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Datasheet for the decision of 28 November 2025

Case Number: T 1937/23 - 3.3.09

Application Number: 18719213.3

Publication Number: 3619194

IPC: C07C273/04, C07C273/16

Language of the proceedings: EN

Title of invention:
PROCESS AND PLANT FOR THE SYNTHESIS OF UREA

Patent Proprietor:
Casale SA

Opponent:
Stamicarbon B.V.

Headword:
Urea production plant/CASALE

Relevant legal provisions:
EPC Art. 54(2), 56
RPBA 2020 Art. 12(4), 13(1)

Keyword:
Main request: novelty and inventive step - (yes)
Consultation of the description and the drawings of the patent when interpreting the claims for assessing patentability requirements (reasons 1.10 to 1.12)

Decisions cited:
G 0001/24

Catchword:

Europäisches Patentamt
European Patent Office
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Beschwerdekammern

Boards of Appeal

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Case Number: T 1937/23 - 3.3.09

D E C I S I O N
of Technical Board of Appeal 3.3.09
of 28 November 2025

Appellant: (Opponent)	Stamicarbon B.V. Mercator 3 6135 KW Sittard (NL)
Representative:	V.O. P.O. Box 87930 2508 DH Den Haag (NL)
Respondent: (Patent Proprietor)	Casale SA Via Giulio Pocobelli 6 6900 Lugano (CH)
Representative:	M. Zardi & Co S.A. Via G. B. Pioda, 6 6900 Lugano (CH)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 8 November 2023 rejecting the opposition filed against European patent No. 3619194 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	A. Haderlein
Members:	A. Veronese
	R. Romandini

Summary of Facts and Submissions

I. The appeal was filed by the opponent (appellant) against the opposition division's decision to reject the opposition filed against the European patent.

II. With its notice of opposition, the opponent requested revocation of the patent in its entirety on the grounds under Article 100(a) (lack of novelty and lack of inventive step) and Article 100(b).

III. Independent claims 1 and 7 of the granted patent read:

"*1. Plant for the synthesis of urea from ammonia and carbon dioxide, comprising:*

a section (101) for the synthesis of urea from ammonia (1) and carbon dioxide (2) operating at a synthesis pressure; at least one recovery section (MP, LP) operating at a recovery pressure lower than said synthesis pressure; a line which supplies an aqueous solution containing urea (3, 11) to said at least one recovery section, said line comprising at least one intercepting member (112, 113) suitable for depressurizing said aqueous solution with formation of a two-phase flow (4, 13); wherein said at least one recovery section (MP, LP) comprises:

a separator (104, 108) which receives said two-phase flow (4, 13) and separates the gaseous phase from the liquid phase, producing a first gaseous stream (5, 14) containing ammonia and carbon dioxide, and a liquid stream (6, 15) containing water, urea and ammonium carbamate;

a pre-decomposer (105, 109) which receives said liquid stream (6, 15) from the separator and wherein at least a part of the ammonium carbamate is decomposed, obtaining an effluent (10, 19) containing residual ammonium carbamate;
a decomposer (106, 110) which receives the effluent (10, 19) of said pre-decomposer (105, 109) and wherein at least a part of the residual ammonium carbamate is decomposed to provide a second gaseous stream (12, 18) containing ammonia and carbon dioxide and an aqueous solution containing urea (11, 17);
a condenser (107, 111), wherein said first gaseous stream (5, 14) and said second gaseous stream (12, 18) are at least partially condensed.

"7. Process for the synthesis of urea from ammonia and carbon dioxide, comprising the following steps: reacting the ammonia (1) and the carbon dioxide (2) at a synthesis pressure, obtaining an aqueous solution (3) containing urea and ammonium carbamate, and subjecting said aqueous solution to a stage for recovery of unconverted reagents, wherein said recovery stage comprises:

supplying an aqueous solution (4, 13) containing urea into a recovery section operating at a recovery pressure lower than said synthesis pressure, said aqueous solution being in a two-phase state;
subjecting said two-phase solution (4, 13) to separation of the gaseous phase from the liquid phase, obtaining a first gaseous stream (5, 14) containing ammonia and carbon dioxide, and a liquid stream (6, 15) containing water, urea and ammonium carbamate;

subjecting said liquid stream (6, 15) to a pre-decomposition step, in which at least a part of the ammonium carbamate is decomposed, obtaining an effluent (10, 19) containing residual ammonium carbamate;
subjecting said effluent (10, 19) to a decomposition step, in which at least a part of the residual ammonium carbamate is decomposed to give a second gaseous stream (12, 18) containing ammonia and carbon dioxide and an aqueous solution containing urea (11, 17);
subjecting said first gaseous stream (5, 14) and said second gaseous stream (12, 18) to a condensation step, obtaining a stream of condensate (7, 16).
recycling said condensate (7, 16) to the synthesis stage."

IV. Claims 2 to 6 of the granted patent depend on claim 1 and further characterise the claimed plant. Claims 8 to 12 depend on claim 7 and further characterise the claimed process. Claim 13 of the granted patent defines a method for revamping a plant comprising the step of installing a separator as defined in claim 1.

V. The claim set of auxiliary request 1, filed by letter dated 25 April 2022, differs from the claims as granted in that claim 13 as granted was deleted.

VI. The documents submitted during the opposition proceedings included:

D1A: K. Jonckers, "*New developments in Stamicarbon's Urea 2000 plus TM Process*", Fertilizer Industry, 2000, 57-63

D1B: K. Jonckers, "*New developments in Stamicarbon's Urea 2000 plus™ process*", presentation at the Stamicarbon Symposium, 9 May 2000, Amsterdam

D2: US 2010/0063321 A1

D6: US 4,296,252

D7: US 3,886,210

VII. The opposition division decided that the claimed invention was sufficiently disclosed. The subject-matter of the patent as granted was novel over D1A, D1B, D1C, D2, D3, D6 and D7 and involved an inventive step over the combination of D1A with D10; over the combination of D2 with D6, D7 and D10; and over D6 combined with D7.

