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D E C I S I O N
of 8 November 2005

Case Number: T 0843/04 - 3.3.04

Application Number: 97115946.2

Publication Number: 0829534

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Language of the proceedings: EN

Title of invention:
Gas driven fermentation system

Patentee:
PRAXAIR TECHNOLOGY, INC.

Opponents:
Linde Aktiengesellschaft
Koninklijke DSM N.V.

Headword:
Gas driven fermentation/PRAXAIR

Relevant legal provisions:
EPC Art. 54, 56, 83, 123(2),(3)

Keyword:
"Main request - clarity of product claims (no)"
"Auxiliary request - clarity (yes)"
"Added matter (no); sufficiency of disclosure, novelty, inventive step (yes)"

Decisions cited:
G 0009/91, T 0301/87, T 0227/88, T 0472/88, T 0182/89, T 0019/90, T 0418/91, T 0922/94, T 0998/97, T 0356/01, T 0500/01, T 0061/03

Catchword:
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Case Number: T 0843/04 - 3.3.04

D E C I S I O N
of the Technical Board of Appeal 3.3.04
of 8 November 2005

Appellant: (Opponent 02)	Koninklijke DSM N.V. P.O. Box 9 NL-6160 MA Geleen (NL)
Representative:	Matulewicz, Emil Rudolf Antonius DSM Intellectual Property Office Delft PP 600-0240 P.O. Box 1 NL-2600 MA Delft (NL)
Other party: (Opponent 01)	Linde Aktiengesellschaft, Wiesbaden Zentrale Patentabteilung D-82049 Höllriegelskreuth (DE)
Representative:	-
Respondent: (Proprietor of the patent)	PRAXAIR TECHNOLOGY, INC. 39 Old Ridgebury Road Danbury CT 06810-5113 (US)
Representative:	Schwan, Gerhard Schwan Schwan Schorer Patentanwälte Bauerstrasse 22 D-80796 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 30 April 2004 concerning maintenance of European patent No. 0829534 in amended form.**

Composition of the Board:

Chairman: M. Wieser
Members: B. Claes
R. Moufang

Summary of Facts and Submissions

I. The appeal was lodged by opponent 02 (appellant) against the interlocutory decision of the opposition division whereby European Patent No. 0 829 534 in amended form was considered to fulfil the requirements of the EPC (Article 102(3) EPC).

II. Claims 1, 7, 9 and 11 as granted read:

"1. A method for carrying out fermentation comprising:

(A) injecting a first oxygen-containing gas into a vessel at a point below the midpoint of the vessel, said vessel containing a broth comprising a constituent capable of undergoing fermentation;

(B) passing said first oxygen-containing gas in a set of first bubbles upwardly through said vessel in a heterogeneous flow causing an upward flow of said broth, said heterogeneous flow having a nonuniform distribution of gas bubbles;

(C) injecting a second oxygen-containing gas having an oxygen concentration exceeding that of the first oxygen-containing gas into the vessel at a point below the midpoint of the vessel and proximate the point where the first oxygen-containing gas is injected into the vessel and passing said second oxygen-containing gas in a set of second bubbles upwardly through said vessel in a homogeneous flow having a uniform gas bubble distribution; and

(D) utilizing oxygen from both the first oxygen-containing gas and the second oxygen-containing gas to carry out fermentation of said constituent."

"7. Apparatus for carrying out fermentation comprising:

(A) a fermenter vessel (20);

(B) a first injector (22; 30) communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel for injecting a first oxygen-containing gas into the fermenter vessel for passage through said fermenter vessel in a heterogeneous flow, said heterogeneous flow having a nonuniform distribution of gas bubbles;

(C) a second injector (25; 31) communicating with the interior of the fermenter vessel for injecting a second oxygen-containing gas having an oxygen concentration exceeding that of the first oxygen-containing gas into the fermenter vessel for vertical passage longitudinally through said fermenter vessel in a homogeneous flow having a uniform gas bubble distribution;

(D) said second injector communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel and proximate where said first injector communicates with the interior of the fermenter vessel."

