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Datasheet for the decision of 11 February 2021

Case Number: T 2792/17 - 3.3.02

Application Number: 11164887.9

Publication Number: 2385043

IPC: C07D251/60, C07D251/62

Language of the proceedings: EN

Title of invention:
Low-energy-consumption process for the production of high-purity melamine, through the pyrolysis of urea and relative equipment

Patent Proprietor:
EUROTECNICA MELAMINE, Luxembourg
Zweigniederlassung in Ittigen

Opponent:
CASALE SA

Headword:

Relevant legal provisions:
EPC Art. 56, 83, 100(a), 100(b)

Keyword:
Inventive step
Sufficiency of disclosure

Decisions cited:

Catchword:

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Beschwerdekammern

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Case Number: T 2792/17 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 11 February 2021

Appellant: (Opponent)	CASALE SA Via Giulio Pocobelli 6 6900 Lugano (CH)
Representative:	Zardi, Marco M. Zardi & Co. SA Via Pioda 6 6900 Lugano (CH)
Respondent: (Patent Proprietor)	EUROTECNICA MELAMINE, Luxembourg Zweigniederlassung in Ittigen c/o Peter Muntwyler, Fürsprecher und Notar Talgut-Zentrum 19 3063 Ittigen (CH)
Representative:	De Gregori, Antonella Studio Legale Bird & Bird Via Borgogna, 8 20122 Milano (IT)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 14 November 2017 rejecting the opposition filed against European patent No. 2385043 pursuant to Article 101(2) EPC.**

Composition of the Board:

Chairman	M. O. Müller
Members:	S. Bertrand
	L. Bühler

Summary of Facts and Submissions

I. European patent No. 2385043 was opposed under Article 100 (a) and (b) EPC. Article 100(a) EPC was invoked for lack of inventive step.

II. The appeal, which was lodged by the opponent ("appellant"), lies from the opposition division's decision to reject the opposition.

III. The patent as granted contains 15 claims, with independent claims 1 and 15 reading as follows:

"*1. A low-energy consumption process for the production of high-purity melamine, through the pyrolysis of urea, comprising the following operative steps:*

*a) separating a biphasic liquid-gas effluent product in a pyrolysis reaction of urea in a liquid stream of raw melamine (**3**) and a first stream of anhydrous off-gas (**15**) comprising NH_3, CO_2 and melamine vapours;*
*b) putting said liquid stream of raw melamine (**3**) in contact with a stream of gaseous anhydrous NH_3 (**13**) and forming a liquid stream of raw melamine impoverished in CO_2 (**4**) and a second stream of anhydrous off-gas (**16**) comprising NH_3, CO_2 and melamine vapours;*
*c) putting said first and second anhydrous off-gas streams (**15, 16**) in contact with at least one aqueous washing stream (**32**) and forming an aqueous stream (**20**) comprising melamine, NH_3, CO_2 and a stream of damp off-gas (**19**) comprising NH_3, CO_2 and water vapour;*

*d) removing from said aqueous stream (**20**) comprising melamine, NH_3, CO_2, at least a part of the CO_2 contained therein, and forming a stream (**22**) comprising the CO_2 removed and an aqueous stream (**21**) comprising melamine and impoverished in CO_2;*

*e) recovering the melamine contained in said liquid stream (**4**) of raw melamine impoverished in CO_2 and the melamine contained in said aqueous stream (**21**) comprising melamine and impoverished in CO_2 through crystallization by cooling, with the formation of a stream (**10**) of crystallized melamine and a stream (**23**) of mother liquor.*"

"*15. Equipment for applying the improved process for the production of melamine as defined in claim 1, comprising:*

*i) a separation section for separating a liquid/gas biphasic effluent produced in a pyrolysis reaction of urea in a liquid stream of raw melamine (**3**) and a first stream of anhydrous off-gas (**15**) comprising NH_3, CO_2 and melamine vapour, said separation section being connected to a reaction section (**R**) for the pyrolysis of urea from which it receives said biphasic liquid/gas effluent, said separation section being inside or outside said reaction section (**R**);*

*ii) a stripping section (**StrN**) for putting said liquid stream of raw melamine coming from said reaction section (**R**) in contact with an anhydrous gaseous stream of NH_3 forming a liquid stream of raw melamine impoverished in CO_2 (**4**) and a second stream of anhydrous of* [sic] *off-gas (**16**) comprising NH_3, CO_2 and melamine vapour, said stripping section (**StrN**) being connected to said*

*reaction section (**R**) from which it receives said liquid stream of raw melamine (**4**);*
*iii) a washing section (**OGQ**) for putting said first and second streams of anhydrous off-gas (**15, 16**) in contact with at least one aqueous washing stream (**32**) and forming an aqueous stream (**20**) comprising melamine, NH_3 and CO_2 and a stream of damp off-gas (**19**) comprising NH_3, CO_2 and water vapour, said washing section (**OGQ**) being connected to said separation section from which it receives said first stream of anhydrous off-gas (**15**) and to said stripping section (**StrN**) from which it receives said second stream of anhydrous off-gas (**16**);*
*iv) a removal section of CO_2 (**OGS**) for removing, from said aqueous stream (**20**) comprising melamine, NH_3 and CO_2, at least a part of the CO_2 contained therein, and forming a stream (**22**) comprising the CO_2 removed and an aqueous stream (**21**) comprising melamine and impoverished in CO_2, said CO_2 removal section (**OGS**) being connected to said washing section (**OGQ**) from which it receives said aqueous stream (**20**) comprising melamine, NH_3 and CO_2;*
*v) at least one melamine recovery section (**Cr**) for recovering both the melamine contained in said liquid stream of raw melamine impoverished in CO_2 (**4**) and the melamine contained in said aqueous stream (**21**) comprising melamine and CO_2 through cooling crystallization, with the formation of a stream (**10**) of crystallized melamine and a stream (**23**) of mother liquor, said recovery section (**Cr**) of the melamine being connected to both the stripping section (**StrN**) from which it receives said liquid stream (**4**) of raw melamine impoverished in CO_2 and said removal section of CO_2 (OGS) from which it receives said aqueous stream (21) comprising melamine and impoverished in CO_2.*"

IV. The following documents are referred to in the present decision:

D1	US 2004/0162429 A1
D2	WO 03/095516 A1
D11	MI2001A001216
A002	US 3,161,638

D11 is the priority document of D1.