VIII. With its statement setting out the grounds of appeal, the appellant filed:

D13: Second declaration of Mr Van den Tillaart

D14: Extract from Wikipedia, "*Shell-and-tube heat exchanger*"

IX. With its letter dated 9 December 2024 the appellant filed:

D15: Extract of Table 2 of ISO standard 10628-2

D16: Third declaration of Mr Van den Tillaart

D17: Combined view of Figures 1A and 1B of D7

X. The appellant's arguments may be summarised as follows.

- D13 to D16 should be admitted. Should the facts presented in the expert opinions D13 and D16 be contested, the technical expert who drafted them should be heard as a witness.

- The subject-matter of claims 1 and 7 was not novel over D1A (and D1B), D2 and over D6 combined with D7. These documents disclosed, explicitly or implicitly, the claimed pre-decomposer, the decomposer, and the condenser in which the first and the second gaseous streams were collected. The claims did not require that the separator, the pre-decomposer and the decomposer be separate units. The claims did not exclude that the first gaseous stream exiting the separator and the second gaseous stream exiting the decomposer be subjected to other treatments either. This was confirmed by Figure 3 of the patent.

- If deemed novel, the claimed subject-matter did not involve an inventive step starting from D1a (and D1B), D2 and over D6 combined with D7 as the closest prior art. The claimed plant and process differed from those in the prior art at most in that the pre-decomposer and the decomposer were separate units and in that the first and the second gaseous streams were condensed in the condenser, without intermediate treatments. No technical effect was associated with these features. At most, a reduction in plant and process performance was foreseeable. The problem was the provision of an alternative plant or process. Providing the claimed alternatives did not involve an inventive step.

XI. The respondent's arguments may be summarised as follows.

- D13 to D16 should not be admitted. The technical expert should not be heard as a witness.

- The claimed subject-matter was novel over D1A, D1B, D2 and over D6 combined with D7. These documents did not disclose a pre-decomposer separated from a decomposer and a condenser in which a first and a second gaseous stream as defined in claim 1 were collected. The claimed effluent liquid stream could not be identified either. The pre-decomposer, the decomposer and the separator of the claimed plant were separate physical and functional units. Moreover, the gaseous streams exiting the separator and the decomposer reached the condenser without further processing steps. This was clear from the wording "*said*" first and second stream and from the teaching of the patent. The prior-art plants did not contain the separate units and streams of claim 1. D7, D13, D14 and D16 could not be used to interpret what was disclosed in D1A, D2 and D6 combined with D7.

- The claimed subject-matter involved an inventive step over the cited documents. It differed at least in the presence of separate pre-decomposer and decomposer units, and in the condenser directly collecting the untreated first and a second gaseous stream.

- Even assuming the problem to be the provision of an alternative, the claimed solution was not obvious. The prior art described real working plants in which each piece of equipment and processing step was essential. Thus, the skilled person would not have had any incentive to modify those systems and would not have provided a plant or process as defined in the claims.

Requests

XII. The appellant requested that the decision under appeal be set aside and that the patent be revoked.

XIII. The respondent requested that the patent be maintained on the basis of the main request, originally filed as auxiliary request 1 by letter dated 25 April 2022 or, alternatively, on the basis of one of auxiliary requests 2 to 9 filed by letter of 25 April 2022.

Reasons for the Decision

1. *Novelty*

1.1 The appellant contested the opposition division's finding that the claimed matter was novel over the teaching of D1A, D1B, D2 and the combined teaching of D6 with D7 (D6/D7 in the following). Since it was common ground that the teaching of D1B does not extend beyond that of D1A, D1B is not considered in this decision.

1.2 In its statement of grounds of appeal, the appellant identified the following technical features F, G, H and I as characterising claim 1:

F: "*a separator (104, 108) which receives said two-phase flow (4, 13) and separates the gaseous phase from the liquid phase, producing a first gaseous stream (5, 14) containing ammonia and carbon dioxide, and a liquid stream (6, 15) containing water, urea and ammonium carbamate*"

G: "*a pre-decomposer (105, 109) which receives said liquid stream (6, 15) from the separator and wherein at least a part of the ammonium carbamate is decomposed, obtaining an effluent (10, 19) containing residual ammonium carbamate*"

H: "*a decomposer (106, 110) which receives the effluent (10, 19) of said predecomposer (105, 109) and wherein at least a part of the residual ammonium carbamate is decomposed to provide a second gaseous stream (12, 18) containing ammonia and carbon dioxide and an aqueous solution containing urea (11, 17)*"

I: "*a condenser (107, 111), wherein said first gaseous stream (5, 14) and said second gaseous stream (12, 18) are at least partially condensed*"

1.3 When discussing novelty, the appellant disputed the opposition division's finding that:

- features F (separator), G (pre-decomposer) and H (decomposer) characterising claim 1 required the claimed plant to comprise three separately identifiable units - namely, a separator, a pre-decomposer and a decomposer - or at least separate sections of a single unit which could be clearly identified as separate physical entities in which the respective functions were separately performed

- feature I (condenser) implied that the first gaseous stream obtained in the separator was condensed directly in the condenser, without any intermediate treatment

1.4 On these premises, the appellant formulated the following attacks based on D1A, D2 and D6/D7.

Novelty of claims 1 and 7 over D1A

1.5 The appellant argued that, contrary to the findings of the opposition division, the plant defined in claim 1 was anticipated by the plant illustrated in Figures 7 and 8 of D1A. The process of claim 7 was likewise anticipated.

1.6 With regard to features F, G and H, the appellant referred to the annotated Figure 8 of D1A, reproduced on page 12 of the statement of grounds of appeal, and essentially argued the following.