"9. The apparatus of claim 7 wherein the first injector (22) comprises a first sparger ring having a plurality of nozzles (23) and the second injector (25) comprises

a second sparger ring having a smaller diameter than the first sparger ring and being oriented concentric with the first sparger ring, the second sparger ring having a plurality of nozzles (26) which are smaller than the nozzles of the first sparger ring."

"11. The apparatus of claim 7 wherein the first injector (30) comprises a nozzle centrally located within the fermenter vessel and the second injector (31) comprises a sparger ring located within the fermenter vessel concentric with said centrally located nozzle."

III. The patent had been opposed by two parties in its entirety on the grounds that the claimed subject-matter was not patentable within the terms of Articles 54, 56 and 57 EPC (Article 100(a) EPC), Article 100(b) EPC and Article 100(c) EPC. The opposition division decided that the patent as amended on the basis of the second auxiliary request before them fulfilled the requirements of the EPC.

IV. Claims 1, 7 and 9 of this second auxiliary request before the opposition division read (amendments over the claims as granted are emphasised in bold font):

"1. A method for carrying out fermentation comprising:

(A) injecting a first oxygen-containing gas into a vessel at a point below the midpoint of the vessel, said vessel containing a broth comprising a constituent capable of undergoing fermentation;

(B) passing said first oxygen-containing gas in a set of first bubbles upwardly through said vessel in a heterogeneous flow causing an upward flow of said broth, said heterogeneous flow having a nonuniform distribution of gas bubbles;

(C) injecting a second oxygen-containing gas having an oxygen concentration exceeding that of the first oxygen-containing gas into the vessel at a point below the midpoint of the vessel and proximate the point where the first oxygen-containing gas is injected into the vessel **where the broth is rising** and passing said second oxygen-containing gas in a set of second bubbles upwardly through said vessel in a homogeneous flow having a uniform gas bubble distribution; and

(D) utilizing oxygen from both the first oxygen-containing gas and the second oxygen-containing gas to carry out fermentation of said constituent."

"7. Apparatus for carrying out fermentation comprising:

(A) a fermenter vessel (20);

(B) a first injector (22; 30) communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel for injecting a first oxygen-containing gas into the fermenter vessel for passage through said fermenter vessel in a heterogeneous flow, said heterogeneous flow having a nonuniform distribution of gas bubbles;

(C) a second injector (25; 31) communicating with the interior of the fermenter vessel for injecting a second oxygen-containing gas having an oxygen concentration exceeding that of the first oxygen-containing gas into the fermenter vessel **where the broth is rising** for vertical passage longitudinally through said fermenter vessel in a homogeneous flow having a uniform gas bubble distribution;

(D) said second injector communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel and proximate where said first injector communicates with the interior of the fermenter vessel**, wherein the first injector (22) comprises a first sparger ring having a plurality of nozzles (23) and the second injector (25) comprises a second sparger having a smaller diameter than the first sparger ring and being oriented concentric with the first sparger ring, the second sparger ring having a plurality of nozzles (26) which are smaller than the nozzles of the first sparger ring**."

Amended claim 7 was a combination of granted claims 7 and 9, additionally including the amendment "where the broth is rising" in feature (C).

"9. Apparatus for carrying out fermentation comprising:

(A) a fermenter vessel (20);

(B) a first injector (22; 30) communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel for injecting a first oxygen-containing gas into the fermenter vessel for passage

through said fermenter vessel in a heterogeneous flow, said heterogeneous flow having a nonuniform distribution of gas bubbles;

(C) a second injector (25; 31) communicating with the interior of the fermenter vessel for injecting a second oxygen-containing gas having an oxygen concentration exceeding that of the first oxygen-containing gas into the fermenter vessel **where the broth is rising** for vertical passage longitudinally through said fermenter vessel in a homogeneous flow having a uniform gas bubble distribution;

(D) said second injector communicating with the interior of the fermenter vessel at a point below the midpoint of the vessel and proximate where said first injector communicates with the interior of the fermenter vessel**; wherein the first injector (30) comprises a nozzle centrally located within the fermenter vessel and the second injector (31) comprises a sparger ring located within the fermenter vessel concentric with said centrally located nozzle.**

Amended claim 9 was a combination of granted claims 7 and 11, including the additional amendment "where the broth is rising" in feature (C).

