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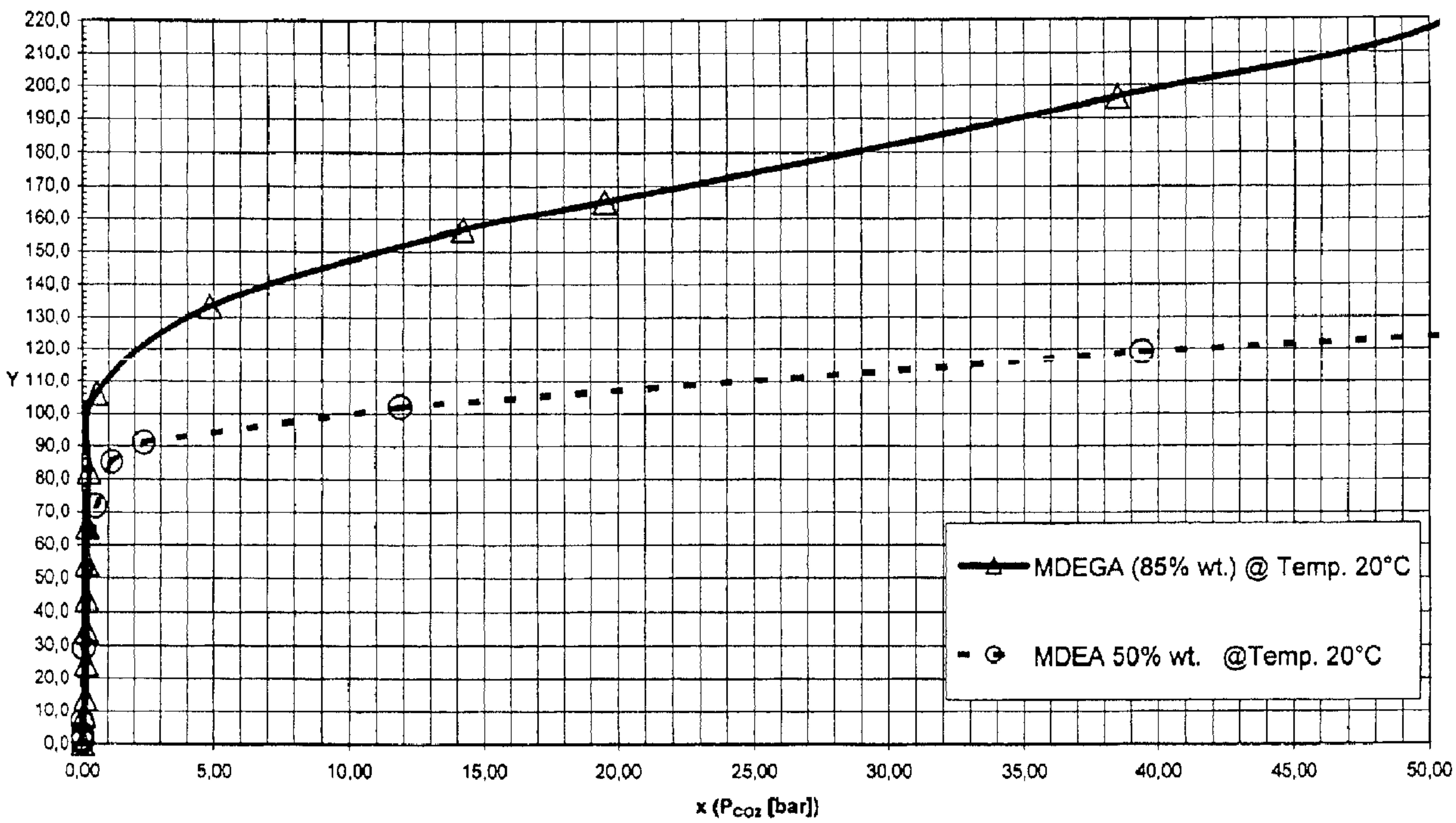
(54) Titre : SOLVANTS DESTINES A LA SEPARATION DE CONSTITUANTS GAZEUX ACIDES A PARTIR DE GAZ INDUSTRIELS
(54) Title: SOLVENT REQUIRED TO SEPARATE SOUR GAS COMPONENTS FROM TECHNICAL GASES