- Figure 8 disclosed an MP recirculation heater unit comprising a separator (2) with two heating sections (5) and (6) which received a urea solution from the pre-separator (2).

- The MP pre-separator (2) in Figure 8 corresponded to the separator of claim 1, the first heating section (5) corresponded to the pre-decomposer, and the second heating section (6) corresponded to the decomposer.

- The MP pre-separator received the urea solution (1) from the stripper (shown in Figure 7), after a valve for expansion to medium pressure, and included a liquid outlet at the bottom which was connected by the flow line (4) to the bottom of the vertical tubes of the pre-decomposer (5).

- The two heating stages (5) and (6) of the MP recirculation heater were operated at different

heating temperatures, 150 and 154°C, respectively, using different heating media. Consequently, they performed different functions and operated in different modes. The effluent streams from the two stages also had different compositions. This interpretation was supported by the opinion expressed in the expert declaration D16.

- The horizontal line between the stages (5) and (6) in Figure 8 had to be interpreted as delineating separate compartments within the shell of the heater. The vertical lines of stages (5) and (6) could not be the tubes of a single heat exchanger. Rather, they corresponded to the tubes of two distinct stacked heat exchangers with aligned tube configurations, operating as separate decomposers. In line with the statements in the expert declarations D13 and D16, such a construction - already implemented in the system of D7 - would have been adopted in practice because it enabled proper welding, ensured a leak-free separation of the shell sides, reduced thermal stress and minimised the risk of corrosion. Accordingly, for reasons related to both fabrication and operation, it could be assumed that two heat exchangers were implemented as separate units.

- Even if the stages (5) and (6) in Figure 8 of D1A comprised a single vertical tube bundle, Figures 1B and 2 of D7 showed that the lower and upper parts of the tube bundle belonged to separate heat exchangers. Hence, the two stages (5) and (6) had to be considered separate units corresponding to the pre-decomposer and decomposer of claim 1.

- A single tube bundle passing through two shell-side components heated at different temperatures would likewise have met the requirements of features G and H. The functions of the pre-decomposer and decomposer in the patent were the same as the stages (5) and (6) in D1A. The system shown in Figure 2 of D7 was also constructed in this manner.

- According to claim 3 and Figure 3 of the opposed patent, the separator and the pre-decomposer of claim 1 were combined in a single apparatus, and claim 12 further specified that they were contained within the same pressurised shell. This indicated that the units defined in claim 1 were not necessarily separate and distinguishable.

1.7 Consequently, according to the appellant, features F, G and H were disclosed in the plant depicted in Figures 7 and 8 of D1A.

1.8 With regard to feature I, the appellant argued essentially the following.

- In view of the "*comprising*" language used, claim 1 did not require that the first and the second gaseous streams be "*directly*" supplied to the condenser.

- The gaseous stream (3) in Figure 8 of D1A corresponded to the first gaseous stream of claim 1. The gaseous stream (3) passed through an MP CO_2 absorber (3a), which modified its composition and exited as stream (3b). However, in view of the "*comprising*" language, claim 1 allowed for the presence of intermediate treatment steps that could change the composition of the streams.

The gaseous stream (7) exiting the decomposer was the second stream.

- Figure 3 of the opposed patent showed that the first gaseous stream originating from the separator could be combined with the stream originating from the decomposer and that the first gaseous stream was formed by mixing with a third gaseous stream emerging from the pre-decomposer. This confirmed that feature I was to be interpreted broadly.

1.9 On the basis of these arguments, the appellant maintained that feature I was also disclosed in D1A. Since it was undisputed that all other features characterising claim 1 were disclosed in D1A, the claimed subject-matter was not novel.

1.10 The appellant's arguments are unconvincing as they are not based on a realistic interpretation of the claims that reflects the teaching of the patent and a proper understanding of the disclosed invention. As set out in decision G 1/24 of the Enlarged Board of Appeal, also referred to by the appellant, the description and the drawings of a patent must always be consulted to interpret the claims when assessing the patentability of an invention under Articles 52 to 57 EPC.

1.11 When reading the opposed patent, the skilled person would understand that the disclosed plant and process require:

- the presence of specific units, namely a separator, a pre-decomposer, a decomposer and a condenser

- the formation of a first gaseous stream flowing from the separator to the condenser and a second

gaseous stream flowing from the decomposer to the condenser

- the formation of a liquid stream exiting the separator and entering the pre-decomposer, and the formation of an effluent in the pre-decomposer which is received by the decomposer

1.12 As noted by the respondent, the skilled person reading the patent would understand that in the disclosed invention, the word "*gaseous stream*" in claim 1 denotes a "*process gaseous stream*" that is identifiable and controllable, flows through a process line from one unit to another, and has properties - such as temperature, pressure and flow rate - that can be controlled and regulated. This interpretation is confirmed by the example disclosed in paragraphs [0054] to [0057] of the patent, which specifies the composition, temperature and pressure of the various gaseous streams, as well as in Figure 1, which depicts distinct process lines connecting the individual units and including, where appropriate, valves regulating pressure and flow of those gaseous streams. The same considerations apply to the liquid stream exiting the separator and entering the pre-decomposer and to the effluent formed in the pre-decomposer, which leaves that unit and is received by the decomposer, as shown in Figure 1.

1.13 Since the gaseous and liquid streams and the effluents must be identifiable and controllable, the separator, the pre-decomposer and the decomposer referred to in features F, G, and H of claim 1 must likewise constitute identifiable and distinguishable units connected by process lines transporting those gaseous streams and effluents between the units of the plant.