Claims 2 to 6 were identical to the corresponding claims as granted.

V. The board expressed its preliminary opinion in a communication dated 8 September 2005. Oral proceedings were held on 8 November 2005 in the presence of the appellant (opponent 02) and the respondent (patentee).

The other party (opponent 01) remained silent during the appeal procedure and was not represented at the oral proceedings although having been duly summoned.

VI. The appellant requested that the decision under appeal be set aside and that the patent be revoked. The respondent requested that the appeal be dismissed or, in the alternative, that the decision under appeal be set aside and the patent be maintained on the basis of a first auxiliary request, filed during the oral proceedings, i.e. consisting of six claims being identical to claims 1 to 6 of the second auxiliary request before the opposition division.

VII. The following documents are mentioned in this decision:

(1): Translation into English of Japanese patent application JP-A-63-283570;

(4): EP-A-0 222 529;

(5): EP-A-0 477 818; and

- Declaration by Dr van 't Riet

VIII. The appellant's arguments relevant for the present decision may be summarised as follows:

Main request

Clarity of the amendment "where the broth is rising" in claims 7 and 9

Claims 7 and 9 were product claims which defined a certain injector arrangement suitable for producing a homogeneous and a heterogeneous flow in an apparatus comprising a fermenter vessel, when carrying out a fermentation. Contrary to the wording of method claim 1, which qualified the heterogeneous flow referred to in method feature (B) as "causing an upward flow of said broth", feature (B) in claims 7 and 9 defining the first injector, was devoid of this qualification. The feature "where the broth is rising" as introduced by amendment and which constituted an essential functional feature of the claimed apparatuses, was therefore unclear within the meaning of Article 84 EPC.

First auxiliary request

Sufficiency of disclosure and industrial application

In feature (C), claim 1 defines as an essential feature of the method that the point of injection of the second oxygen-containing gas into the vessel is "proximate" to the point where the first oxygen-containing gas is injected into the vessel. Since the opposed patent fails to sufficiently disclose how proximate the two injectors must be located in order to attain the intended effect of the invention resulting from the coexistence of a heterogeneous and homogeneous bubble flow, the subject-matter of claim 1 contravened Article 83 EPC.

The method of claim 1 for carrying out fermentation, furthermore, was not able to avoid coalescence of the first and second oxygen containing gas bubbles which,

however, was a prerequisite for the invention in order to improve the rate of fermentation. According to the van 't Riet declaration, either a homogeneous or a heterogeneous flow regime could be established in a vessel. It was however physically impossible that upon injection of two gasses according to claim 1, the required co-existing of homogeneous and heterogeneous flow regimes could be established. On the contrary, as soon as a heterogeneous flow of the liquid phase was established by injection of the first gas, injection of the second gas under conditions that would give a homogeneous flow in an isolated system, caused the bubbles to follow immediately the flow of the heterogeneous liquid phase and to become heterogeneous instantly so that the feature that the bubbles of the second gas should pass "upwardly through said vessel in a homogeneous flow having a uniform gas bubble distribution" (see claim 1, feature (C)) would not take place. In this respect the patent did not contain any experimental result that demonstrated the actual co-existence of the two flow regimes. Accordingly, the method as subject-matter of claim 1 was not sufficiently disclosed and consequently was devoid of industrial application.

Inventive step

Independently of any objective technical problem formulated, the argumentation under Article 83 EPC had shown that the process for carrying out fermentation as subject-matter of claim 1 was unable to solve such problem. Accordingly, the subject matter of claims 1 to 6 lacked an inventive step.