(57) Abrégé/Abstract:
Application of a liquid containing the following substances: 0.1 to 100% of an amine or several amines in accordance with the formula $H_2N\text{-}CH_2(CHR_2)_x\text{-}(OCH_2(CHR_3)_y)_z\text{-}OR_1$, with the following variables: R_1 = C_1 to C_6 alkyl, R_2 = H or CH_3, R_3 = H or CH_3, x = 0 to 3, y = 0 to 3, z = 0 to 10, 0 to 99.9% of any other solvent, including piperazine and/or water, the said liquid being required for the separation of sour gas components from technical gases.

Abstract:

Application of a liquid containing the following substances: 0.1 to 100% of an amine or several amines in accordance with the formula $H_2N\text{-}CH_2(CHR_2)_x\text{-}(OCH_2(CHR_3)_y)_z\text{-}OR_1$, with the following variables: $R_1 = C_1$ to C_6 alkyl, R_2 = H or CH_3, R_3 = H or CH_3, x = 0 to 3, y = 0 to 3, z = 0 to 10, 0 to 99.9% of any other solvent, including piperazine and/or water, the said liquid being required for the separation of sour gas components from technical gases.

Solvent required to separate sour gas components from technical gases

[0001] The invention relates to a solvent required to separate sour gas components from technical gases and suited for a scrubbing process which is performed to remove sour gas components from a technical gas bearing impurities, with the aid of a liquid, the said liquid being subsequently regenerated and recycled in a closed loop.

[0002] A large number of separation methods are known in order to remove sour gas components from technical gases with the aid of solvents. A clear distinction is drawn between physically acting solvents and chemically acting solvents. Chemically acting scrubbing agents are capable of efficiently removing sour gas components at high loads, even at low to medium sour gas partial pressures (e.g. 0.1 to 2 bar). Higher sour gas partial pressures (e.g. >2 bars) permit the use of physically acting solvents at a higher sour gas content of the solvent, such that the physically acting solvent has a real benefit under these conditions.

[0003] The state-of-the-art removal of sour gas components from technical gases with the aid of chemically acting solvents is constituted, for example, by the MDEA scrubbing process which uses, for example, a solvent with a 50% by wt. solution of methyldiethanol amine and water for sour gas removal. This amine concentration is in line with the present state of technology, the concentration best suited for the removal of large sour gas quantities. The physically acting solvents known for this application are, e.g. Selexol, Morphysorb, Rectisol, etc.

[0004] The objective of the invention is to provide an improved solvent that combines the advantages of the chemically and physically acting absorbents and that permits particularly high loads.

[0005] The objective of the invention is achieved by a method for removing sour gas components from technical gases, the method comprising:

bringing a technical gas loaded with sour gas components into contact with a liquid, wherein the liquid comprises:

- 85% by wt. of an amine or several amines of the following formula:
  $H_2N\text{-}CH_2(CHR_2)_x\text{-}(OCH_2(CHR_3)_y)_z\text{-}OR_1$;

  wherein:

- R_1 is CH_3;
- R_2 is H;
- R_3 is H;
- x is 1;
- y is 1;
- z is 1; and
- 15% by wt. of bismethyl diethylene glycol amine.

Provided the said liquid is circulated in a closed loop, it may also contain solved residual components of the removed sour gas components as well as impurities.

[0006] The technical gas loaded with sour gas components comes into contact with the said liquid, standard processes and devices being used for this purpose, such as scrubbing columns, membrane type contactors, spray-type scrubbers, etc. It is common practice to regenerate the loaded liquid in one or several steps, the steps primarily utilised serving for pressure reduction, temperature rise and stripping of the solution with the aid of a stripping agent in a column. The inventive liquid is well suited for this purpose and for the circulation in a closed loop operated in a continuous cycle. Upon removal of the sour gas components, the technical gas is regarded as purified and thus becomes available for further applications.