The appellant further referred to claim 3 and Figure 3 of the opposed patent, which refer to a system in which the separator and the pre-decomposer are combined within a single apparatus housed in the same pressurised shell. However, as submitted by the respondent, even in this configuration, the pre-decomposer and the separator remain separate and distinguishable units, separated by an inverted funnel-shaped baffle. Furthermore, this system also generates the "*first*" gaseous stream (6) that is condensed in the condenser, the liquid stream (6) received by the pre-decomposer and the effluent (10) exiting the pre-decomposer which is received by the decomposer, as defined in claim 1. Claim 1 does not exclude that the first gaseous stream exiting the separator includes some gas generated in the pre-decomposer. Accordingly, while the system of Figure 3 of the patent falls within the claimed scope, it does not undermine the interpretation of the claims set out above. Finally, claim 12, which addresses the option of the pre-decomposer and the decomposer being in the same pressurised shell, does not imply that the effluent leaving the pre-decomposer and entering the decomposer cannot identified, i.e. that the units would be indistinguishable.

1.14 Figure 8 of D1A is not sufficiently detailed to directly and unambiguously disclose the structure of the section identified by the appellant with the numbers (5) and (6) in the annotated version of the figure. From the schematic nature of Figure 8, it cannot be established whether the vertical lines represent a single bundle of tubes through which the urea solution undergoing dissociation flows. Although it may be assumed that the shell is divided into two components by a central baffle - given that two

different heat streams are used for heating - it remains conceivable that the stream from the MP pre-separator (2) flows through the tubes and that the dissociation process proceeds continuously from the bottom to the top of the tube bundle. In this configuration, no effluent stream leaving a first section can be identified because the urea solution can simply traverses a single, uninterrupted tube bundle. Consequently, it is not possible to distinguish a pre-decomposer and its effluent or a decomposer receiving the effluent of a pre-decomposer. Any point along the tubes could be regarded merely as an arbitrary, imaginary demarcation between a first and a second part of the same tubes.

1.15 Furthermore, the horizontal line between sections (5) and (6) does not necessarily imply a physical separation between tubes belonging to a pre-decomposer and a decomposer. If two heat exchangers were stacked on top of one another, two clearly separated horizontal lines and a visible gap would normally appear between the upper plate of the lower bundle and the lower plate of the upper bundle.

1.16 Furthermore, as noted by the appellant, heat transfer involving both latent and sensible heat is common in heat exchangers. D1A does not disclose in detail the conditions of the hot stream and therefore does not allow the relative contributions of latent and sensible heat to be assessed. The temperatures cited by the appellant (156 and 200°C) are not precisely disclosed in D1A either. This lack of information prevents any reliable determination of whether the two sections (5) and (6) of the MP recirculation heater in Figure 8 can be regarded as separate "*pre-decomposer*" and

"*decomposer*" units within the meaning of the independent claims.

1.17 The appellant's argument that to achieve a leak-free seal on the shell side of the recirculation heater, two heat exchangers (functioning as separate decomposers) would need to be stacked is not convincing. As noted by the respondent, in an arrangement with continuous tubes extending from sections (5) and (6) of the separator in Figure 8 of D1A:

- a seal between the baffle and the tubes would not necessarily require welding since other means such a pipe expander may be employed

- a small amount of steam leakage from one component to the other would not pose any technical problem

- thermal stress arising from the tube length cannot be regarded as an issue, particularly since the tube length in Figure 8 is not even specified

1.18 The appellant's arguments, which rely on the opinions expressed in the expert declarations D13 and D16 and on the construction of a decomposer shown in the earlier patent document D7, amount to speculation regarding how the device shown in Figure 8 of D1A could be constructed rather than an assessment of what is directly and unambiguously disclosed in that document. D7, as a patent document, does not represent the common general knowledge and cannot be relied upon as a basis for the interpretation of D1A.

1.19 For these reasons, D1A does not disclose the combination of features F, G and H of claim 1.

1.20 As far as feature I was concerned, the appellant argued that the stream numbered (3) in the annotated Figure 8 of D1A, which was sent to the evaporator (9) after passing through the MP CO_2 absorber (3a), qualified as the first gaseous stream of claim 1. In view of the "*comprising*" language used in this claim, further intermediate steps, such as the passage through the MP CO_2 absorber, were not excluded from the claimed scope.

1.21 This argument is not convincing because in the claimed invention, the wording "*a condenser (107, 111), wherein said first gaseous stream (5, 14) and said second gaseous streams (12, 18) are at least partially condensed*" (emphasis added) implies that the gaseous stream (5) emerging from the separator is sent to the condenser without passing through other intermediate units, like the MP CO_2 absorber of D1A, which substantially alter its composition by removing carbon dioxide. The description and Figure 1 of the opposed patent support this interpretation. In the plant described in the patent, the totality of the gaseous unconverted ammonia and carbon dioxide from the reactor, along with that released by decomposition of the unconverted carbamate, are recycled back to the condenser via the gaseous streams, with no intermediate steps removing either substance.

1.22 The appellant referred to some earlier decisions of the boards concerning process claims using the term "*comprising*". Nevertheless, the claims in the patents underlying those decisions related to different processes and plant configurations. None of them defined gaseous streams as in claim 1 which leave a separator or a decomposer and are condensed in a condenser to be then recycled in the reactor.

1.23 The appellant drew attention to Figure 3 of the opposed patent, observing that, in the illustrated unit, the gaseous stream separated by the separator was combined with the gas exiting the pre-decomposer prior to being directed to the condenser. However, even in this case, the entire gaseous stream containing ammonia and carbon dioxide - which exits the separator and comprises both the gas separated from the two-phase flow (4) and that exiting the pre-decomposer - is sent to the condenser, without further processing steps. This differs from the system of D1A, in which the gaseous stream exiting the separator is sent to an MP CO_2 absorber, which removes one of its components, namely carbon dioxide.