The respondent's arguments relevant for the present decision may be summarised as follows:

Main request

Clarity of the amendment "where the broth is rising" in claims 7 and 9 of the main request

The feature "where the broth is rising" as contained in claims 7 and 9 of the main request defined the injector arrangement of the claimed apparatuses in terms of where in the vessel second injector (B) had to be placed. It therefore constituted, in its context, a technical feature of the claimed apparatus which complied with the requirements of Article 84 EPC.

First auxiliary request

Sufficiency of disclosure and industrial application

The coexistence of both flow regimes, within the meaning of the definitions in paragraphs [0013] and [0014] of the patent in suit, in one fermentation vessel was well possible and the skilled person would easily implement such fermentation by avoiding to generate a heterogeneous flow within the entire cross section of the vessel, such as for instance with a sparger configuration as in figures 3 and 4 of the patent, and avoiding geometrical overlap of the two gas injection points.

Furthermore, paragraph [0031] of the patent in suit contained exact instructions for the skilled person in the form of design variants and corresponding numerical

ranges for implementing a "proximate" positioning of the first and the second injector.

Inventive step

Since the entire argumentation of the appellant was based on the wrong assumption that it was physically impossible to establish the two flow regimes referred to in claim 1 in one and the same vessel, the appellant's argumentation under inventive step had no basis.

Reasons for the decision

Main request

Clarity of the amendment "where the broth is rising" in claims 7 and 9

1. In accordance with G 9/91 (OJ EPO 1993, 408, point 19), amendments made to a patent during opposition proceedings are to be examined in accordance with Article 102(3) EPC as to their conformity with the requirements of the EPC. Whereas Article 102(3) EPC does not provide for objections to be based upon Article 84 EPC if they do not arise out of the amendments made to the patent during opposition proceedings, Article 102(3) EPC requires such amendments to be examined to ascertain whether the EPC, including Article 84 EPC, is contravened as a result (see e.g. T 301/87, OJ EPO 1990, 335, point 3.8). Furthermore, Article 102(3) EPC confers such jurisdiction upon the opposition division as well as

the boards of appeal (T 472/88 of 10 October 1990), so that both instances have the power to deal with grounds and issues arising from those amendments, irrespective of whether or not they were specifically raised by an opponent (e.g. T 227/88, OJ EPO 1990, 292 and T 922/94 of 30 October 1997).

2. The feature "where the broth is rising" present in feature (C) of claims 1, 7 and 9 of the main request was introduced by the respondent during opposition proceedings into the wording of method claims 1 and apparatus claim 7 as granted (which is identical to the second auxiliary request before the opposition division). Claims 7 and 9 of the main request before the board result from an additional combination of such amended claim 7 with the subject-matter of granted claims 9 and 11.

3. It is established case law of the boards of appeal that product claims, including claims for an apparatus, in addition to the structural features defining their subject-matter, may include functional indications defining the suitability of the structural features in relation to a defined process or purpose, thereby possibly restricting the subject-matter claimed. A claim containing such functional indications must however comply with the requirements of Article 84 EPC, i.e. that a claim shall define the matter for which protection is sought and shall *inter alia* be clear.

4. The subject-matter of claims 7 and 9 of the main request are apparatuses for carrying out fermentation which comprise (A) a fermentation vessel, the interior of which two injectors communicate with. Feature (B)

defines the first injector as being "for injecting a first oxygen-containing gas into the fermenter vessel for passage through said fermenter vessel in a heterogeneous flow ... having a nonuniform distribution of gas bubbles" and feature (C) similarly defines the second injector "for injecting a second oxygen-containing gas ... into the fermenter vessel ... for vertical passage longitudinally through said fermenter vessel in a homogeneous flow having a uniform gas bubble distribution". Feature (D) defines *inter alia* that the position of the two injectors relative to each other must be "proximate".

4.1 It needs to be established whether, in the context of claims 7 and 9 of the main request, the newly introduced feature "where the broth is rising" complements the definition of the claimed subject-matter in clear terms, thereby not shedding doubts as to the matter for which protection is sought.