V. In its decision, among other things the opposition division came to the following conclusions.

- The grounds for opposition under Article 100(b) EPC did not prejudice maintenance of the patent as granted.

- The subject-matter of claim 1 as granted involved an inventive step in view of D1 (and D11) as the closest prior art.

VI. In its statement setting out the grounds of appeal, the appellant submitted that claims 1 and 15 as granted did not involve an inventive step in view of either D1 or D2 as the closest prior art, and that the patent application as filed did not disclose the invention according to the claims as granted in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art. It submitted annex 1.

VII. In its reply to the grounds of appeal, the patent proprietor ("respondent") contested the appellant's objections, and submitted that the claims as granted involved an inventive step and that the invention defined in the claims as granted was sufficiently

disclosed in the application as filed. It submitted an auxiliary request and annex P1.

VIII. In a further letter, and in response to the respondent's reply to the grounds of appeal, the appellant provided further arguments on lack of sufficiency of disclosure and inventive step. It submitted document A002.

IX. On 3 September 2020, the board issued a communication in preparation for the oral proceedings, which had been requested by the parties.

X. In a second further letter, the appellant submitted further arguments regarding the objection of lack of inventive step in view of either D1 or D2 as the closest prior art.

XI. Oral proceedings before the board were held on 11 February 2021 by videoconference.

XII. The parties' final requests were the following.

The appellant requested that the decision under appeal be set aside and that the patent be revoked. It also requested that document A002 be admitted into the appeal proceedings, and that the first auxiliary request not be admitted.

The respondent requested that the appeal be dismissed, or, in the alternative, that the patent be maintained in amended form on the basis of the first auxiliary request.

XIII. The appellant's case, where relevant to the present decision, may be summarised as follows.

Articles 100(a) and 56 EPC

D1 as the closest prior art

- D1 disclosed a process for preparing melamine.
- The distinguishing features of claim 1 as granted over D1 were steps (c), (d) and (e) of claim 1.
- The objective technical problem, as submitted during the oral proceedings, was the provision of a less sophisticated process with simpler equipment.
- The solution proposed by claim 1 was obvious in view of D2 (point 3.5 below).
- The subject-matter of claims 1 and 15 did not involve an inventive step in view of D1 in combination with D2.

D2 as the closest prior art

- D2 disclosed a process for producing melamine comprising among other things an aqueous washing step of the off-gas from a melamine reactor (a step corresponding to step c) according to claim 1 as granted).
- The subject-matter of claim 1 differed from figure 2 of D2 in step b), step c) (partially) and step d).
- The objective technical problem, as submitted during the oral proceedings, was the provision of a process for purifying the melamine stream coming from the melamine reactor.

- D2, by referring directly to D11 (priority document of D1), taught a CO_2-removing step with anhydrous ammonia for the raw melamine, i.e. a step corresponding to step b) according to claim 1 as granted.

- The further distinguishing features were merely straightforward options for a skilled person, aimed at optimising the melamine process of D2 (point 4.4 below).

- Therefore, the subject-matter of claim 1 also lacked an inventive step in view of D2.

Article 100(b) EPC

- In the aqueous washing step, NH_3 and CO_2 partly dissolved in the aqueous washing stream and were carried along in the process, rather than leaving the actual process in the stream (**19**). The degree of off-gas solubilisation depended upon the temperature, pressure and water/off-gas ratio used in the aqueous washing step (for details see point 6 below).

XIII. The respondent's case, where relevant to the present decision, may be summarised as follows.

Articles 100(a) and 56 EPC

D1 as the closest prior art

- D1 did not disclose steps c), d) and e) according to claim 1 as granted.

- The objective technical problem was the provision of a less sophisticated process with simpler equipment.

- Nothing was said or disclosed in D2 about any further treatment of the aqueous melamine stream (**9**) coming from the aqueous washing of the off-gas (**3**). There was no teaching in D2 to apply the aqueous washing step to both the off-gas from the melamine reactor and the off-gas exiting the post reactor.

- The molten raw melamine exiting the melamine reactor **A** of D2 was charged into the dissolution and quench apparatus **C**, where, together with said aqueous melamine stream (**9**) coming from the washing column **B**, it was treated with an aqueous stream of ammonia and then underwent crystallisation. From this and from the passages of page 11, lines 6-18 and page 15, line 12 to page 16, line 5 of D2, it was evident that D2 taught that subjecting the stream (**9**) to a CO_2-removing step was not necessary and should in fact be avoided.

- D2 did not teach further purifying the aqueous melamine stream (**9**) obtained from the aqueous washing step, said stream (**9**) having a "very high purity" (page 13, lines 3-6) and being sent directly to crystallisation.

- The appellant's argument, that a skilled person was aware that CO_2 was undesirable in the crystallisation of melamine and that the melamine aqueous stream of D2 comprised a non-negligible amount of CO_2, as evidenced by annex 1, was based on an *ex-post facto* analysis.