1.24 Accordingly, D1A does not disclose feature I of claim 1 either.

1.25 With regard to independent claim 7, in the decision under appeal, the opposition division acknowledged that claim 7 related to a process defined in terms of process steps, rather than plant units. It considered, however, that the claimed steps must be carried out in separate pre-decomposer and decomposer units, as defined in claim 1. It also considered that the first gaseous stream was not subjected to any intermediate treatment before being condensed. For these reasons, the opposition division decided that the same arguments reached when dealing with claim 1 applied *mutatis mutandis* also to claim 7.

1.26 There are no reasons to overrule this finding. In appeal, when discussing the novelty of claim 7 over D1A, the appellant relied essentially on the same arguments as those presented for claim 1. Accordingly, since it has been concluded that claim 1 is novel over D1A, the same conclusions apply to claim 7.

1.27 For these reasons, the plant and the process defined in claims 1 and 7 are novel over the teaching of D1A.

Novelty over D2

1.28 The appellant argued that, contrary to the findings of the opposition division, the plant defined in claim 1 was anticipated by the plant illustrated in Figure 2 of D2. The process of claim 7 was likewise anticipated.

1.29 The appellant focused on the annotated versions of the drawing of the dissociator (17) in Figure 2 of D2, as presented on pages 9 and 10 of the appellant's letter dated 28 October 2025. In its opinion, the internal construction of the dissociator (17) could be inferred by considering the construction of shell-and-tube exchangers known from the prior art, as exemplified by patent document D7 and documents representing common general knowledge, like D14 and D15. Moreover, it referred to the expert opinions D13 and D16 in support of its argument.

1.30 The appellant argued that the plant in Figure 2 of D2 contained all the features of the claimed plant, including features F to I. In drawing attention to the structure of a tube heat exchanger illustrated in D14 (a Wikipedia extract) and the annotated drawing of the dissociator (17), it contended that this dissociator included the separator, the pre-decomposer and the decomposer as well as the gaseous streams defined in claim 1 because of the following.

- The inlet plenum (17A) functioned as a separator. The gas from stream (28) went up toward the

condenser (18), whereas the liquid went down toward the chambers, owing to the effect of gravity.

- The liquid part of stream (28) entered from the inlet plenum (17A) (functioning as a separator), passed through chamber 17B (functioning as a pre-decomposer) and subsequently reached chamber (17C) (functioning as a decomposer). The liquid stream flowing from the plenum (17A) to chamber (17B) was the liquid stream, and the effluent flowing from chamber (17B) to chamber (17C) was the effluent defined in claim 1 of the opposed patent.

- The gaseous component of stream (28) of Figure 2, which exited directly from the inlet plenum 17A toward the condenser (18), corresponded to the first gaseous stream according to claim 1. The gas released by the decomposition of carbamate in chamber 17C, which flowed first upward to chamber 17B, then to the inlet plenum 17A, and subsequently to the condenser (18), corresponded to the second gaseous stream as defined in claim 1. These two gaseous streams were initially independent but were subsequently combined and condensed in the condenser. The tube bundle of the dissociator operated in a falling-film mode to maximise the decomposition of the carbamate, while allowing the ascent of the gas formed.

- Claim 1 did not rule out that the claimed streams could be subjected to intermediate steps, nor that the second gaseous stream could flow through a liquid in chamber 17B and combine with the first gaseous stream in the separator. This was demonstrated by the fact that the construction of the dissociator (17) in Figure 2 of D2 was similar

to that of the device in Figure 3 of the opposed patent. In fact, in the device of Figure 3 of the patent, the first gaseous stream was combined with a gaseous stream from the pre-decomposer before condensation. Gas formed in the pre-decomposer flowed upward through the tubes, was mixed with the first gaseous stream and exited via outlet 5.

- For the reasons discussed for D1A, an expert in the field would have constructed the dissociator (17) using two heat exchangers mounted so that the tubes were aligned. This design allowed for reliable welding, ensured leak-free separation of the shell sides, and minimised thermal stress and the risk of corrosion. These points were confirmed by the expert declaration D16. Accordingly, for reasons related to both fabrication and operation, it could be assumed that the dissociator (17) contained two heat exchangers operating as separate decomposers.

- Even assuming that sections (17B) and (17C) of the dissociator (17) comprised a single vertical tube bundle, Figures 1B and 2 of D7 showed that the lower and the upper parts of the tube bundle operated as separate decomposers.

1.31 For these reasons, according to the appellant, the plant of D2 anticipated the plant defined in claim 1.

1.32 The appellant's arguments are not convincing.

1.33 As found when dealing with D1A, since claim 1 requires the presence of identifiable and controllable gaseous streams and effluents, the separator, pre-decomposer and decomposer referred to in features F, G and H of claim 1 must likewise constitute identifiable and

distinguishable units connected by process lines transporting the gaseous streams and effluents within the claimed plant.

1.34 Like Figure 8 of D1A, Figure 2 of D2 is not sufficiently detailed to allow a direct and unambiguous determination of the internal structure of the dissociator (17), nor to establish whether the central line represents a single bundle of tubes traversed by the urea solution undergoing dissociation or two series of tubes mounted so that the tubes are aligned with each other. The considerations made when discussing D1A apply also to the analysis of D2. Although the shell could be divided into two components by a central baffle, it is nevertheless conceivable that a liquid stream flows through a single tube bundle that traverses both chambers (17B) and (17C). Hence, it is conceivable that the dissociation process proceeds continuously from the top to the bottom of the tubes. Accordingly, a liquid effluent stream leaving a pre-decomposer and being received by a separate distinguishable decomposer cannot be identified.

1.35 As found for D1A, the appellant's arguments relying on D7 and D13 to D16 are mere speculations on how the dissociator (17) could be constructed, rather than evidence of what is directly and unambiguously disclosed in D2. Neither the structure of the inlet plenum 17A, nor of the sections (17B) and (17C) - which according to the appellant are present in the dissociator (17) - is disclosed. Accordingly, the separately identifiable units (separator, pre-decomposer and decomposer) defined by features G and H cannot be identified in Figure 2 of this document.

