being any necessity
5 to add corrosion inhibitors.

Examples of gases which can be treated using the novel process are coal gasification gases, coke oven gases, natural gases, synthesis gases and refinery gases.

The gases generally contain from 1 to 90, preferably from 2 to 90, in particular from 5 to 60, mol % of
10 CO₂. The gases can contain H₂S alone or as a further acidic gas in addition to the CO₂, for example in amounts of a few mol ppm, for example from 1 mol ppm to 50 mol %, preferably from 10 mol ppm to 40 mol %.

15 The solvent used for the novel process is an aqueous absorption liquid which contains from 3 to 60, as a rule from 5 to 60, in general from 10 to 60, advantageously from 20 to 50, preferably from 25 to 45, in particular from 25 to 35, % by weight of methyldiethanolamine
20 and from 1 to 50, advantageously from 5 to 40, preferably from 10 to 30, in particular from 15 to 20, % by weight of monoethanolamine.

The aqueous absorption liquid containing methyldiethanolamine and monoethanolamine can additionally contain a physical
25 solvent. Examples of suitable physical solvents are N-methylpyrrolidone, tetramethylene sulfone, methanol and oligoethylene glycol dialkyl ethers, such as oligoethylene glycol methyl isopropyl ether (SEPASOLV MPE[®]) or oligoethylene glycol dimethyl ether (SELEXOL[®]). The physical solvent is present in the absorption
30 liquid in general in an amount of from 1 to 60, pre-

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ferably from 10 to 50, in particular from 20 to 40, % by weight.

For removal of CO_2 and/or H_2S , from the gas being purified, by treatment with the absorption liquid used according to the invention, the absorption zone is generally operated at from 30 to 90°C, preferably from 35 to 80°C, in particular from 40 to 60°C, and advantageously under from 5 to 110, preferably from 10 to 100, in particular from 20 to 90, bar. The absorption can be carried out in one absorption stage or in two absorption stages in series. It is generally effected in a single stage. The absorption is advantageously carried out using an absorption column, in general a packed column or a column equipped with trays. The treated gas is advantageously removed at the top of the absorption zone. The absorption liquid, which is generally taken off at the bottom of the absorption zone and is laden with the acidic gases CO_2 and/or H_2S , is advantageously fed to a stripping zone to be regenerated. The acidic gases expelled in the stripping zone are advantageously removed at the top of this zone. The regenerated absorption liquid obtained at the bottom of the stripping zone is advantageously recycled to the absorption zone. Advantageously, the stripping zone used is a stripping column, in general a packed column or a column equipped with trays. The stripping zone is generally operated at from 100 to 130°C, preferably from 105 to 125°C, in particular from 110 to 120°C, depending on the boiling point of the absorption liquid under the operating pressure of the stripping column.

The Example which follows illustrates the invention in more detail, the course of the process being shown diagrammatically in the Figure.

A gas containing CO_2 and/or H_2S , for example a synthesis gas containing CO_2 as the acidic gas, is fed into the bottom of the absorption column 2 via line 1, under superatmospheric pressure. At the same time, an

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aqueous solution containing, for example, from 12 to 22% by weight of monoethanolamine and from 20 to 40% by weight of methyldiethanolamine is fed, as the absorption liquid, via line 3 into the top of the absorption column. The gas being treated and the absorption liquid are fed counter-current to one another. The product gas is taken off at the top of the absorption column, via line 5. The aqueous absorption liquid laden with the acidic gases and obtained at the bottom of the absorption column is subsequently heated in a heat exchanger 11 and then, in order to regenerate it, is introduced at the top of the stripping column 6, in which the acidic gases absorbed in absorption column 2 are expelled from the laden absorption liquid by means of heat and steam. The heat energy required for this purpose is supplied by a reboiler 7, and the acidic gases CO_2 and/or H_2S ascend in the stripping column, together with steam. The said acidic gases together with the steam and small amounts of solvent vapors leave the stripping column via line 8. The gas stream 8 is cooled in a condenser 9, and water and the solvent present in a small amounts in the steam condense and are collected in a vessel 10. The acidic gases CO_2 and/or H_2S are discharged from the plant via a line 12. The water recovered in vessel 10, and containing traces of the alkanolamines employed in the solvent, is recycled to the stripping column via a line 13. By means of a solvent circulation pump 14, the regenerated absorption liquid is recycled from the bottom of the stripping column 6 to the absorption column 2, through the heat exchanger 11 and the condenser 15 and via line 3.

The Examples which follow illustrate the invention.

EXAMPLE 1

In an absorption column, 0.22 kmol/h of a gas consisting of 10 mol % of CO_2 and 90 mol % of nitrogen was washed with 15 kg/h of an aqueous absorption liquid which contained 15% by weight of monoethanolamine and 35% by weight of methyldiethanolamine, the absorption column being maintained under a pressure of 30 bar. The absorp-

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tion liquid was fed in at a temperature of 50°C. The CO₂ content of the treated gas leaving the absorption column was 68 ppm by volume. The absorption liquid laden with CO₂ was taken off at the bottom of the absorption column, let down and then introduced at the top of a stripping column, in which the laden absorption liquid was regenerated by stripping with steam. The gas stream taken off at the top of the stripping column contained 99% by volume of CO₂ and 1% by volume of N₂. The regenerated absorption liquid was recycled to the top of the absorption column.

EXAMPLE 2

A gas wash was carried out as described in Example 1, except that the aqueous absorption liquid used contained 20% by weight of monoethanolamine and 30% by weight of methyldiethanolamine. In this procedure, the treated gas obtained had a CO₂ content of 13 ppm by volume.

EXAMPLE 3

A gas wash was carried out as described in Example 1, except that the aqueous absorption liquid used contained 20% by weight of monoethanolamine and 20% by weight of methyldiethanolamine. In this procedure, the treated gas obtained had a CO₂ content of 23 ppm by volume.

COMPARATIVE EXAMPLE 1

A comparative experiment was carried out as described in Examples 1 to 3, except that the absorption liquid used was an aqueous solution containing 20% by weight of monoethanolamine. In this procedure, the treated gas obtained had a CO₂ content of 2.3% by volume, ie. higher than the CO₂ content of the treated gas obtained in Example 3 by a factor of 1,000.

COMPARATIVE EXAMPLE 2

In another comparative experiment, a gas wash was carried out as described in the above Examples, an aqueous absorption liquid containing 15% by weight of monoethanolamine and 35% by weight of methyldiethanolamine being used, and the amount of absorption liquid being reduced until

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the CO₂ content of the treated gas at the top of the absorption column was 2.3% by volume. The amount of solvent which had to be circulated to achieve this result was 11.6 kg/h. Compared with Comparative Example 1, it was possible to reduce the amount of absorption liquid circulated, and hence the amount of energy required for the regeneration, by about 22%.