4.2 In contrast to the wording of method claim 1, which qualifies the heterogeneous flow referred to in method feature (B) as "causing an upward flow of said broth", feature (B) in claims 7 and 9 of the main request (as well as claim 7 as granted), defines the first injector devoid of this qualification. Indeed, the subject-matter of apparatus claims 7 and 9, similarly to claim 7 as granted and apart from the newly introduced feature, is defined independently of the broth that would be contained in the apparatus, if and when the fermentation referred to by the feature "for carrying out fermentation" were to be carried out.

4.3 The feature "where the broth is rising" as newly introduced in these claims refers to the broth contained in the vessel when a fermentation were to be carried out, in particular to a position within the vessel where the broth is in a certain flow, being rising. Claims 7 and 9 do not define the kind of fermentation process as such for which the apparatus ought to be suitable. In the opinion of the board, in the context of the construction of claims 7 and 9 of the main request, the introduced feature "where the broth is rising" is unclear. It does not functionally define in an unambiguous way the suitability of a structural technical feature present in the vessel for a certain purpose or process (see point 3 above), since it refers to a position within the vessel which, in the context of the structural features indicated, relates to and depends on a particular but non-defined fermentation method implemented in the vessel which in turn depends on a particular but non-defined putting into action of the apparatus.

4.4 The board therefore considers claims 7 and 9 of the main request not to comply with the requirements of Article 84 EPC.

First auxiliary request

Clarity

5. Claim 1, itself being directed to a method for carrying out a fermentation, defines in feature (B) that the injection of the first oxygen-containing gas causes an upward flow, thereby establishing an area in the vessel "where the broth is rising" as referred to in feature

(C) of the same claim. Accordingly, and as can be taken from the discussion of the clarity of claims 7 and 9 of the main request (see especially point 4.2 above), the board is satisfied that the claims of the first auxiliary request meet the requirements of Article 84 EPC.

Article 123(2) and (3) EPC

6. The board is satisfied that the amendment "where the broth is rising" in claim 1 of the first auxiliary request finds a basis in the application as published in column 5, lines 15 to 20 and therefore meets the requirements of Article 123(2) EPC. Seeing that the introduced feature constitutes a limitation of the subject-matter now defined as compared to claim 1 as granted the board also considers the requirements of Article 123(3) to be fulfilled.

Sufficiency of disclosure and industrial application

7. The appellant has developed two lines of argumentation to support the allegation that the subject-matter of claim 1 is not sufficiently disclosed in the patent in suit.

8. The fundamental basis for the appellant's first line of argumentation is the contention that in any given vessel the establishment of a "heterogeneous flow" would render it physically impossible to simultaneously generate at another place in the vessel another kind of flow, albeit a "homogeneous flow". According to the appellant, any air generated heterogeneous flow initiated in a fermenter vessel resulted immediately in

a flow characterized by circulatory flows which are chaotic in time and cover the whole vessel, with liquid velocities of about 1 m/sec, i.e. **chaotic motion over the whole of the fermenter** of liquid and bubbles in all directions. Bubbles in a homogeneous flow in the same fermenter would immediately coalesce, also with the bubbles in heterogeneous flow, thereby not resulting in the homogeneous flow as required by claim 1 being a prerequisite for improving the rate of fermentation.

8.1 The board notes that the patent in suit defines the two flow regimes referred to in claim 1 in the indicated paragraphs as follows:

[0013] As used herein the term "heterogeneous flow" means flow having a nonuniform distribution of gas bubbles and characterized by the presence of large bubbles or agglomeration of bubbles. Heterogeneous flow does not occur at a superficial velocity of less than 0.03 m/sec.

[0014] As used herein the term "homogeneous flow" means flow having a uniform gas bubble distribution and a narrow bubble size distribution wherein there is no observable gas/liquid downflow. Homogeneous flow does not occur at a superficial velocity greater than 0.05 m/sec.