1.36 The gas mixture containing NH_3 and CO_2 formed by dissociation of carbamate within the dissociator (17), which emerges from that dissociator, cannot be seen as a "*gaseous stream*", let alone as the second gaseous stream according to claim 1. As established above for D1A, in the invention, a "*gaseous stream*" in claim 1 denotes a "*process gaseous stream*" that is identifiable and controllable, flows through a line from one unit to another, and has properties that can be controlled and regulated. As submitted by the respondent, a gas which bubbles out from a liquid stream flowing through the dissociator (17) or emerges from the upper part of a plurality of tubes contained in that dissociator, where the liquid possibly descends in a falling-film mode, does not qualify as a "*gaseous stream*" within the meaning of the claimed invention. The second gaseous stream identified by feature I of claim 1, which is produced in the decomposer and then condensed in the condenser, is thus not disclosed in D2.

1.37 For these reasons, D2 does not disclose the combination of features F, G, H and I of claim 1. Hence, the plant defined in this claim is novel over the teaching of D2.

1.38 With regard to claim 7, as in the discussion of novelty over D1A, the appellant relied essentially on the same arguments presented for claim 1. Thus, since it has been concluded that the subject-matter of claim 1 is novel over D2, the same conclusion applies to claim 7.

Novelty over D6/D7

1.39 The appellant argued that, contrary to the findings of the opposition division, the plant defined in claim 1 and the process defined in claim 7 were anticipated by the combined teaching of D6/D7.

1.40 D6 teaches how to modify the urea production plant described in D7 by including an additional separating system. It was not contested that D6 incorporates the teaching of D7 by reference and that the resulting unit contains a separator (identified as (6) in D6), a pre-decomposer (identified as (7) in D7), a decomposer (identified as (9) in D7) and a condenser (identified by the appellant as (21) in D7)(see Figure 1 in D6; Figures 1A and 1B in D7; and D17, presenting a combined view of Figures 1A and 1B of D7).

1.41 What was disputed was whether D6/D7 discloses feature I of claim 1, which requires that the first and the second gaseous streams defined in that claim be condensed in the condenser.

1.42 As established above for D1A, within the framework of the invention defined in the opposed patent, the wording in claim 1 "*a condenser (107, 111), wherein said first gaseous stream (5, 14) and said second gaseous streams (12, 18) are at least partially condensed*" (emphasis added) implies that the first gaseous stream (5) emerging from the separator is sent to the condenser and not to intermediate units that would substantially alter its composition. This interpretation applies equally to the second gaseous stream (12) emerging from the decomposer as defined in claim 1. The plant described in D6/D7 does not fulfil these requirements.

1.43 The appellant referred to the gas (12) released by the major stream (2) in the lower part of the separator (6) depicted in the figure of D6 as the first gaseous stream. However, this gas (12) passes through the packed section (7), where it contacts a descending

liquid (18). As stated in column 4, lines 20 to 32 of D6, part of the water vapour and the CO_2 in the gas (12) reacts with ammonia and is dissolved in the liquid downstream (18). Accordingly, the gas (12) shown in the figure of D6 is not condensed in the condenser (21) shown in Figure 1B of D7 but is instead subjected to a different processing step. Therefore, the gas (12) does not qualify as the first gaseous stream of claim 1.

1.44 Even assuming that the gaseous stream (20)/(22) emerging from the separator (6) shown in Figure 1 of D6 corresponds to the "*first gaseous stream*" sent to the condenser (21) depicted in Figure 1B of D7, the requirements of claim 1 would still not be fulfilled. This is because, as explained below, the gaseous stream (10) exiting the decomposer (9) in Figure 1B of D7 is not condensed in that same condenser (21) and therefore does not qualify as the "*second gaseous stream*" within the meaning of claim 1.

1.45 In the plant described in D6/D7, the gaseous stream (10) exiting the decomposer (9) enters a separator, where it is mixed with reactor effluent (20). The resulting mixture (11) is sent to the shell side of the decomposer (7), where it reacts with stream (12) and CO_2 (see column 6, line 59 to column 7, line 27 of D7). From there, the processed mixture passes through condensers (22) and (23) before finally reaching the condenser (21), where it meets the gaseous stream (22) coming from the separator (6). In view of these numerous transformative steps, the gaseous stream (10) exiting the decomposer (9) does not reach the condenser (21). Accordingly, the gaseous stream (10) does not qualify as the "*said second gaseous stream*" of claim 1. No other gaseous stream that could qualify as the second gaseous stream can be identified in claim 1.

1.46 Consequently, claim 1 is novel over the teaching of D6 combined with D7.

1.47 With regard to the process claim 7, during the oral proceedings, the appellant submitted that this claim did not require that the first and the second gaseous streams be condensed in the same condenser.

1.48 This argument is not persuasive because, as further discussed during the proceedings, the wording of the last sentence of claim 7, namely "*subjecting said first gaseous stream (5, 14) and said second gaseous stream (12, 18) to a condensation step, obtaining a stream of condensate (7, 16). recycling said condensate (7, 16) to the synthesis stage*" (emphasis added), leaves no doubt that the condensation occurs in the same condenser and results in one single condensate.

1.49 Concerning the other features of claim 7, the appellant relied essentially on the same arguments presented when discussing claim 1. Consequently, since, as concluded above, the subject-matter of claim 1 is novel over D6/D7, the same conclusions apply to claim 7.

2. *Inventive step*

2.1 The appellant contested the opposition division's conclusion that the claimed subject-matter involved an inventive step over the teaching of any of D1A, D1B, D2 and D6/D7. As in the assessment of novelty, since it was undisputed that the teaching of D1B does not extend beyond that of D1A, D1B is not considered.

