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**Datasheet for the decision
of 2 December 2021**

Case Number: T 2067/19 - 3.3.10

Application Number: 04763960.4

Publication Number: 1716111

IPC: C07C273/12

Language of the proceedings: EN

Title of invention:

INTEGRATED PROCESS FOR UREA AND MELAMINE PRODUCTION

Patent Proprietor:

CASALE SA

Opponent:

Stamicarbon B.V.

Headword:

Relevant legal provisions:

EPC Art. 123(2), 123(3), 56, 84, 83

Keyword:

Decisions cited:

T 2374/16

Catchword:



Beschwerdekammern

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Case Number: T 2067/19 - 3.3.10

D E C I S I O N
of Technical Board of Appeal 3.3.10
of 2 December 2021

Appellant: Stamicarbon B.V.
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Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
15 May 2019 concerning maintenance of the
European Patent No. 1716111 in amended form.**

Composition of the Board:

Chair P. Gryczka
Members: R. Pérez Carlón
K. Kerber-Zubrzycka

Summary of Facts and Submissions

- I. The appellant (opponent) lodged an appeal against the opposition division's decision to maintain European patent No. 1 716 111 in the form of the then pending first auxiliary request.
- II. This is the second appeal in the case. In T 2374/16, the board remitted the case to the opposition division due to a substantial procedural violation.
- III. Notice of opposition was filed on the grounds of added subject-matter (Article 100(c) EPC), insufficiency of disclosure (Article 100(b) EPC), and lack of novelty and inventive step (Article 100(a) EPC).
- IV. The documents filed include the following:
 - D1 WO 2004/011419 A1
 - D2 DE 2 053 385
 - D4b "Melamine and Guanamines" in Ullmann's Encyclopedia of Industrial Chemistry, 31, 2003, 205-221
 - D5 W. Ripperger "The world melamine industry", Nitrogen No. 228, 1997, 43-51
 - D7 WO 03/080584
 - D8 WO 03/095516
- V. The opposition division concluded that the claims of the first auxiliary request before it found the required basis in the application as originally filed and were clear. The claimed invention was sufficiently disclosed for it to be carried out by a skilled person. Document D1 was the closest prior art. The process in claim 1 differed from that in D1 in that it required a

non-catalytic high-pressure melamine plant and a step of removing water. Even if the problem underlying the claimed invention were to be considered as that of providing an alternative, the claimed solution would not have been obvious to a skilled person and was thus inventive.

VI. The main request in the appeal corresponds to auxiliary request 1 underlying the opposition division's decision. Claims 1 and 6 of the main request read as follows:

Claim 1. *"Integrated process for urea and melamine production, wherein urea is produced in a urea plant of the so called CO₂ or ammonia stripping type comprising a high pressure urea synthesis section operated at 130-170 bar and comprising at least one urea synthesis reactor, stripper and carbamate condenser, connected one to the other so as to form a substantially isobaric loop, and a urea recovery section for separating urea from a carbamate aqueous solution, and melamine is produced in a melamine plant of the non-catalytic high pressure type wherein off-gases resulting as by-products of the melamine synthesis are discharged therefrom at a pressure between 2 and 30 bar and recycled to said high pressure urea synthesis section, the process being characterized in that it further comprises the steps of:*

- feeding said off-gases coming from said melamine plant to an off-gas condensation section operated at a pressure substantially equal to the pressure of said off-gases;*
- feeding said carbamate aqueous solution coming from said urea recovery section to said off-gas condensation*

section;

- condensing said off-gases with said carbamate aqueous solution in said off-gas condensation section obtaining a concentrated carbamate aqueous solution;

- feeding the so obtained concentrated carbamate aqueous solution to said high pressure urea synthesis section."

Claim 6. "Integrated plant for urea and melamine production, wherein urea is produced in a urea plant (12) of the so called CO₂ or ammonia stripping type comprising a high pressure urea synthesis reactor, stripper and carbamate condenser, connected one to the other so as to form a substantially isobaric loop, and a urea recovery section (16) for separating urea from a carbamate aqueous solution, and melamine is produced in a melamine plant (11) of the non-catalytic high pressure type comprising a melamine synthesis section (13) wherein off-gases resulting as by-products of the melamine synthesis are discharged therefrom at a pressure of between 2 and 30 bar and recycled to said high pressure urea synthesis section (15), the plant being characterized in that it further comprises:

- an off-gas condensation section (17) arranged between said the plant (11) for melamine production and said plant (12) for urea production and in fluid communication with said melamine synthesis section (13), said urea recovery section (16) and said high pressure synthesis section (15),

- connecting means (37) for feeding said off-gases coming from said melamine synthesis section (13) to said off-gas condensation section (17);

- connecting means (38) for feeding said carbamate aqueous solution coming from said urea recovery section (16) to said off-gas condensation section (17), wherein said off-gases are condensed with said carbamate aqueous solution obtaining a concentrated carbamate aqueous solution;

- connecting means (31) for feeding the so obtained concentrated carbamate aqueous solution to said high pressure urea synthesis section (15)."

