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**Datasheet for the decision
of 8 August 2019**

Case Number: T 2037/16 - 3.3.05

Application Number: 03741152.7

Publication Number: 1533323

IPC: B01D1/14, B01D3/38, C08F6/10,
C08F6/12, C08C2/06

Language of the proceedings: EN

Title of invention:

METHOD OF REMOVING SOLVENT FROM POLYMER SOLUTION AND SOLVENT
REMOVING APPARATUS

Patent Proprietor:

JSR Corporation

Opponent:

LANXESS Deutschland GmbH

Headword:

Method of removing solvent from polymer solution/JSR

Relevant legal provisions:

EPC Art. 54(1), 54(2), 56, 123(2), 123(3)

Keyword:

Novelty - main request (yes) - auxiliary request (yes)
Inventive step - obvious alternative - reformulation of the
technical problem - main request (no) - auxiliary request
(yes)
Amendments - allowable (yes)

Decisions cited:

Catchword:



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Case Number: T 2037/16 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 8 August 2019

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Decision under appeal: **Decision of the Opposition Division of the
European Patent Office posted on 6 July 2016
rejecting the opposition filed against European
patent No. 1533323 pursuant to Article 101(2)
EPC.**

Composition of the Board:

Chairman E. Bendl
Members: T. Burkhardt
R. Winkelhofer

Summary of Facts and Submissions

I. The appeal lies from the opposition division's decision to reject the opposition against European patent No. EP 1 533 323 B1.

II. The following documents were among those discussed at the opposition stage:

D1 US 4,408,039 A1

D2 US 3,862,103 A1

D14 H. Kuchling, "Taschenbuch der Physik", 5.-7. Auflage, Leipzig, VEB Fachbuchverlag, 1985, 604-607

III. In the contested decision it was held, *inter alia*, that the requirements of Articles 123, 83, 54 (in view of document D1) and 56 EPC did not prejudice the maintenance of the patent as granted.

IV. Claim 1 of the patent as granted (now the main request) reads as follows (feature numbering in square brackets):

[1] "1. A **method** for removing solvent from polymer solution by putting the polymer solution in contact with steam to remove the solvent by steam stripping, comprising:

[2] a step of feeding a part of said steam

[2.1] into a tube for transferring said polymer solution to a tank for removing solvent,

[2.2] wherein the amount of the steam fed into the tube for transferring said polymer solution is 0.5- to 2- folds the calculated amount

thereof required for the evaporation of the solvent; and

- [3] a step of feeding the remaining part of said steam
 - [3.1] into the inside of said tank for removing solvent by a steam feed tube for a tank;
- [4] wherein a gas-liquid mixer for mixing said part of said steam and said polymer solution is arranged in said tube for transferring polymer solution, and
- [5] a mixture of said part of said steam and said polymer solution is fed to said tank for removing solvent;
- [6] wherein
 - [6.1] (A) the whole amount of said steam is large as 100 parts by mass or more per 100 parts by mass of the solvent contained in said polymer solution and a part of said steam is 10 to 50% by mass when the whole amount of said steam is defined as 100% by mass; or
 - [6.2] (B) the whole amount of said steam is less than 100 parts by mass per 100 parts by mass of the solvent contained in the polymer solution and a part of said steam is 20 to 90% by mass when the whole amount of said steam is defined as 100% by mass;
- [7] wherein
 - [7.1] the temperature of the polymer solution is 0 to 150°C and
 - [7.2] the number average molecular weight (Mn) of the polymer is 5,000 to 5,000,000; and
 - [7.3] wherein the solvent has a boiling point of 25 to 180°C at a pressure of 0.1 MPa."

V. In a communication according to Article 15(1) RPBA, the board, *inter alia*, informed the parties that the subject-matter of method claim 1 of the main request appeared not to fulfil the requirements of Article 56 EPC.

VI. In reply thereto, the patent proprietor (respondent) submitted, *inter alia*, auxiliary request M II.

The respondent additionally stated that it withdrew its request for oral proceedings and previously submitted auxiliary requests A-L in case the board decided to maintain the patent on the basis of auxiliary request M II.

The opponent (appellant) thereupon indicated that it withdrew its request for oral proceedings in this event, too.