Closest prior art

2.2 The opposed patent relates to a plant and a process for producing urea. The plant comprises a synthesis section, in which ammonia and carbon dioxide react, and at least one recovery section. The recovery section comprises a separator configured to separate unreacted ammonia and carbon dioxide, as well as a pre-decomposer and a decomposer for decomposing residual ammonium carbamate. The separator and the decomposer generate a first and a second gaseous stream containing ammonia and carbon dioxide, which are subsequently condensed in a condenser and recycled to the reactor. According to the patent, positioning a separator upstream of the pre-decomposer reduces the material and thermal load of the pre-decomposer, enhances water separation, decreases ammonium carbamate formation in the reactor effluent, and lowers overall consumption (paragraphs [0031] to [0035]).

2.3 The appellant referred to D1A, D2 and D6/D7 as possible starting points for assessing inventive step. It was not contested that these documents, which describe, like the opposed patent, urea-producing plants comprising recovery sections, are suitable starting points for assessing the inventive step of the claimed invention.

Inventive step over D1A

Distinguishing features

2.4 As decided when assessing novelty, D1A does not disclose:

- the combination of features G and H, which define a pre-decomposer distinct from the decomposer, in conjunction with feature F, which defines the separator

- feature I, which requires that the first (and the second) gaseous stream obtained from the separator be condensed in the condenser, without any intermediate treatment altering its composition, for example, by passing through an MP CO_2 absorber

Technical effect and technical problem

2.5 As noted above, the patent indicates that positioning a separator upstream of the pre-decomposer is advantageous as it enhances water separation, reduces ammonium carbamate formation in the reactor effluent and lowers overall consumption. These advantages are supported by the tests reported in the opposed patent, which compare the composition of the gaseous streams in a plant comprising the claimed separator with those in a plant lacking that separator.

2.6 However, since the plant of D1A already comprises a separator upstream of a decomposing unit, the mere presence of the separator in the claimed plant cannot confer inventive step.

2.7 In the decision under appeal, the opposition division considered that the absence, in the claimed plant, of the MP CO_2 absorber present in the plant of D1A could reduce the amount of water sent to the condenser and recycled to the reactor. This was advantageous because water was detrimental to urea formation.

2.8 This argument is not persuasive. No evidence of this effect was provided. Furthermore, as submitted by the appellant and explained in the expert opinion D13, since water is the highest boiling component of the gaseous stream flowing throw the MP CO_2 absorber and the operational parameters of that absorber are not specified in D1A, it is not possible to establish whether the water content in the gaseous stream is lowered when the absorber is removed.

2.9 Since no comparison has been made between the properties of the claimed plant and process and those of the plant of D1A, it is not possible to determine whether the distinguishing technical features induce any technical effect beyond those achievable by following the teaching of the prior art.

2.10 For these reasons, the objective technical problem is the provision of an alternative urea-producing plant and process for the synthesis of urea.

Non-obviousness of the claimed solution

2.11 The appellant argued that D1A did not describe the MP CO_2 condenser as being essential for the operation of the plant. Hence, when confronted with the underlying problem, the skilled person would have considered removing the MP CO_2 condenser of D1A and feeding the gaseous stream exiting the separator directly to the condenser. The appellant referred to D10, which disclosed a system in which the gas exiting a separator was conveyed to a condenser, without any intermediate treatment. It then argued that D10 gave to the skilled person a clear incentive to remove the MP CO_2 absorber from the plant of D1A.

2.12 The appellant added that if the MP CO_2 condenser were important for the operation of the plant in D1A, its removal would have been associated with a foreseeable deterioration in plant performance. In the absence of any unexpected technical advantage accompanying this foreseeable disadvantage, the claimed invention could not be considered to involve an inventive step.

2.13 Furthermore, the appellant submitted that it would have been obvious to arrange two separate decomposers in series - a pre-decomposer and a decomposer implemented as separate pieces of equipment - rather than a single decomposer comprising continuous tubes passing through sections heated at different temperatures. As explained in the expert opinions D13 and D16, this construction avoided technical constraints, such as limitations on equipment size and the diameter of the tubes passing through the decomposer, and ensured reliable welds and a leak-free system.

2.14 For these reasons, starting from D1A, it would have been obvious to provide a urea-producing plant as defined in claim 1.

2.15 The appellant's arguments are not convincing.

2.16 D1A describes a real working plant, Urea 2000 Plus™, which was set up by re-introducing an MP stage - consisting of an MP recirculation heater and an MP CO_2 absorber - into a pre-existing urea plant. As stated by the respondent, in that plant, each piece of equipment, and especially any unit of the re-introduced MP stage - including the MP CO_2 absorber - serves a purpose. Thus, changes in the amount of CO_2 in the gaseous stream resulting from direct condensation of the first gaseous stream without passing it through the MP CO_2 absorber,

or from effectively removing the MP CO_2 absorber as submitted by the appellant, would be expected to significantly affect the equilibrium of the reactions downstream of that absorber. This would likely compromise the entire operation of the plant.

2.17 The capacity and operational performance of the claimed plant have not been compared with those of D1A. Nevertheless, it is credible that the claimed configuration, which includes features F to I and is intended to improve the performance of a pre-existing industrial plant, would provide satisfactory performance. No evidence has been provided that directly condensing the first gaseous stream, i.e. the absence of an MP CO_2 absorber, in the claimed plant leads to suboptimal performance.

2.18 D10 discloses a plant which differs from that of D1A in several sections and flow configurations. The skilled person would not have been motivated to directly condense the first gaseous stream, i.e. to remove the MP CO_2 absorber of D1A, merely because the plant of D10, which has a substantially different overall design, does not contain one.