During the opposition and subsequent appeal procedures, both the appellant and the respondent, at various occasions in presenting their arguments, have variably referred to homogeneous and heterogeneous flow either in the meaning as given to the terms by the definitions in the patent in suit or in the meaning given to these

terms in the art. Whereas the definitions contained in paragraphs [0013] and [0014] define the terms homogeneous and heterogeneous flow with reference to the gas bubbles in respect of their size, distribution and superficial velocity, the art appears to have a definition of these flow regimes by reference to the motion of the broth in the fermenter vessel. Both the appellant and the respondent have consented to this finding.

8.2 In this context the board notes that it is an accepted principle that a claim should be read giving the words the meaning and scope which they normally have in the relevant art. Nevertheless, a patent, being a legal document, may be its own dictionary and may define technical terms and determine how a skilled person has to interpret a specific term when used in the description or the claims. If it is intended to use a word which is known in the art to define a specific subject-matter to define a different matter, the description may give this word a special, overriding meaning by explicit definition (see e.g. T 500/01 of 12 November 2003, point 6, and T 61/03 of 12 April 2005, point 4.2). Accordingly, from these principles it follows that any assessment of insufficiency of disclosure related to the subject-matter of present claim 1, should start from the framework of the definitions as established in paragraphs [0013] and [0014] of the patent in suit.

8.3 The board furthermore notes that in accordance with established case law of the boards of appeal, the question of sufficiency of disclosure is a question of fact that must be assessed on the basis of the

available facts and evidence whereby the burden of proof is on the opponent (see for instance T 418/91, of 23 August 1994, point 4.1.4, T 998/97 of 11 July 2001, point 2, 6 and 6.1 and T 356/01 of 30 September 2004, point 3.1). It is upon an opponent to establish on the balance of probabilities that a skilled reader of the patent, using his common general knowledge, would be unable to carry out the invention (T 182/89, OJ EPO 1991, 391). In T 19/90 (OJ EPO 1990, 476), the board established the principle that an objection of lack of sufficiency of disclosure also presupposes that there are serious doubts substantiated by verifiable facts. It therefore follows that as a prerequisite for the possible validity of the appellant's arguments, in accordance with the established principles of the law of evidence developed by the boards of appeal, it needs to be examined whether or not, and if then to what extent, the appellant has discharged its burden to prove the underlying contention.

8.4 In support of its first line of argument that the method of claim 1 is not able to avoid coalescence of the first and second oxygen containing gas bubbles whereas this however being a prerequisite of the invention to improve the rate of fermentation, the appellant has filed a declaration by Dr. K. van 't Riet confirming the statements of the appellant, also similarly submitted during opposition proceedings, that it was impossible to generate the two flow regimes coexisting in the same fermentation vessel.

8.5 In respect of the heterogeneous bubble flow, the appellant submitted, based on the van 't Riet declaration, that as a matter of fact and independently

of the definitions for heterogeneous and homogeneous flow adhered to in the art or as defined in paragraphs [0013] and [0014] of the patent in suit, the flow properties of the gasses in the vessel are dependent on the flow properties of the surrounding liquid. In particular and from a technical point of view:

(a) in the art, the liquid in an air-lifted fermenter vessel is brought into heterogeneous flow by injecting large volumes of gas at a superficial velocity of at least 0,03 m/sec. This also was a requirement of the heterogeneous flow in accordance with the definition in paragraph [0013] of the patent in suit, resulting in a chaotically moving broth including the bubbles covering the whole vessel. Conventionally, this was called heterogeneous flow in the art, i.e. as long as large volumes of gas at the indicated superficial velocities are injected, heterogeneous flow conditions can be realised (see point 7 of the declaration).

(b) for establishing a homogeneous flow very special conditions were required, i.e. only an even distribution of the injection points over the bottom of the vessel could result in a homogeneous flow (see point 8 of the declaration).

(c) the coexistence of the two flows is physically impossible, i.e. there would always be a surface at which the two flows would adjoin and the theoretically derived flow equations (Navier-Stokes) based on physical principles, show that in that case, drag forces and buoyancy forces

inevitably lead to the instantaneous disruption of the homogeneous liquid flow conditions (see point 9 of the declaration).