VII. Claim 1, the only independent claim of auxiliary request M II, reads as follows:

"1. An **apparatus** for removing solvent from polymer solution, wherein the solvent has a boiling point of 25 to 180°C at a pressure of 0.1 MPa, the temperature of the polymer solution is 0 to 150°C and the number average molecular weight (Mn) of the polymer is 5,000 to 5,000,000, including a tank for removing solvent, comprising:

a tube for transferring polymer solution to transfer polymer solution to the tank for removing solvent, one end of which is opened in the tank for removing solvent,

a steam feed tube for piping which is in communication with said tube for transferring polymer solution to feed steam to the said tube, and a steam

feed tube for tank, one end of which is opened in said tank for removing solvent,

wherein said apparatus is equipped with a gas-liquid mixer arranged in said tube for transferring polymer solution and a steam feed tube for the gas-liquid mixer which is in communication with said tube for transferring polymer solution or said gas-liquid mixer to feed steam into said gas-liquid mixer;

said tank for removing solvent is equipped with the following member (3):

(3) a flush nozzle structure selected from the following members (a), (c), or (d) to reduce the flush speed of the polymer solution discharged from a flush nozzle arranged in communication with said tube for transferring polymer solution and to suppress the flow of the solvent vapor down to the side of the liquid phase;

(a) a flush nozzle structure is a flush nozzle with a branch tube arranged on the side of the tip end thereof;

(c) a flush nozzle structure is a spiral tube arranged in communication with said tube for transferring polymer solution and formed in a spiral shape along the vertical direction of said tank for removing solvent, where an opening is arranged toward the downwardness of said tank for removing solvent;

(d) a flush nozzle structure is equipped a flush nozzle arranged large diameter tube on the tip end of said flush nozzle and baffle arranged in the inside of said large-diameter tube."

Claims 2 to 5 are dependent on claim 1 and describe preferred embodiments thereof.

VIII. The appellant's arguments of relevance for the present decision are essentially as follows.

The subject-matter of method claim 1 of the main request (patent as granted) lacked novelty in view of D1. The parameters that were not explicitly disclosed therein could be deduced in a direct and unambiguous manner.

Even if novelty vis-à-vis D1 were to be accepted, the claimed subject-matter still lacked inventive step when starting from this document.

The subject-matter of several alternatives in apparatus claim 3 of the main request was rendered obvious by D2.

IX. The respondent essentially argues as follows.

The subject-matter of the claims of the main request was novel and inventive. D1 failed to disclose several features of claim 1:

- Prestripper 6 in the figure could not be construed as a tube with a gas-liquid mixer.
- Contrary to feature 5, stream 4 of the figure in D1 contained water, and no longer steam.
- The data given in D1 were incomplete and it could not be ascertained that the water balance of stripper 7 was respected. Consequently, it was not possible to determine whether criteria 2.2 and 6 in claim 1 were fulfilled.

Figure A on page 7 of the grounds of appeal should not be considered.

X. The appellant requests that the decision be set aside and the patent be revoked in its entirety.

The respondent requests that the appeal be dismissed and the patent be maintained as granted (main request). As auxiliary measures, it requests that the patent be maintained on the basis of auxiliary request M II as filed with submission of 6 August 2019 or on the basis of one of auxiliary requests M or N, filed with submission of 27 March 2017.

Reasons for the Decision

1. Main request: Novelty

For the following reasons, the subject-matter of claim 1 of the contested patent is novel in view of **D1** (Article 54(1) and (2) EPC).

1.1 D1 refers to a method for removing solvent from a polymer solution by steam stripping (corresponding to feature 1 of present claim 1).

Contrary to the respondent's allegation, the system comprising prestripper 6, lines 1, 2 and 4 of Figure 1 of D1, can be construed as the "tube for transferring said polymer solution" comprising "a gas-liquid mixer" within the meaning of features 2, 2.1 and 4 of claim 1 of the contested patent. The claim does not specify any dimensions, and D1 does result in a premixing of the polymer-solvent solution 1 with a first portion of the stripping steam 2 followed by a transfer to the downstream tank system.

Line 21 of Figure 1 (column 4, lines 11/12) is construed as the "steam feed tube" to feed the

"remaining part of [the] steam" within the meaning of features 3 and 3.1.

The system comprising the primary steam stripper 7 and the secondary steam stripper 8 is construed as the "tank" (features 2.1 and 5).

Both the patent in suit (paragraph [23]) and Example 1 of D1 disclose a styrene-butadiene rubber solution. Polymer solution stream 1 is provided at a temperature of 63°C. Eventually, cyclohexane has a boiling point of 81°C, i.e. within the claimed range. Consequently, features 7, 7.1 and 7.3 are also disclosed in D1.

- 1.2 The respondent further asserts that, according to feature 5, steam, i.e. uncondensed steam, has still to be present after contacting the polymer solution.

This argument is not convincing. According to feature 2.2, the "part of said steam" may correspond to as little as 0.5 times the amount required for the evaporation of the solvent. In this event, the steam condenses as soon as it contacts the polymer solution in the gas-liquid mixer, resulting in a fluid without steam being transferred to the tank, contrary to the literal wording of feature 5.