2.19 In the absence of any teaching in the prior art that would allow the skilled person to predict the consequences of directly condensing the first gaseous stream, i.e. removing the MP CO_2 absorber from the MP unit of D1A, the alternative plant defined in claim 1 is considered to involve an inventive step.

2.20 The process for producing urea according to claim 7 has to be conducted in a plant containing the units and generating the gaseous streams and effluent defined in claim 1. Thus, the same conclusions apply.

Inventive step over D6/D7

2.21 The conclusions reached for D1A apply equally when considering the combination of D6 and D7 as the starting point.

2.22 As established for novelty, D6/D7 fails to disclose feature I of claim 1, which requires that the first and second gaseous streams be condensed in the condenser.

2.23 In the plant described in D6/D7, like in that of D1A, the gaseous stream (10) exiting the decomposer (9) - allegedly corresponding to the second gaseous stream of claim 1 - is not condensed together with the first gaseous stream in the same condenser. Instead, it flows to a separator where it is mixed with the reactor effluent (20). The resulting mixture (11) is sent to the shell side of the decomposer (7), where it reacts with stream (12) and CO_2. From there, the processed mixture passes through condensers (22) and (23), before finally reaching condenser (21), where it is condensed together with the gaseous stream (22) coming from separator (6). This means that the gaseous stream (10) does not qualify as the "*said second gaseous stream*" of claim 1.

2.24 As in the case of D1A, when taking D6/D7 as the starting point, the objective technical problem is the provision of an alternative urea-producing plant and process for the synthesis of urea.

2.25 Substantial structural and processing modifications would be necessary to obtain the claimed plant starting from D6/D7. The plant and the process would have to be modified so that the gas stream (10) exiting the

decomposer (9) neither flows through the separator (15), the shell side of the decomposer (7) nor passes through the condensers (22) and (23), and is therefore not subjected to all the modifications occurring in those units.

2.26 This means that the entire plant and process would have to be redesigned, with unpredictable consequences on plant operation.

2.27 Accordingly, for the reasons set out for D1A, in the absence of a clear pointer towards the claimed solution - which cannot be found in the cited prior-art documents - the provision of the claimed plant and process involves an inventive step over the teaching of D6/D7.

Inventive step over D2

2.28 The same reasoning and conclusions reached when starting from D1A and D6/D7 apply when starting from D2. As noted in the assessment of novelty, D2 does not disclose a second gaseous stream exiting a decomposer and being directed to the condenser, where both the first and second gaseous streams are condensed (features G to I).

2.29 To arrive at the claimed plant, the skilled person would have to substantially modify the dissociator (17) of D2 with two separate decomposition units, with the second unit generating the second gaseous stream flowing to the condenser as required by claim 1.

2.30 Implementing such a modification would not only require substantial structural changes to the plant of D2, but would also run counter to the operating principle of

the dissociator (17), which relies on the gas formed by carbamate decomposition rising in counter-current to the downward-flowing liquid.

2.31 Departing from this operating principle would be expected to significantly affect the reaction equilibria within the plant and lead to unpredictable effects on process performance. Faced with the objective technical problem of providing an alternative plant and process, the skilled person would therefore have had no incentive to make - and would indeed have been dissuaded from making - such modifications to the plant and process of D2.

2.32 The appellant noted that D10 disclosed a urea plant generating two gaseous streams flowing to a condenser and argued that the skilled person would have found in this document the incentive to modify the plant of D2 according to the invention. This argument is not persuasive. D10 discloses a plant which differs from that of D2, not only with respect to the dissociator units but also in several other sections and flow configurations. Consequently, the skilled person would not have been motivated to replace the dissociator (17) of D1A with different units described in D10, which operate in a substantially different manner within a different overall plant design.

2.33 Accordingly, the plant of claim 1 involves an inventive step. The process for producing urea according to claim 7 has to be conducted in a plant containing the units and generating the gaseous streams and effluent defined in claim 1. Thus, the same conclusions apply.

Admission of certain documents and requests

2.34 The appellant filed the expert declarations D13 and D16, as well as documents D14 and D15, with its statement of grounds of appeal and its rejoinder to the respondent's reply. The documents were intended to substantiate the novelty and inventive-step attacks.

2.35 The respondent requested that they not be admitted into the appeal proceedings.

2.36 However, these documents merely provide substantiation for refinements of arguments presented during the opposition proceedings. They aim to set out the common general knowledge at the relevant date and support arguments presented by an expert in the field, without introducing new complex issues. For these reasons, they were admitted into the appeal proceedings (Articles 12(4) and 13(1) RPBA).

2.37 The appellant requested that should the content of D13 and D16 be contested, a technical expert be heard as a witness before the board. However, as noted by the respondent, the hearing of a witness is essentially to establish facts, such as the circumstances surrounding a disclosure. In the case at hand, the issue in dispute concerns only the interpretation of the cited documents, which was already set out in the expert declarations D13 and D16. Hearing a witness for this purpose was therefore not necessary. To the extent that the request aimed to present new facts, these should have been submitted during the opposition proceedings. Accordingly, the board decided not to hear the technical expert as a witness. It offered him the possibility to speak as an accompanying person during

the oral proceedings, but no such oral submissions were made.

Adaptation of the description

2.38 The description was adapted to the amended set of claims, from which claim 13 as granted was deleted. No objections were raised against the amendments.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the opposition division with the order to maintain the patent on the basis of the following documents:

   - claims 1 to 12 according to the main request (originally filed as auxiliary request 1 by letter dated 25 April 2022)

   - description: paragraphs 2 to 28 and 30 to 60 of the patent specification and paragraphs 1 and 29 as submitted in the oral proceedings before the board

   - drawings: Figures 1 to 3 of the patent specification

The Registrar: The Chairman:

K. Götz-Wein A. Haderlein

Decision electronically authenticated