- Paragraph [0009] of D1 related to a process not claimed by D1. It referred to a step of purifying the raw melamine stream and did not teach removing

CO_2 from the aqueous melamine stream (**9**) in the process of D2.

- There was no teaching in paragraph [0026] of D1 to remove CO_2 from the aqueous melamine stream (**9**) entering the quenching column **C** in the process of D2. On the contrary, D2 (page 13, lines 15-18) taught that said stream was not further purified but was fed directly to the quenching column **C**, in which the polycondensates were efficiently eliminated.

- The skilled person could have washed both off-gas streams (**15**) and (**16**) with water but, in the absence of a clear teaching, would not have done so.

D2 as the closest prior art

- The subject-matter of claim 1 differed from figure 2 of D2 in:

  (i) putting the liquid stream of raw melamine (**3**) in contact with gaseous anhydrous NH_3 for removing CO_2,
  (ii) subjecting the off-gas stream (**16**) from step b) to the aqueous washing step together with the off-gas stream (**15**) from the melamine reactor, and
  (iii) step d), namely the step of at least partly removing CO_2 from the aqueous stream (**20**) of the aqueous washing of step c).

- The objective technical problem was the provision of a process for purifying the melamine stream coming from the melamine reactor.

- No recycling at all of said aqueous stream of melamine was disclosed in D2. D2 did not provide any teaching of further removing CO_2 from the aqueous stream of melamine exiting the off-gas washing section.

- In view of the teaching of D2, the skilled person would not have removed at least a part of the CO_2 from said aqueous stream comprising melamine, NH_3 and CO_2 and resulting from the off-gas washing step and thereafter formed a stream comprising the removed CO_2 and an aqueous stream comprising melamine and impoverished in CO_2.

- There was no clear teaching in D2 that the off-gas stream exiting the post reactor should be combined with the off-gas stream and washed with water.

Article 100(b) EPC

- The passage on page 19, lines 14-18 of the patent application provided the required information for performing the aqueous washing step.

- The passage on page 32, lines 5-9 presented an example in which the value of the water/off-gas ratio was clearly indicated.

Reasons for the Decision

Main request - claims 1-15 as granted

Articles 100(a) and 56 EPC

1. The appellant disputed that there was an inventive step in claim 1 in view of D1 or D2 as the closest prior art.

2. The aim of the patent is to provide a low-energy-consumption process for the production of high-purity melamine involving the collection and purification in aqueous solution of the melamine produced in a pyrolysis reactor from molten urea, and crystallisation of the melamine (paragraphs [0001], [0002]).

The pyrolysis of molten urea is represented by the following equation:

$$6\,NH_2CONH_2 \rightarrow (CN)_3(NH_2)_3 + 6NH_3 + 3CO_2$$

The ammonia and carbon dioxide originating from this reaction form a stream called the off-gas.

Accordingly, claim 1 as granted relates to a process for the production of melamine comprising the following steps:

(i) Step a): separating a first off-gas stream (**15**) from a stream of raw melamine (**3**),

(ii) Step b): bringing the stream of raw melamine (**3**) into contact with anhydrous NH_3 and producing a stream of raw melamine impoverished in CO_2 (**4**) and a second off-gas stream (**16**),

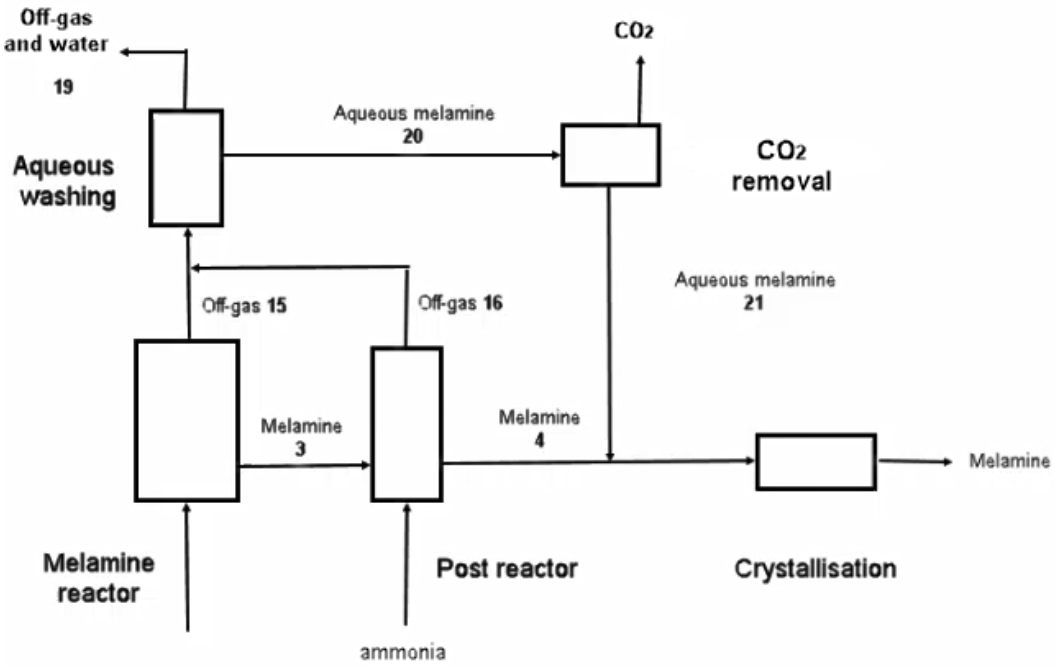
(iii) Step c): washing the anhydrous off-gas streams (**15**) and (**16**) using an aqueous solution, forming an aqueous stream (**20**) comprising melamine, NH_3 and CO_2, and a stream (**19**) of damp off-gas comprising NH_3, CO_2 and water vapour,

(iv) Step d): removing CO_2 from the aqueous melamine stream (**20**) to form an aqueous

melamine stream with a lower CO_2 content (**21**), and

(v) Step e): recovering the melamine present in the stream of raw melamine (**4**) and the aqueous melamine stream (**21**) by crystallisation.

