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**Datasheet for the decision
of 19 April 2023**

Case Number: T 0268/21 - 3.3.05

Application Number: 16151560.6

Publication Number: 3059002

IPC: B01D53/40

Language of the proceedings: EN

Title of invention:

METHOD AND SYSTEM FOR ACID GAS SEPARATION USING A SELF-
CONCENTRATING ABSORBENT WHICH FORMS A CONCENTRATED-AGENT PHASE
AND A REMAINDER

Applicant:

Hu, Liang

Headword:

Acid gas separation/Hu

Relevant legal provisions:

EPC Art. 84

Keyword:

Clarity - result to be achieved (no)

Decisions cited:

Catchword:



Beschwerdekammern

Boards of Appeal

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Case Number: T 0268/21 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 19 April 2023

Appellant:
(Applicant)

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Representative:

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Decision under appeal:

**Decision of the Examining Division of the
European Patent Office posted on 2 November 2020
refusing European patent application No.
16151560.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chair

G. Glod

Members:

S. Besselmann

R. Winkelhofer

Summary of Facts and Submissions

- I. The applicant's (appellant's) appeal is against the examining division's decision to refuse European patent application No. 16 151 560.6 for lack of clarity and lack of sufficiency of disclosure. The application concerns a method and a system for acid gas separation using a self-concentrating absorbent which forms a concentrated-agent phase and a remainder.
- II. With the statement of grounds of appeal, the appellant maintained the main request and auxiliary requests 1-3 that formed the basis of the decision under appeal, and also filed auxiliary request 4.
- III. Claim 1 of the main request reads as follows:

"A method for deacidizing a gaseous mixture comprising an acid gas, comprising:

contacting the gaseous mixture with an absorbent in an absorption unit, wherein the absorbent comprises an agent dissolved in a solvent at a first concentration; wherein the agent:

(a) is an amine; or

(b) is selected from the group consisting of amino-acid salts, amides, alkaline salts, alkaline-earth salts, ammonium salts, ureas, alkaline metal phosphates, carbonates, borates, acid phosphites, phosphites, phosphonite, phosphinate, phosphonate, acid phosphates, pyrophosphites, bicarbonates, metaborates, diborates, tetraborates, pentaborates, and combinations thereof;

allowing the absorbent to absorb the acid gas to form a concentrated-agent phase, wherein the

concentrated-agent phase is mechanically separable from the remainder of the absorbent and comprises a concentrated agent at a concentration higher than the first concentration and an absorbed acid gas, wherein the concentrated agent comprises the agent and the agent having a chemical modification, and the absorbed acid gas comprises the acid gas and the acid gas having a chemical modification;

separating the concentrated-agent phase from the remainder of the absorbent;

cycling the remainder of the absorbent back into the absorption unit;

providing the concentrated-agent phase to a regeneration unit, so as to obtain the acid gas and the concentrated agent; and

cycling the regenerated concentrated agent back into the absorption unit."

Claim 1 of auxiliary request 1 differs from the main request in that the phrase

"wherein the agent having a chemical modification is a reaction product resulting from a chemical reaction between the amine and the acid gas, and the acid gas having a chemical modification is the reaction product resulting from a chemical reaction between the amine and the acid gas"

has been inserted before *"separating the concentrated-agent phase..."*.

Claim 1 of auxiliary request 2 differs from auxiliary request 1 in that the group of agents under (b) has been restricted as follows:

" (b) is selected from the group consisting of amino-acid salts, amides, and combinations thereof;".

Claim 1 of auxiliary request 3 differs from auxiliary request 2 in that the acid gas has been further defined. The first part of the claim now reads as follows (with the insertion underlined by the board):
"A method for deacidizing a gaseous mixture comprising an acid gas selected from the group consisting of carbon dioxide (CO₂), sulfur dioxide (SO₂), sulfur trioxide (SO₃), hydrogen sulfide (H₂S), carbon oxysulfide (COS), carbon disulfide (CS₂), mercaptans (RSH), nitric oxide (NO), nitric dioxide (NO₂), fluorides, HCl, HF and a combination thereof, comprising:...".

Claim 1 of auxiliary request 4 differs from auxiliary request 3 in that the acid gas has been defined to be carbon dioxide. The first part of the claim now reads as follows (with the insertion underlined by the board):
"A method for deacidizing a gaseous mixture comprising an acid gas, wherein the acid gas is carbon dioxide, the method comprising:...".

IV. Oral proceedings were held on 19 April 2023.

V. The appellant's arguments, where relevant to the present decision, can be summarised as follows:

The skilled person would have no difficulty understanding the term "acid gas". Processes for removing an acid gas were widely known. The use and selection of solvents were also within the scope of the skilled person's routine activities. Suitable agents were specifically listed in the claim. The available examples provided guidance as to the selection of the right conditions, including temperature, pH and concentration. The breadth of the claims was justified.

There was no undue burden on the skilled person (i) to identify which solvents dissolve a particular agent and (ii) to determine whether that absorbent was able to absorb a given acid gas to form an agent-concentrated phase which is mechanically separable from the remainder of the absorbent. This involved simple visual or analytical methods and was nothing more than routine trial and error. The impugned decision was based on mere assumptions. It was irrelevant whether hypothetical unsuitable embodiments could be conceived, because the skilled person would not consider them.

- VI. The appellant requested that the decision under appeal be set aside and amended such that a patent can be granted on the basis of the main request, or alternatively, on the basis of one of auxiliary requests 1 to 4.