8.6 The respondent has argued that coexistence of both flow regimes, within the meaning of the definitions in paragraphs [0013] and [0014] of the patent in suit, in one fermentation vessel was well possible and that the skilled person would easily implement this by avoiding to generate a heterogeneous flow within the entire cross section of the vessel and avoiding geometrical overlap of the two gas injection points.

8.7 In the impugned decision, the opposition division found that the requirements of Article 83 EPC were fulfilled for a claim identical to claim 1 of the auxiliary request before the board in view of the absence of any convincing fact and/or evidence which demonstrated the invalidity of the arguments of the patentee.

8.8 Before analysing the technical content of the declaration by Dr. van 't Riet, the board notes in this context that the declaration, in its relevant parts, does not refer to any documentary evidence.

8.8.1 Concerning point (a) the board considers that it may be true that a skilled person, with reference to the meaning of the term heterogeneous flow as established in the art, would envisage establishing such a flow with "large" volumes of air or any other gas, possibly even injecting this gas over the whole or a major part of the cross-section of the vessel. The board can however not conceive or infer from the declaration of Dr van 't Riet that **any** heterogeneous flow as defined

in paragraph [0013] of the patent in suit necessarily establishes a broth and bubble flow in the sense of the art, i.e. creating such a chaotic flow that the broth and the bubbles in the vessel are in such state over the whole vessel. The board judges that the skilled person can very well establish a circulatory flow in a fermentation broth by means of injecting a heterogeneous flow within the meaning of the definition in paragraph [0013] of the patent in suit. In fact, the appellant has not supported its contention by any facts or evidence that would substantiate any doubt to such finding. The board therefore concludes in this aspect that the allegation of the appellant cannot support a finding of insufficiency.

8.8.2 Concerning point (b), the board notes that the definition of homogeneous flow as contained in paragraph [0014] of the patent in suit does not require, for the establishment of the defined bubble flow regime, that the gas is injected by an even distribution of the injection points over the bottom of the vessel. Any argument of insufficiency based on the statement of the appellant in point b) above must therefore fail.

8.8.3 In point (c), the appellant refers to certain "theoretical flow equations based on physical principles", so-called Navier-Stokes equations. The board notes however that the appellant has not submitted any of such equations or calculations based on such equations. The board considers that merely to allege that such equations show that coexistence of the two flows, be it in the meaning of the art or in the meaning given to the flows in the patent, is physically impossible, i.e. that there would always be a surface

at which the two flows would adjoin, does not, in absence of any evidence in support of these allegations, discharge the appellant of the burden of proof of the alleged fact.

8.8.4 From the above it follows that the board considers that in relation to the first line of argumentation in relation to insufficiency of disclosure, the appellant has not discharged its burden to substantiate serious doubts by means of verifiable facts that the skilled person could not work the fermentation method of claim 1. This argumentation can therefore not lead to a finding of lack of sufficiency of disclosure within the meaning of Article 100(b) EPC of the patent in relation to the subject-matter of claim 1.

9. In a second line of argumentation in relation to sufficiency of disclosure, the appellant considered that the patent in suit failed to sufficiently disclose for a skilled person how "proximate" (see wording of feature (D) of claim 1) the two injection points must be located in order to attain the intended effect of the invention.

9.1 The board considers however, that in its paragraph [0031], the patent in suit discloses sufficient technical guidance for set-ups of fermenter vessels which are suitable to implement the method of claim 1, whereby the relative position and structure of the injection points of the two different oxygen-containing gasses are technically described. The board can therefore, also in this point, not concur with the appellant.

10. In view of the above, the board comes to the conclusion that the subject-matter of claims 1 to 6 of the auxiliary request meets the requirements of Article 83 EPC. Furthermore, seeing that the skilled person is enabled by the patent to perform the methods as subject-matter of claims 1 to 6, these methods may be used by the same skilled person in industry. Accordingly, the boards finds these claims to comply with the requirement of susceptibility of industrial application (Article 57 EPC).