The process of claim 1 as granted may be summarised as follows:



3. D1 as the closest prior art

3.1 D1 discloses a process for producing melamine from pyrolysis of molten urea. Among other things, the process (illustrated in figure 2 of D1) comprises the following steps:

(a) molten urea is pyrolysed in a melamine reactor. A raw liquid stream of melamine (paragraph [0019]) and "anhydrous off-gases" are separated. The

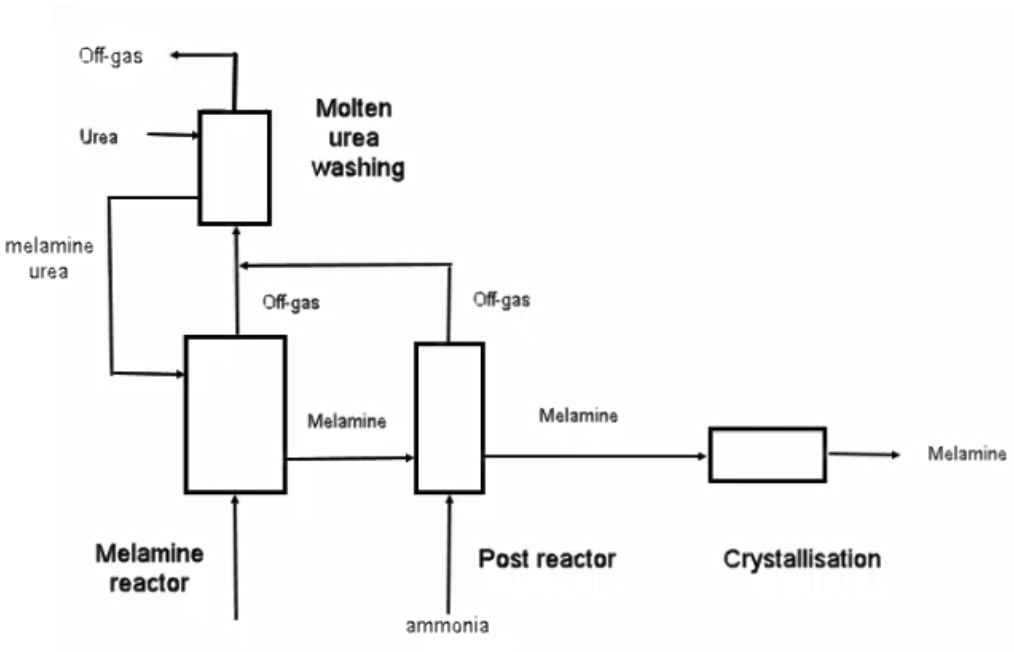
anhydrous off-gases comprise NH_3, CO_2 and vaporised melamine (paragraph [0020]).

(b) The raw liquid stream of melamine is directed to a "post-reactor". Superheated anhydrous gaseous ammonia is added to extract CO_2 from the raw liquid stream of melamine (paragraph [0022]) and to produce a liquid stream of melamine and off-gases.

(c) The off-gases of the melamine reactor and the post reactor are directed to the "washing section". The melamine is removed from the off-gases in the "washing section" by direct contact with molten urea (paragraph [0020]).

(d) The raw liquid stream melamine from step (b) is subjected to a crystallisation step.

The process of D1 may be illustrated as follows:



Step (a) of D1 as identified above involves the separation, from a biphasic liquid-gas effluent product resulting from a pyrolysis reaction of urea, of a

liquid stream of melamine and a stream of anhydrous off-gas comprising NH_3, CO_2 and melamine vapours (in the melamine reactor). Therefore, this step in D1 corresponds to step a) according to claim 1 as granted.

In step (b) of D1 as identified above, in the post reactor the liquid stream of raw melamine is put in contact with a stream of gaseous anhydrous NH_3. A liquid stream of raw melamine impoverished in CO_2 (paragraph [0024]) and a stream of anhydrous off-gas comprising NH_3 are obtained. It was common ground between the parties that the anhydrous off-gas comprising NH_3 exiting the post reactor also comprises CO_2 and melamine vapours, and that step (b) identified above therefore corresponds to step b) according to claim 1 as granted.

3.2 Distinguishing features

The distinguishing features of claim 1 as granted over D1 are steps c) and d) and part of step e) of claim 1:

- Step c): aqueous washing of off-gas streams (**15**) and (**16**).
- Step d): removal of CO_2 from the aqueous stream (**20**) comprising melamine from step c) to form an aqueous stream comprising melamine with a lower CO_2 content (**21**).
- Step e): recovering the melamine in the aqueous stream with a lower CO_2 content from step d) (**21**) by crystallisation.

In D1, the washing step is performed in the presence of molten urea, see step (c) identified in point 1.3 above. No aqueous stream comprising melamine is formed in the washing step of D1 (paragraphs [0020] and [0021]), the melamine being trapped by the molten urea.

The resulting stream comprising melamine and molten urea is fed to the melamine reactor.

3.3 Technical problem

According to the patent (paragraph [0030]), a significant portion of the off-gas directed to the washing section containing the molten urea (i.e. in the process of D1) dissolves therein and the off-gas needs to be recycled. Furthermore, washing with molten urea has the following additional disadvantages (paragraph [0031] of the patent):

- the need to use expensive materials for the washing section because of the corrosiveness of molten urea,
- a reduction in the volume available for the synthesis reaction in the reactor owing to the presence of recycled melamine and dissolved off-gases, and
- the need for a specific additional section for receiving the sublimation products obtained when emptying the melamine reactor.