VII. The appellant's arguments were as follows.

Claim 1 of the first auxiliary request before the opposition division (the present main request) did not find the required basis in the application as originally filed. The specific type of melamine plant and the pressure of the off-gases required by claim 1 were not disclosed in combination. If a basis were nevertheless to be considered to be found on page 5 of the application as originally filed, that passage related to the embodiment in Figure 1 and not every feature of that embodiment was included in claim 1.

The feature "high pressure" introduced in claim 1 was not present in claim 1 as granted and was not clear.

The claimed invention could not be carried out by a skilled person for various reasons. First, a high pressure melamine plant could not produce off-gases at the required pressure unless a valve was included. Second, not every embodiment of claim 1 allowed a "concentrated" carbamate feed to be obtained, in particular at the lower end of the pressure range set by claim 1. Lastly, claim 4 required the concentrated

carbamate solution to be fed directly to the high pressure urea synthesis section. This was not possible in view of the pressure difference.

Both documents D1 and D2 were suitable as starting points for examining inventive step. In both cases the problem underlying the claimed invention with regard to the closest prior art was merely to provide an alternative process and plant.

Starting from D1, the claimed solution was characterised by the type of melamine plant and would have been obvious to the skilled person in view of D1, D4b or D7.

With respect to D2, the claimed solution was characterised by the type of urea plant. Stripping urea plants were the most common type of plant on the filing date of the patent. This solution would thus have been obvious to a skilled person.

The claimed method and plant were thus not inventive.

VIII. The respondent's (patent proprietor's) arguments were as follows.

The combination of the pressure and type of melamine plant could be found on page 5, lines 3-11, of the application as originally filed. The claimed process and plant thus found the required basis.

Claim 1 did not require a "high pressure" but a melamine plant of the "non-catalytic high pressure type". This type of plant was known in the art. Claim 1 was thus clear.

The claimed invention could be carried out by a skilled person. Claim 1 required the off-gases to be discharged "therefrom", i.e. from the melamine plant. The skilled person would recognise whether an expansion valve was needed. Claim 1 did not require any specific concentration of the "concentrated feed". Even if water needed to be added, the solution was nevertheless concentrated, as required by claim 1. Lastly, claim 4 did not exclude compression of the feed.

Regardless of whether D1 or D2 was considered as the closest prior art and even if the problem were to be formulated as that of providing an alternative process and plant, the claimed solution would not have been obvious to a skilled person. The claimed process and plant were thus inventive.

IX. Oral proceedings were held before the board of appeal on 2 December 2021.

X. The parties' final requests were as follows:

- 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. Auxiliarily, it requested that the patent be maintained with the claims of one of auxiliary requests two to six before the opposition division.

XI. At the end of the oral proceedings, the decision was announced.

Reasons for the Decision

1. The appeal is admissible.

2. The respondent's main request in these appeal proceedings, namely that the appeal be dismissed, implies that it is requesting that the patent be maintained as allowed by the opposition division, i.e. in the form of the first auxiliary request before it.

3. Amendments
 - 3.1 The process in claim 1 of the main request finds a basis in the combination of claims 1 and 2 as originally filed, the preferred type of urea plant on page 5, lines 23-27, the preferred type of melamine plant on page 5, lines 8-9, and the pressure of the off-gases discharged from the latter on page 5, lines 6 and 11, of the application as originally filed.

 - 3.2 The appellant argued that the application as originally filed did not disclose the combination of the pressure of the off-gases discharged from the melamine plant of between 2 to 30 bar and the specific type of melamine plant required by claim 1.

It is not disputed that the application as originally filed, on page 5, lines 8-11, discloses the melamine plant as preferably being of the non-catalytic high pressure type, and that the off-gases discharged from it have a pressure of between 3 and 30 bar.

The preceding paragraph discloses that the melamine plant can either be of the low-pressure or high-pressure type, provided that the off-gases discharged have a pressure of at least 2 bar. This passage thus discloses the combination of the type of melamine plant and the lowest pressure of the off-gases discharged

from the melamine plant required by claim 1.