Novelty

11. The statement of grounds of appeal as submitted by the appellant did not contain arguments as to the effect that claims 1 to 6 of the first auxiliary request lack novelty.

11.1 The board is satisfied that neither of the documents (1), (4) or (5), the cited prior art describing fermentation processes involving the simultaneous injection of two oxygen-containing gasses into a fermentation vessel, disclose the flow of the bubbles of the first and second injected oxygen-containing gas upwardly through the fermentation vessel in a heterogeneous or homogeneous flow, respectively.

11.2 Accordingly, and already for this reason alone, the subject matter of claim 1 is novel.

Inventive step

12. For assessing whether or not a claimed invention meets the requirements of Article 56 EPC, the boards of

appeal consistently apply the "problem and solution" approach, which requires as a first step the identification of the closest prior art. In accordance with established case law of the boards of appeal the closest prior art is generally a teaching in a document conceived for the same purpose or aiming at the same objective as the claimed invention and having the most relevant technical features in common, i.e. ideally requiring the minimum of structural modifications to arrive at the claimed invention.

12.1 In accordance with paragraph [0010] of the patent in suit it is an object of the claimed invention to provide an improved gas driven fermentation or bubbling column system wherein a supplemental gas may be used to provide additional oxygen for the fermentation while avoiding the detrimental effects experienced with conventional supplemental gas provision systems.

12.2 Document (1), implicitly referred to in paragraph [0009] of the patent, discloses air-lifted fermenters where a supplemental gas is provided into an air-lifted fermenter in a direction which is opposite to the flow of the circulating liquid. The document specifies the supplemental oxygen injection to occur in the downflowing region of the broth in the vessel to assure proper fine division and prolonged contact of the oxygen with the broth (see document (1), page 4, lines 7 to 12; paragraph bridging pages 4 and 5; and figure 1).

12.3 During oral proceedings, both the appellant and the respondent identified as closest prior art the teaching of document (1). The board agrees with the parties.

12.4 In paragraph [0007] the patent in suit states that such a fermentation process as implemented, *inter alia*, in accordance with document (1) reduces the circulation effect within the vessel because of the braking action of the supplemental gas bubbles which try to rise within the downflowing broth. While providing additional oxygen for the fermentation, the method of document (1) reduces the lifting action and the carbon dioxide stripping action, which are needed to provide high fermentation production.

12.5 The problem to be solved by the subject-matter of claim 1 of the auxiliary request can therefore be seen to provide air-lifted fermentation methods involving supplemental oxygen-containing gas injection, having an improved lifting action and/or carbon dioxide stripping action, whilst maintaining the advantageous effects of the supplemental oxygen provision.

12.6 The board is satisfied that the subject-matter of claim 1 solves the above formulated problem.

12.7 It therefore needs to be established whether the solution to the above problem as subject-matter of claim 1 was rendered obvious to the skilled person in view of the prior art.

12.7.1 Firstly, the board notes that neither document (1) itself, nor any of the remainder of the prior art cited explicitly discloses or suggests the simultaneous generation of the two specific flow regimes as required by claim 1 and as defined in paragraphs [0013] and

[0014] of the patent in suit in an air-lifted fermentation process.

12.7.2 Secondly, the documents cited which relate to air-lifted fermentation systems which are provided with separate oxygen injection, all suggest such injection in the downcoming part of the broth (see document (1), paragraph bridging pages 4 and 5, document (4), column 2, lines 23 to 27 and document (5), e.g. column 4, lines 37 to 47).

12.7.3 In view of the foregoing the board is satisfied that the subject matter of claim 1 was not suggested in an obvious manner to a person skilled in the art.

12.8 The subject-matter of claims 1 to 6 of the auxiliary request therefore involves an inventive step.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the department of first instance with the order to maintain the patent in amended form on the basis of the following documents:

   - claims 1 to 6 of the first auxiliary request filed at the oral proceedings

   - description pages 2 to 4 filed at the oral proceedings

   - drawings as granted

The Registrar: The Chairman:

P. Cremona M. Wieser