Reasons for the Decision

Main request

1. Article 84 EPC (Clarity)
 - 1.1 The examining division found that it amounted to a significant research programme for the skilled person to find the right combination of compounds (acid gas, solvent, agents) and conditions (temperature, pH, concentration) that ensured that the "spontaneous concentration" occurred (see paragraphs [0023], [0038] and [0039] of the description as filed) and that the claimed "concentrated-agent phase" formed. The examining division argued in essence that the claimed

result could not be obtained across the entire scope claimed, and therefore the requirements of Article 84 EPC were not met.

- 1.2 The claimed method involves "*allowing the absorbent to absorb the acid gas to form a concentrated-agent phase, wherein the concentrated-agent phase is mechanically separable from the remainder of the absorbent*". This amounts to specifying the desired result to be achieved.
- 1.3 Functional features defining a technical result are permissible in a claim if, *inter alia*, these features provide instructions which are sufficiently clear for the skilled person to reduce them to practice without undue burden, if necessary with reasonable experiments (see Case Law of the Boards of Appeal of the EPO, 10th edition, 2022, II.A.3.4).
- 1.4 This requirement is not met in the case at issue.
 - 1.4.1 There is no indication that the desired result would inevitably be achieved, in the sense that all of the absorbents in the claim (meaning any absorbent obtained by dissolving any arbitrary one of the agents in the claim in any concentration in any solvent, possibly in the presence of additional components (claims 4 and 7)), when contacted with any acid gas, would inevitably produce the desired result, and this irrespective of the process conditions used (concentration, pH, temperature, pressure) - nor was this argued. By contrast, the typical prior art gas/liquid absorption process also involves using an amine dissolved in a solvent (an aqueous amine solution, see paragraph [0005] of the application as published), but is described to be limited to one liquid phase (see

paragraph [0006], last sentence, of the application as published).

1.4.2 The appellant recognised that trial and error would be needed to identify which solvents dissolve a particular agent, and to determine whether the absorbent is able to absorb a given acid gas to form an agent-concentrated phase which is mechanically separable from the remainder of the absorbent. However, they viewed this as a routine measure (see point V.).

1.4.3 The board does not agree that only reasonable routine experiments would be needed. The desired result is the core of the claimed invention, because it is this "self-concentrating" effect resulting in a mechanically separable concentrated-agent phase which is not obtained in common processes, even though similar absorbents are used (see point 1.4.1), and which provides for the desired energy costs saving (see paragraphs [0003] and [0007] of the application as published). There is no basis to assume common general knowledge as to which combinations of agent, solvent, additional components (claims 4 and 7), acid gas and process conditions provide for the desired result, nor is any evidence of such common general knowledge available.

Even within the group of common acid gases (claim 8), common solvents and the (groups of) agents listed in the claim, a large number of choices remains necessary, and there is no teaching as to how to identify a suitable combination of these in a targeted manner.

While the application provides two examples, it is not apparent that a mere extrapolation of these would lead to all other combinations of agents, solvents,

additional components, acid gases and process conditions encompassed by the claim. The application itself does not explain on what basis such an extrapolation should be possible. Furthermore, Examples 1 and 2, which are both conducted with the same acid gas (CO₂), are principally different in that Example 1 yields a concentrated liquid phase, whereas a solid phase forms in Example 2, and there is no indication that the same agents and solvents were suitable in either case.

1.4.4 This objection does not merely concern isolated hypothetical embodiments, but also the more fundamental question of obtaining the desired result. The skilled person does not know which features are implied by the functional definition.

1.5 The impugned decision was thus correct. The requirements of Article 84 EPC have not been met.

Auxiliary request 1

2. In claim 1 of auxiliary request 1, it is further specified that the agent having a chemical modification is a reaction product resulting from a chemical reaction between the amine and the acid gas, and the acid gas having a chemical modification is the reaction product resulting from a chemical reaction between the amine and the acid gas.

These amendments do not change the considerations set out above with respect to the main request.

3. Clarity is additionally lacking, because the agent having the chemical modification is now a reaction

product of an *amine*. This is not consistent with alternative (b) of the claim, which is not limited to an amine. The same issue arises in view of the reaction product of the acid gas.

4. Auxiliary request 1 is therefore not allowable either.

Auxiliary request 2

5. Compared with claim 1 of auxiliary request 1, alternative (b) in claim 1 was restricted to the group consisting of amino-acid salts, amides and combinations thereof.

This amendment does not change the considerations set out above with respect to the main request. The objection did not only concern the breadth of the definition of the "agent" as such, but also its implications when identifying an absorbent providing the claimed result, the choice of the agent being only one of several choices that need to be made.

Clarity is additionally lacking for the same reasons as those set out with respect to auxiliary request 1 (see point 3. above).

6. Auxiliary request 2 is therefore not allowable either.

Auxiliary request 3

7. Compared with claim 1 of auxiliary request 2, claim 1 additionally specifies a list of acid gases.

This amendment does not overcome the objections raised in view of auxiliary request 2. The list of acid gases was already taken into consideration in the discussion of the main request (see point 1.4.3 above).

8. Auxiliary request 3 is therefore not allowable either.

Auxiliary request 4

9. Compared with claim 1 of auxiliary request 3, the acid gas according to these claims is now carbon dioxide.

This does not overcome the objections raised against auxiliary request 3.

Even alternative (a), according to which the agent is an amine, encompasses a large number of possible compounds. As indicated, these compounds are described in the application as those most commonly used, including for CO₂ separation (see paragraph [0005]), but in these common processes, the self-concentrating effect is not obtained (see paragraph [0006]).

The consideration that the skilled person could not, without undue burden, identify those combinations of solvent, agent, possible additional components and process conditions such that the desired result is obtained continues to apply.

10. Auxiliary request 4 is therefore not allowable either.
11. Consequently, there is no need to address any further procedural or substantive questions.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



C. Vodz

G. Glod

Decision electronically authenticated