- 3.3 The appellant further argued that the disclosure on page 5 of the application as originally filed related to the embodiment in Figure 1. Not every feature required by that embodiment was included in claim 1, as was the case for the compression sections 18 and 19. For this reason too, the process in claim 1 went beyond the disclosure of the application as originally filed.

However, the compressors 18 and 19 are optional (page 6, lines 9-18). For this reason alone, they do not need to be introduced into claim 1.

- 3.4 These arguments apply analogously to claim 6 of the main request, directed to an integrated plant, which results from the combination of claim 6 as originally filed, the preferred types of urea and melamine plant, and the pressure boundaries as in claim 1.

- 3.5 The requirements of Article 123(2) EPC are thus fulfilled.

4. Clarity

- 4.1 Claim 1 relates to a process including a melamine plant of the "non-catalytic high pressure type".

- 4.2 The appellant argued that the feature "high pressure" in claims 1 and 6 of the main request was not clear.

The patent disclosed that melamine plants of the "catalytic low pressure" type required a pressure of up to 70 bar. Those of the "non-catalytic high pressure" type required a pressure above that threshold. The patent thus disclosed a seamless boundary.

The prior art set the boundary for "high pressure" in the context of melamine plants at either 80 bar (D4b, page 208, point 4) or 70 bar (Table 1 of D5), depending on the authors. For these reasons, the term "high pressure" did not clearly define the subject-matter for which protection was sought, as there was no unequivocal boundary between the two types of plant.

4.3 The prior art discloses two types of melamine plants (D4b, page 211, point 4.2, second paragraph):

- "catalytic", "low pressure", "gas phase", requiring a catalyst and pressure below approx. 10 bar
- "non-catalytic", "high-pressure", "gas phase", at pressures over 70 bar, such as that in claim 1

4.4 It is undisputed that the prior art defined the threshold between these processes as being at either 70 or 80 bar; however, there is a considerable gap between high-pressure and low-pressure processes, as the latter are carried out at less than 10 bar. Therefore, regardless of the disclosure of the patent, the feature "non-catalytic high pressure melamine plant" is not ambiguous and clearly defines the subject-matter for which protection is sought, as required by Article 84 EPC.

4.5 Other clarity issues raised by the appellant in the written procedure were not maintained at the oral proceedings before the board.

5. Sufficiency of disclosure

5.1 The appellant argued that the claimed invention was not sufficiently disclosed for it to be carried out by a

skilled person for a number of reasons.

5.2 First, the claimed process could not be carried out at the lower end of the pressure range set by claim 1. It was known that the amount of water in a carbamate solution needed to avoid precipitation was dependent on the pressure of the feed. At 2 bar, at least 32% water was needed. Such a solution was, however, not a "concentrated carbamate aqueous solution" as required by claim 1.

By its own argument, however, the appellant acknowledged that the skilled person knew what water content and pressure were needed in order to avoid crystallisation. Although the presence of water was disadvantageous, the synthesis of urea was nevertheless possible under those conditions.

In addition, claim 1 requires a "concentrated" carbamate aqueous solution to be obtained by condensing the off-gases. Contrary to the appellant's argument, claim 1 does not require the solution to be "more concentrated" than the carbamate solution arising from the urea plant. A solution containing more than 60% of solute (carbamate) and less than 40% of solvent (water) is arguably "concentrated", as required by claim 1.

This argument is therefore not convincing.

5.3 Second, the appellant argued that the claimed invention did not disclose the technical means which could allow off-gases to be discharged at 2 to 30 bar from a high pressure melamine plant. If a step for reducing the pressure were foreseen, the gases would be discharged from the expansion valve and not from the reactor, as required by claim 1.

Claim 1, however, requires the off-gases to arise from a melamine plant. There is no limitation to the equipment of the plant and no reason to exclude from it any expansion means. This argument is thus not convincing.

- 5.4 Lastly, the appellant argued that claim 4 required the concentrated carbamate solution to be fed directly to the high pressure urea synthesis section. It thus excluded any intermediate compression step. Since the carbamate solution pressure was lower than the pressure of the urea synthesis section, it was not technically possible to feed that solution directly to the latter.

The board is, however, inclined to interpret the feature "directly" as meaning without any change to its composition and thus as not excluding any compression step. This argument is not convincing either.

- 5.5 Like the opposition division, the board is thus of the view that the claimed invention is sufficiently disclosed for it to be carried out by a skilled person.

6. Inventive step

- 6.1 The claimed invention relates to an integrated process and an integrated plant containing a CO₂ or ammonia urea stripping plant and a melamine non-catalytic high pressure plant.