In view of the above and as acknowledged by the appellant, the objective technical problem may be formulated as the provision of a less sophisticated process with simpler equipment.

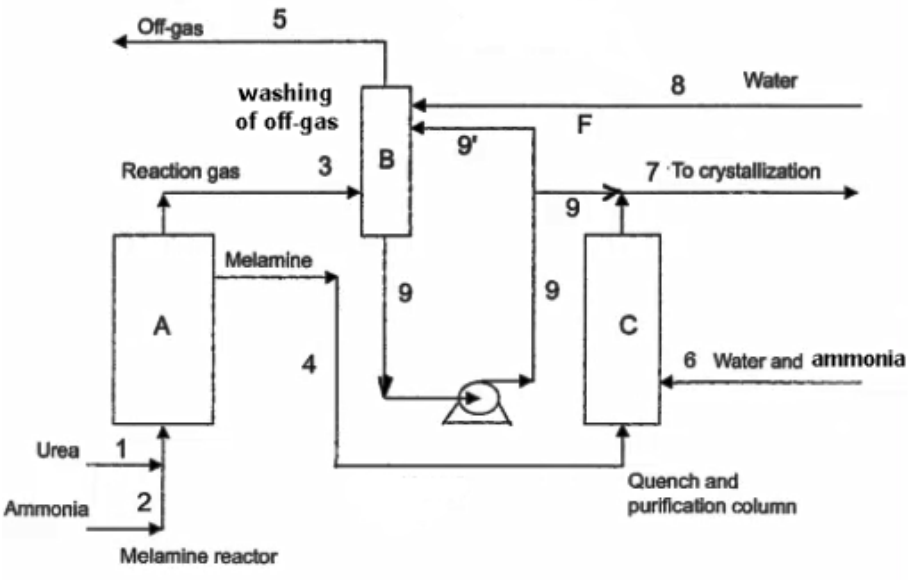
3.4 Obviousness

The appellant submitted that the solution proposed by claim 1 was obvious in view of D2.

3.5 Step d) of claim 1 (CO_2 removal step)

3.5.1 D2 (figure 2 and the passage from page 9, line 23 to page 11, line 22) is concerned with a process for the production of melamine from urea and particularly with the provision of a melamine-free off-gas. Melamine is produced by the pyrolysis of urea in the melamine reactor **A**. The raw liquid comprising melamine (**4**) is separated from the off-gas (**3**) ("*reaction gas*") in the melamine reactor **A**. This off-gas (**3**), consisting of ammonia, carbon dioxide and vaporised melamine, is washed with water (**8**) in the section **B**. This aqueous washing step affords a melamine-free off-gas (**5**) and a solution of melamine (**9**). The solution of melamine (**9**) is mixed with the raw liquid comprising melamine (**4**) to form a stream (**7**) which is sent to crystallisation (figure 2 of D2).

Figure 2 of D2 is reproduced below:



D2 (page 5, line 4 to page 6, line 23) further refers to various drawbacks of using molten urea for recovering melamine from off-gases, including an expensive construction due to the corrosiveness of

molten urea (page 5, lines 11-15), an increase in reaction volumes and thus reduction of the volume available for the synthesis reaction in the melamine reactor owing to the presence of recycled melamine and dissolved off-gases (page 5, line 16 to page 6, line 1), and the need for an additional specific section for receiving the sublimation products obtained when emptying the melamine reactor (page 6, lines 16-23).

In view of the teaching of D2, the skilled person would have replaced the washing step with molten urea of D1 by the aqueous washing step disclosed in D2.

However, by doing so, the skilled person would not have arrived at the subject-matter of claim 1 as granted, since neither D1 nor D2 discloses any CO_2-removing step applied to the aqueous melamine stream (**20**) coming from the aqueous washing step (step d) according to claim 1 as granted). It is noted that D2 does not teach further purification of the aqueous melamine stream (**9**) obtained from the aqueous washing step. On the contrary, D2 teaches that the aqueous melamine stream (**9**) "*has a very high purity*" and is sent directly to crystallisation (page 13, lines 3-7 of D2). Furthermore, there is no clear teaching in D1 or D2 that the off-gas stream (**16**) (according to claim 1 as granted) exiting the post reactor should be combined with the off-gas stream (**15**), which are together washed with water.

For these reasons, the board considers that, even on combining D1 with D2, the skilled person would not have arrived at the subject-matter of claim 1 as granted. The same reasoning applies to the subject-matter of claim 15 as granted.

3.5.2 The appellant argued that there was no clear and unambiguous indication in D2 that the effluent of an aqueous off-gas washing section, as in figures 2 to 5, should not be subjected to a CO_2-removing step. Even if it were accepted that some embodiments of D2 did not require said CO_2-removing step because the effluent of the aqueous washing column had a CO_2 content that was acceptable for crystallisation, this would not have taught against the provision of such a CO_2-removing step. The skilled person was aware that CO_2 was undesirable in the crystallisation of melamine. Annex 1 confirmed that the process according to figure 2 and the example on pages 13-16 of D2 produced a melamine aqueous stream comprising a non-negligible amount of CO_2. Thus, the CO_2-removing step applied to the aqueous melamine stream (**20**) according to claim 1 as granted was an obvious technical measure that the skilled person would have envisaged.

The board does not agree with the appellant, for the following reasons.

Annex 1 is a calculation of the CO_2 content of the aqueous melamine stream (**9**) sent to crystallisation in the process disclosed in figure 2 and the example of pages 13-16 of D2.