[0007] According to an embodiment of the invention, CH_3 (C_1 alkyl, methyl) is selected as R_1. In a further embodiment of the invention, x equals 1 and R_2 equals H. In accordance with a further embodiment, x equals 2 and R_2 equals H. In a further embodiment of the invention, y equals 1 and R_3 equals H. In accordance with a further embodiment, z is a value of 1 to 4, the value 1 being preferably selected.

[0008] In a further embodiment of the invention, in which CH_3 (C_1 alkyl, methyl) is selected as R_1, x = 1 or 2, and R_2 = H, 0 is selected as z. Further embodiments provide for the following variables: CH_3 (C_1 alkyl, methyl) selected as R_1, x equals 1 and R_2 = CH_3. In further embodiments of the invention, the latter values are selected as follows: z = 0 or y = 1, R_3 = CH_3 and z = 1.

[0009] In accordance with a further embodiment, the component piperazine, also known under the name of diethylenediamine, is added to the said liquid, using a quantity of up to 10% by wt. Hence, the preferred liquid thus obtained complies with the formula $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$, which may be diluted with water or another solvent and contain up to 10% by wt. piperazine.

[0010] The benefits of the invention are outlined on the basis of a test of comparison and a load comparison shown in Fig. 1. It reflects the solubility Y of CO_2 versus the CO_2 partial pressure x in the technical gas. The unit of measure for Y is Ndm^3/kg, CO_2 partial pressure x being indicated in terms of bar. The solution of $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ is designated as MDEGA in Fig. 1.

[0011] The solution investigated consisted of 85% by wt. of the $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ (MDEGA) compound and 15% by wt. of the secondary amine bismethyl diethylene glycol amine (MEEDA) and was tested for its solubility potential for sour gas components. In fact, the test series surprisingly revealed that a solution with as high a portion as 85% by wt. $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ and 15% by wt. bismethyl diethylene glycol amine possesses a CO_2 absorption capacity that exceeds by factor 4 that of a solution mainly consisting of bismethyl diethylene glycol amine, a fact that clearly confirms the importance of as high a portion of $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ as possible to achieve as high a sour gas absorption capacity as possible.

[0012] Fig. 1 shows the comparison of an 85% by wt. solution of $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ with a 50% by wt. MDEA solution, the latter being considered as the state-of-the-art solvent best suited for CO_2 removal. The test carried out at a CO_2 partial pressure of 0.2 to 2 bar furnished proof of a 30 to 50% higher CO_2 absorption, at 5 to 10 bar a 50% higher CO_2 absorption and at 20 bar CO_2 partial pressure, the CO_2 absorption was even higher, i.e. 75% for the 85% by wt. solution of $H_2N\text{-}(CH_2)_2\text{-}O(CH_2)_2\text{-}OCH_3$ compared to the 50% by wt. MDEA solution.

[0013] The inventive solvent also absorbs other sour gas components, such as H_2S, HCN, COS and mercaptans, which constitutes a further benefit of the present invention.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