The off-gases from the melamine plant are discharged at a pressure of between 2 and 30 bar, and condensed into the carbamate solution coming from the urea recovery section at a pressure substantially equal to that of the off-gases. The solution obtained is fed into the

high pressure section of the urea plant.

- 6.2 The appellant argued that documents D1 and D2 were suitable starting points for examining inventive step. The board had informed the appellant that it was inclined to consider document D7 to be further from the claimed invention, as it focused on the purification of melamine and provided no details on the recycling of off-gases. The appellant did not argue against the board's preliminary view in this respect at the oral proceedings before it.

Document D1 as the closest prior art

- 6.3 The appellant argued that Figure 4 of document D1 disclosed an integrated process which only differed from that of claim 1 on account of the type of melamine plant, which was of the catalytic low-pressure type. The respondent considered there to be more differences.

In the following, in favour of the appellant, the type of melamine plant will be considered the sole feature distinguishing the claimed subject-matter from that of Figure 4 of D1.

- 6.4 Technical problem underlying the invention

The appellant argued that the technical problem underlying the claimed invention was to provide an alternative integrated process and plant.

The board arrived at the conclusion that the claimed process and plant were inventive even as a solution to that problem. It is therefore not necessary to examine whether a more ambitious problem, as relied on by the

respondent, has also been solved.

6.5 Solution

The solutions to this technical problem are the claimed process and plant, characterised in that they require a melamine plant of the non-catalytic high pressure type.

6.6 Success

It is undisputed that the problem of providing an alternative integrated process and plant has been credibly solved by the process in claim 1 and the plant in claim 6.

6.7 It thus remains to be decided whether the proposed solution to the objective problem defined above would have been obvious to the skilled person in view of the prior art.

6.7.1 The appellant argued that D1 disclosed not only low-pressure but also high-pressure melamine processes in combination with urea synthesis. The skilled person would have considered combining this teaching with the process and plant in Figure 4. In doing so, they would have arrived at the claimed invention without exercising inventive skill.

6.7.2 Document D1 discloses low-pressure and high-pressure melamine processes in combination with urea plants.

In a preferred embodiment (page 7, lines 6-8), the off-gases from the high pressure melamine plant are fed to a carbamate condenser and returned to the urea plant (page 7, line 30 to page 8, line 3). The condenser is operated at the same pressure as the melamine reactor

(page 8, lines 4-5), which is well above the upper limit of 30 bar set by claim 1. On page 7, lines 13-16, D1 discloses that condensation at high pressure is advantageous since it reduces the water content of the carbamate feed sent to the urea plant and avoids solidification.

D1 thus discloses that, if high-pressure melamine synthesis were to be chosen, it should be combined with high-pressure condensation. There is nothing to prompt the skilled person to condense off-gases and carbamate at a pressure within the boundaries set by claim 1, in particular since it implies subsequent pressurisation to feed it to the high pressure part of the urea plant, which is disadvantageous.

This argument is thus not convincing.

- 6.7.3 The appellant also argued that it was common general knowledge that some high-pressure melamine processes provided off-gases at the condensation pressure of the process in Figure 4 of D1. An example of this type of process was the Montedison (Ausind) process on page 212 of document D4b.
- 6.7.4 Point 4.2.2. on page 212 of document D4b, which is a textbook in the field, discloses that the Montedison process is carried out at 7 MPa (70 bar). After the reaction mixture leaves the reactor, the pressure is lowered to 2.5 MPa (25 bar). This mixture, however, does not correspond to the off-gases from the process as defined on page 4, line 17, of D1 as it contains the product of the reaction, melamine. This mixture is subsequently treated in a quencher to precipitate melamine, forming a water-saturated mixture of ammonia and carbon dioxide (page 4, lines 17-18). This mixture

is also different from the off-gases in D1, which mainly contain ammonia and carbon dioxide (page 4, lines 17-18). In addition, its pressure is not disclosed. The skilled person would thus not consider that a Montedison melamine process could simply replace the low-pressure melamine unit MELAF in the integrated process in Figure 4 of D1.

This argument is not convincing either.

- 6.7.5 Lastly, the appellant argued that document D7 hinted at the claimed solution. D7 (abstract) disclosed the treatment of off-gases from urea pyrolysis to produce melamine in liquid phase, at high pressure. It also disclosed that, in normal industrial practice, plants for producing melamine from urea were coupled with urea production plants, so that the off-gases could be returned to and reused in the latter.
- 6.7.6 D7 focuses on the efficient separation of melamine from off-gases (claim 1) by expanding, cooling, and separating. On page 12, lines 10-18, D7 discloses that the separation pressure can be selected as a function of the reuse of the off-gases. It continues by disclosing that "when the off-gas was to be recycled to the urea production plant, condensing them in its carbamate recovery section: in this case a pressure of 25-30 bar can be appropriate".