First, as set out above, D2 does not teach further purification of the aqueous melamine stream obtained from the aqueous washing step, the aqueous melamine stream (**9**) having a "very high purity" (page 13, lines 3-6) and being sent directly to crystallisation. Consequently, D2 does not teach a purification step of the aqueous melamine stream obtained from the aqueous washing step, let alone a CO_2-removing step applied to this stream.

Secondly, the appellant's argument that a skilled person was aware that CO_2 was undesirable in the crystallisation of melamine and that the melamine aqueous stream (**9**) of D2 comprised a non-negligible amount of CO_2 as evidenced by annex 1 is based on an *ex-post facto* analysis. In the problem solution/ approach, the question to be answered is whether the prior art, rather than post-published data (in the present case, Annex 1), teaches the solution to the objective technical problem and whether, in view of this, the skilled person would arrive at the claimed subject-matter in an obvious manner. In the present case, as set out above, D2 does not suggest any CO_2-removing step applied to the aqueous melamine stream (**9**). This conclusion cannot be changed by the post-published results provided by Annex 1, which are hence not relevant to the present problem/solution approach.

3.5.3 The appellant also argued that D1 indicated the removal of CO_2 prior to crystallisation (paragraph [0009]). This prompted the skilled person to prepare a melamine stream with a low content of CO_2 and thus to remove CO_2 from the aqueous melamine stream (**21**).

The board cannot accept the appellant's argument.

Paragraph [0009] of D1 reads: "*The aqueous solution from the quench also contains a certain amount of dissolved ammonia and CO_2 that is eliminated in the following CO_2 stripper. The elimination of the CO_2 is necessary in order to get a high degree of purity of melamine in the down-stream treatment.*"

First, this paragraph does not refer to the process of D1 but to the process of the prior art cited in D1. Paragraph [0009] is to be read in combination with paragraphs [0006]-[0008] and figure 1, which disclose

the process of a document cited in D1 ("*A simplified block diagram of an embodiment of the process according to the above-mentioned patent no, U.S. Pat. No. 3,161,638 is shown in* ***FIG.1***"). Secondly, the process of D1 itself does not require any CO_2 stripper, since CO_2 in the raw melamine is eliminated in the post reactor before entering the quenching column.

3.5.4 The appellant also referred to paragraph [0026] of D1 in combination with figures 4 and 5 of D2, stating that said paragraph of D1 taught that a low concentration of CO_2 was required to hydrolyse the polycondensates. In figures 4 and 5 of D2, the quenching column **C** received the raw melamine stream (**4**) from the melamine reactor **A** and the aqueous melamine stream (**9**) recovered after aqueous washing of the off-gas. The latter stream might comprise CO_2, and the skilled person would have considered a CO_2-removing step prior to the introduction to the quenching column **C** in order to ensure the very low content of CO_2 suggested by D1.

The board cannot accept the appellant's argument, for the following reasons.

It is true that, in figures 4 and 5 of D2, the quenching column **C** receives the raw melamine stream (**4**) from the melamine reactor **A**, and the aqueous melamine stream (**9**) from the aqueous washing device **B**. However, the corresponding explanation of the figures in the description of D2 (page 11, lines 6-18) teaches that CO_2 in the raw melamine (bringing the raw melamine into contact with NH_3 to eliminate CO_2) is removed using the process disclosed in D1, reference being made to D11, which is the priority document of D1. Thus, contrary to the appellant's submission, there is no teaching to remove the CO_2 from aqueous melamine stream (**9**) entering the quenching column **C**. On the contrary, D2

(page 13, lines 15-18) teaches that said stream is not further purified and is fed to the quenching column **C**, and that the polycondensates are efficiently eliminated in said column C, the content of CO_2 in the resulting solution being "no longer [...] significant".

3.6 Step c) of claim 1 (aqueous washing of off-gas streams (**15**) and (**16**))

3.6.1 Regarding the further distinguishing feature of the aqueous washing of off-gas stream (**16**) according to claim 1 as granted, the appellant argued that the skilled person would try to recover melamine contained in said stream (**16**) and that an off-gas stream must be melamine-free before being discharged from the plant. This was a clear teaching to wash the stream (**16**) in the existing washing section used for treating off-gas (**15**).

The board does not share the appellant's view. While it is accepted that an off-gas stream to be discharged must be melamine-free and that the skilled person would try to recover melamine, there is no direct disclosure in D1 or D2 that the off-gas stream (**16**) exiting the post reactor should be treated in the same way as off-gas stream (**15**) from the melamine reactor **A**. As submitted by the respondent, the skilled person could have washed both off-gas streams (**15**) and (**16**) with water but, in the absence of a clear teaching in either D1 or D2, would not necessarily have done so.

3.7 Therefore, the subject-matter of claim 1 as granted is not rendered obvious by the combination of D1 and D2.

4. D2 as the closest prior art

4.1 As set out above (3.4), D2 is concerned with a process for the production of melamine and particularly with the provision of a melamine-free off-gas washed with water. Hence, D2 can also be considered to represent the closest prior art.

4.2 Distinguishing features

D2 (figure 2, reproduced below for convenience of the reader) discloses the pyrolysis of molten urea in the melamine reactor **A**, and the separation of a liquid stream of raw melamine (**4**) and an off-gas stram (**3**), thus disclosing step a) according to claim 1 as granted.