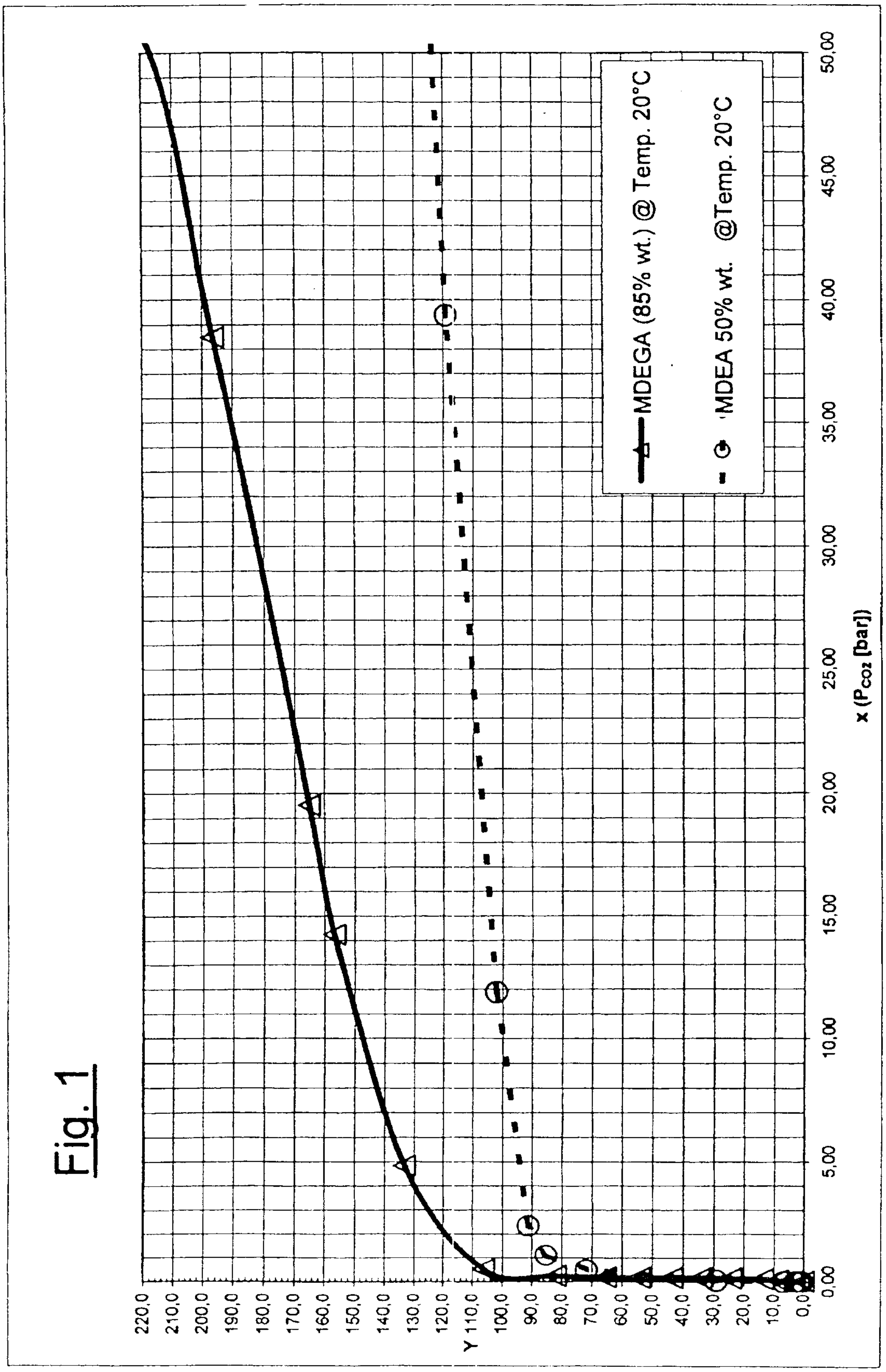
1. A method for removing sour gas components from technical gases, the method comprising:

bringing a technical gas loaded with sour gas components into contact with a liquid, wherein the liquid comprises:

- 85% by wt. of an amine or several amines of the following formula: $H_2N\text{-}CH_2(CHR_2)_x\text{-}(OCH_2(CHR_3)_y)_z\text{-}OR_1$;
  wherein:
  - R_1 is CH_3;
  - R_2 is H;
  - R_3 is H;
  - x is 1;
  - y is 1;
  - z is 1; and
  - 15% by wt. of bismethyl diethylene glycol amine.

2. A liquid comprising:

- 85% by wt. of an amine or several amines of the formula: $H_2N\text{-}CH_2(CHR_2)_x\text{-}(OCH_2(CHR_3)_y)_z\text{-}OR_1$;
  wherein:
  - R_1 is CH_3;
  - R_2 is H;
  - R_3 is H;
  - x is 1;
  - y is 1;
  - z is 1; and
  - 15% by wt. of bismethyl diethylene glycol amine.