Figure 4 of document D1 discloses the combination of a low-pressure melamine plant and a urea plant. Such a melamine plant operates at pressures below 10 bar. Its off-gases are not expected to have a higher pressure. This pressure is well below the lowest pressure disclosed in D7.

If the skilled person were to combine the separation system from D7 with the plant from D1, a higher pressure would be more advantageous according to D1 and the appellant's own arguments, as it would not require the carbamate to be diluted. Therefore, even if the skilled person had combined the teaching of D1 and D7, they would not have arrived at the process in claim 1.

This argument is not convincing either.

Document D2 as the closest prior art

- 6.8 Document D2 discloses an integrated process with a urea and a melamine plant (page 2, lines 20-23), in which the off-gases from the latter are fed into the former. The urea plant has a high-pressure section and subsequent parts at lower pressure (page 2, lines 26-27). The off-gases from the melamine plant to the urea plant are absorbed in a carbamate solution in the high-pressure part (page 2, line 30), of which the pressure is lower than that of the synthesis step (page 4, line 33). Absorption can be performed at 15 to 60 atm (15 to 69 bar). This pressure overlaps with that required by claim 1.

On page 4, with reference to the figure, D2 discloses that the gases arising from the urea synthesis are fed by the feeds 9 and 10 to the absorbers 11 and 12 to form a carbamate solution. After leaving the absorbers, the carbamate solution is compressed to the pressure of the high-pressure part, fed to the absorber 16 and brought into contact in said absorber with gases arising, for example, from a melamine plant, and is compressed and fed to the reactor.

It is not disputed that D2 does not disclose the type

of urea plant required by claim 1.

The appellant argued that D2 disclosed high-pressure melamine synthesis, since the prior art cited in D2 related to that type of melamine synthesis in combination with a urea synthesis reactor.

However, document D2 cites that piece of prior art as an example of the combination of urea and melamine plants. The skilled reader would not conclude that the process in D2 is inevitably carried out with that type of melamine plant.

6.9 Technical problem underlying the invention

The appellant argued that the technical problem underlying the claimed invention was to provide an alternative integrated process and plant.

Since the board arrived at the conclusion that the claimed process and plant were inventive even as a solution to that problem, it is not necessary to examine whether a more ambitious problem has also been solved.

6.10 Solution

The solution to this technical problem is the claimed process and plant, characterised in that they require a melamine plant of the non-catalytic high pressure type and a urea plant of the CO₂ or ammonia stripping type.

6.11 Success

It is undisputed that the problem of providing an alternative integrated process and plant has been

credibly solved by the process in claim 1 and the plant in claim 6.

- 6.12 It thus remains to be decided whether the proposed solution to the objective problem defined above would have been obvious to the skilled person in view of the prior art.

The appellant argued that stripping urea plants were the most common type of plant on the filing date. The part of D2 relating to the prior art referred to high-pressure melamine synthesis. With regard to this teaching, the skilled person would have arrived at the claimed invention without exercising inventive skill.

Document D2 aims to maximise the concentration of carbamate, i.e. minimise the amount of water, while avoiding crystallisation of the feed (page 3, second paragraph). In the context of sufficiency of disclosure, the appellant argued that higher pressures are more favourable for that purpose. Therefore, even if the skilled person had considered high-pressure melamine synthesis when seeking an alternative, they would have combined it with absorption at higher pressure, outside of the pressure required by claim 1. The skilled person would thus not have arrived at the claimed invention.

- 6.13 The appellant also argued that the plant in claim 6 was not limited by the pressure of the process and thus that the issue of inventive step differed from that of the process in claim 1.

However, the absorption pressure in claim 6 limits the plant by requiring means for allowing the different feeds to arrive at that pressure, and means for

pressurising it and sending the carbamate mixture to the urea high-pressure zone.

Be that as it may, inventive step has been examined on the assumption that the pressure of the off-gas was not a distinguishing feature with respect to either D1 or D2. The arguments put forward with respect to the method thus apply in the same manner to the plant in claim 6.

6.14 The board thus concludes that the claimed subject-matter is inventive (Article 56 EPC), regardless of whether D1 or D2 is considered to be closest to the claimed invention.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chair:



C. Rodríguez Rodríguez

P. Gryczka

Decision electronically authenticated