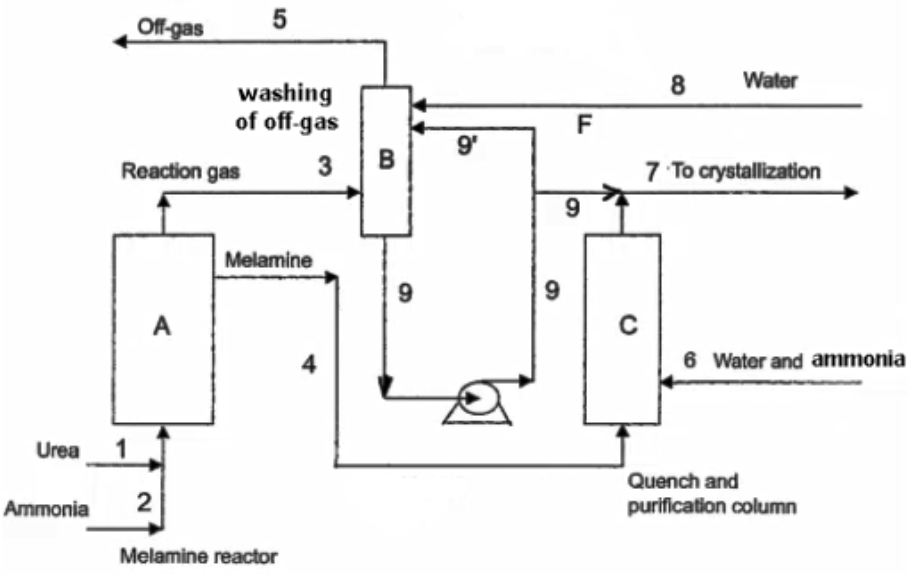


Figure 2 of D2

D2 also discloses an aqueous washing step applied to the off-gas (**3**) produced during the pyrolysis of molten urea in apparatus B. No off-gas from a CO_2-stripping step with NH_3 of the liquid stream of raw melamine (**4**) is disclosed in D2. Thus, the aqueous washing step

according to claim 1 as granted, involving washing of the off-gas from the reactor (**15**) and the off-gas of the CO_2 stripping with NH_3 (**16**), is only partially disclosed in D2.

D2 further refers to the crystallisation of the melamine stream (**7**) from the quenching column **C** and the aqueous melamine stream (**9**) from the washing column **B**. Crystallisation necessarily implies the presence of a mother liquor. Thus, step e) according to claim 1 as granted is also disclosed.

Therefore, the subject-matter of claim 1 as granted differs from D2 in

- putting the liquid stream of raw melamine (**3**) in contact with gaseous anhydrous NH_3 for removing CO_2, hereinafter "CO_2-stripping step with NH_3",
- subjecting the off-gas stream (**16**) from step b) to the aqueous washing step together with the off-gas stream (**15**) from the melamine reactor, and
- step d), namely the step of removing at least a part of the CO_2 from the aqueous stream (**20**) of the aqueous washing of step c).

4.3 Objective technical problem

It was common ground between the parties that the purpose according to claim 1 as granted was to purify the stream of raw melamine exiting the melamine reactor.

As formulated by the appellant, the objective technical problem may thus be seen in the provision of a process for purifying the melamine stream coming from the melamine reactor.

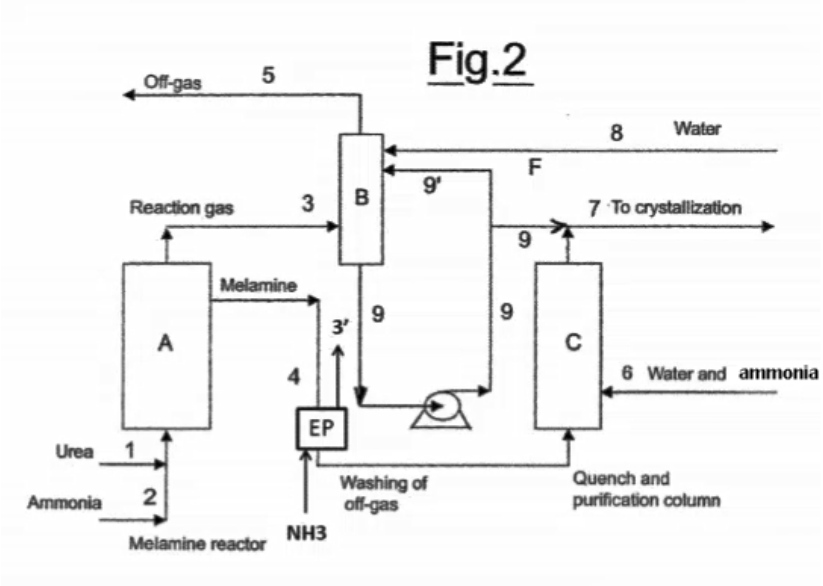
4.4 Obviousness

D2 (from page 10, line 23 to page 11, line 3) suggests a purification of the stream of raw melamine (**4**) exiting the melamine reactor **B**. Since the above passage refers to D11 (priority document of D1), the skilled person would have applied the step of purifying the stream of raw melamine disclosed in D1, namely the step of CO_2 stripping with NH_3 (first distinguishing feature identified above).

However, as established in the context of discussing D1 as the closest prior art, applying a CO_2-removing step to the aqueous melamine stream from the washing step (**20**) (third distinguishing feature identified above) is not obvious in view of D2. Furthermore, there is no clear teaching in D2 that the off-gas stream (**16**) exiting the post reactor should be combined with the off-gas stream (**15**) and washed with water (second distinguishing feature identified above).

4.5 The appellant argued that the annotated figure on page 10 of the statement of grounds of appeal reflected the interpretation that would be made by a skilled person in view of the disclosure of D2, and that the missing features were straightforward options.