MDEGA (85% wt.) @ Temp. 20°C
MDEA 50% wt. @Temp. 20°C
x (P_{CO2} [bar])
Y
0,00
5,00
10,00
15,00
20,00
25,00
30,00
35,00
40,00
45,00
50,00
0,0
10,0
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110,0
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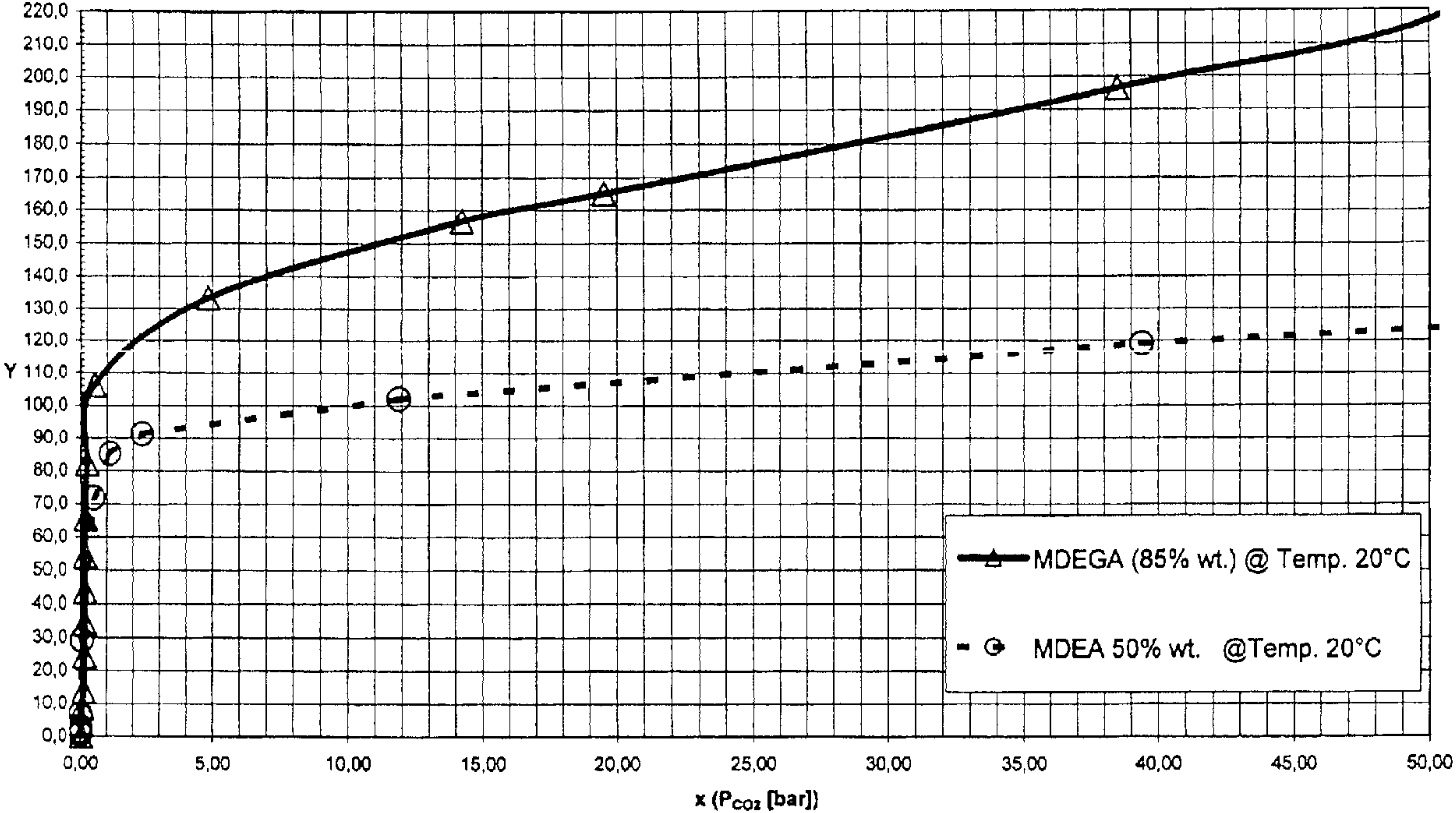
190,0
200,0
210,0
220,0

Fig. 1



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50,0
40,0
30,0
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10,0
0,0
0,00
5,00
10,00
15,00
20,00
25,00
30,00
35,00
40,00
45,00
50,00
x (P$_{CO2}$ [bar])
MDEGA (85% wt.) @ Temp. 20°C
MDEA 50% wt. @Temp. 20°C