The board does not agree. The annotated figure referred to by the appellant is reproduced below:



The appellant modified the disclosure of D2 by combining it with that of D1 (referred to in D2 by means of the priority document D11 of D1) in order to forcibly arrive at the subject-matter of claim 1 as granted. However, as set out above when discussing inventive step in view of D1 as the closest prior art, the application of a CO_2-removing step to the aqueous melamine stream (**9**) (third distinguishing feature above) is not obvious in view of the annotated figure above. Furthermore, there is no clear teaching in D2 that the off-gas stream (**3'**) exiting the post reactor **EP** in the annotated figure above should be combined with the off-gas stream (**3**) and washed with water (second distinguishing feature above). Therefore, there is no suggestion of combining the missing features (aqueous washing of the off-gas stream (**3'**) and CO_2-removing step applied to the aqueous melamine stream (**9**)) with the relevant parts of D2 to arrive at the subject-matter of claim 1.

The appellant further argued that the skilled person knew that the melamine stream to be crystallised had to have a high pH and thus a low content of CO_2. They

would thus have investigated whether the aqueous melamine stream (**9**) of D2 would have the required low CO_2 content, and if necessary would have applied a CO_2-removing step to the aqueous melamine stream (**9**).

As set out above in the context of D1 as the closest prior art, the argument is based on an *ex-post facto* analysis. Neither D1 nor D2 teaches removing CO_2 from the aqueous stream of melamine coming from the off-gas washing step.

Therefore, the subject-matter of claim 1 as granted is not rendered obvious by D2.

5. Based on the above considerations, the board comes to the conclusion that, taking into consideration the cited prior art, it was not obvious to the skilled person to modify the process of the closest prior art such as to arrive at the process as defined in claim 1 as granted.

Therefore the subject-matter of claim 1, and by the same token of claims 2-15, as granted involves an inventive step.

6. During the oral proceedings, the appellant did not rely on A002. This document essentially discloses the purification of a crude melamine containing hydroxy-triazines as impurities. Since this feature is not relevant in the assessment of inventive step (see above), there was no need to decide on the admittance of A002.

7. Articles 100(b) and 83 EPC

7.1 In the communication pursuant to Article 15(1) RPBA, the board has already expressed its preliminary view on the following points regarding Articles 100(b) and 83

EPC. The appellant did not contest the board's preliminary view in that respect.

7.2 Claim 1 as granted requires, in step c), at least one aqueous washing stream to be brought into contact with first and second anhydrous off-gas streams (**15**) and (**16**) obtained in steps a) and b) of the claim.

7.3 The appellant objected to the fact that the operating conditions (temperature, pressure and water/off-gas ratio) for the aqueous washing step (step c)) were missing from claims 1 and 15 as granted. It submitted that, in the aqueous washing step, NH_3 and CO_2 partly dissolved in the aqueous washing stream and were carried along in the process, rather than leaving the actual process in the stream (**19**). It argued that the degree of off-gas solubilisation depended upon the temperature, pressure and water/off-gas ratio used in the aqueous washing step. The patent application did not provide information on the requirements of the aqueous stream and the related temperature and pressure for obtaining the advantage of low energy consumption. The skilled person was unable to carry out the invention over the scope of the claims, and was faced with undue burden for selecting the operating conditions.

7.4 Sufficiency of disclosure may not be assessed solely on the basis of the claims; an objection under Article 83 EPC must rather be judged on the basis of the European patent application as a whole (T 68/85, reasons 8.1). In this respect, the following passages of the description are of relevance:

The passage on page 19, lines 14-18 of the application as filed reads as follows: "*The section OGQ operates at temperatures ranging from 125-190°C, preferably*

160-175°C, and pressures within the range of 20-30 bar_{rel}., preferably at about 25 bar_{rel}.; the mass ratio between the stream 32 and the stream 17 ranges from 0.3 to 2.0, preferably from 0.4 to 0.7.". The stream (**32**) is the aqueous washing stream, and the stream (**17**) is the off-gas stream formed from the first and second anhydrous off-gas streams (**15**) and (**16**) (figure 3). Thus, this paragraph provides the skilled person with the relevant information regarding the temperature, pressure and water/off-gas ratio for the aqueous washing step of the process of claim 1 as granted (step c)).

The passage on page 32, lines 5-9 of the application as filed is part of the sole example according to the invention. It discloses the conditions for bringing the aqueous washing stream (**32**) into contact with the first and second anhydrous off-gas streams (**15**) and (**16**) in the aqueous washing column. The operating conditions are a temperature of 169°C, a relative pressure of 25 bar and a velocity of 7.0 t/h of the aqueous solution. The passage on page 31, lines 8-18 of the application as filed discloses the velocity (13.0 t/h) of the stream formed from the first and second anhydrous off-gas streams (**15**) and **16**) and the content of melamine in this stream (3.8% in mass).

In view of this information, the board considers that the skilled person is not faced with undue burden for selecting the operating conditions (temperature, pressure and water/off-gas ratio) for carrying out the process defined in claim 1 as granted. Nor is a skilled person who knows the operating conditions faced with undue burden for selecting the aqueous washing section (**OGQ**) required by claim 15, which is to be adapted for putting first and second anhydrous off-gas streams (**15**) and (**16**) in contact with the aqueous washing stream

under the operating conditions defined in the passages on page 19, lines 14-18 and page 32, lines 5-9.

For these reasons, the invention as defined in claims 1 and 15 of the patent is sufficiently disclosed within the meaning of Article 83 EPC.

8. The board thus comes to the conclusion that the grounds for opposition under Article 100(a) EPC in combination with Article 56 EPC, and under Article 100(b) EPC do not prejudice maintenance of the patent as granted.

Order

For these reasons it is decided that:

1. The appeal is dismissed.

The Registrar: The Chairman:

N. Maslin M. O. Müller

Decision electronically authenticated