Consequently, in order to make technical sense of feature 5 of claim 1 as granted, it is understood that the expression "part of said steam" also encompasses any part of *condensed* steam.

Hence, the absence of (uncondensed) steam in stream 4 is not a distinguishing feature.

1.3 However, feature 5 of claim 1 of the patent in suit requires that "a mixture of said part of **said** steam and **said** polymer solution is fed to said tank ..." (emphasis added). The word "said" in the above expression means that the *entire* steam and polymer solution is fed to the tank, not only portions of these streams. By contrast, in D1 a portion of the steam entering prestripper 6 via line 2 and a portion of the polymer solution entering via line 1 leave the prestripper *via* overhead 3 (column 4, lines 26-28).

At least this feature distinguishes the subject-matter of claim 1 of the main request from D1.

2. Main request: Inventive step

For the following reasons, the subject-matter of claim 1 of the main request is not inventive in view of D1.

2.1 Contested patent

The contested patent relates to a method and an apparatus for removing solvent from polymer solution.

2.2 Closest prior art

2.2.1 D1 also relates to the efficient removal of solvents from polymer solutions by stripping with steam (abstract, column 1, lines 7-11) within the meaning of feature 1 of claim 1 of the main request.

As shown in point 1.1, D1 also discloses the features 2, 2.1, 3, 3.1, 4, 5, 7, 7.1 and 7.3.

2.2.2 While feature 7.2 (average molecular weight) has not been explicitly mentioned in D1, it is highly plausible that the styrene-butadiene rubber solution disclosed in Example 1 of D1, which is also a preferential rubber solution of the present invention according to paragraph [23], has an average molecular weight in the claimed range. At least no effect with regard to the range presently indicated has been rendered plausible.

2.2.3 The appellant has presented calculations in its grounds of appeal (pages 7-11) to show that the data of Example 1 of D1 allow the following parameters to be deduced:

- the amount of steam necessary to evaporate the cyclohexane present in prestripper bottom 4 (this cyclohexane being entirely evaporated according to Example 1) by using the enthalpies of vaporisation, "the remaining part of [the] steam" added via line 21 by adding the amount of steam as determined in step (i) and the (uncondensed) amount of steam present in primary steam stripper overhead stream 5,
- the "whole amount of [...] steam" by adding the "remaining part" as determined in step (ii) and the steam of stream 2, and
- the calculated amount of steam required for the evaporation of the (*entire*) solvent (cyclohexane amount in streams 4 and 3) from the enthalpies of vaporisation.

Accordingly, it would follow that the ratio of the steam fed into prestripper 6 and the mass of the steam calculated for the evaporation of the solvent was 1.24 and thus within the claimed range of 0.5 to 2 (feature 2.2 of claim 1 of the contested patent).

It would also follow that feature 6.2 of claim 1 was fulfilled, since there was less steam than solvent - consequently criterion (B) applied - and the part of the steam fed to the prestripper *via* line 2 was 45% of the whole amount of steam, i.e. the steam provided to the prestripper and the steam provided to the tank *via* line 21, 45% being clearly within the claimed range of 20% to 90% of feature 6.2.

2.2.4 Admittedly, the appellant's calculations comprise several simplifications and an error.

- The calculations only account for the latent heat that is necessary for vaporising the cyclohexane solvent. The amount of steam necessary for the change in temperature (sensible heat) of the polymer-solvent mixture is neglected.
- Heat losses, e.g. through the vessel and tube walls, are neglected.
- Any vaporisation/condensation effects due to the reduction in pressure from 345 kPa to 117 kPa between prestripper 6 and primary stripper 7 are neglected.
- In the calculations, the enthalpy of vaporisation of hexane is used, and not that of *cyclo*-hexane. The "dHv so" value of 332 kJ/kg (see the appellant's grounds of appeal, page 8) corresponds to hexane as shown by **D14** (page 604, "Hexan").

However, the results of the calculation are situated quite in the middle of the claimed ranges of features 2.2 and 6.2, and the predominant phenomena in Example 1 of D1 are accounted for as explained above. The features at issue are therefore considered to lie within the claimed ranges or at least in the vicinity thereof. In any case, no effect associated with the claimed ranges was identified.

The parties were already informed in the communication under Article 15(1) RPBA about the then preliminary view of the board with regard to features 2.2 and 6 (end of point 11.2). Still, no evidence or further arguments were submitted in this respect. There are no reasons to deviate from this preliminary view.

- 2.2.5 The respondent argues that it remains unclear how the mass balance of stripper 7 in D1 was respected, since the details of several streams were missing. Consequently, it could not be ascertained that Example 1 of D1 fulfilled criteria 2.2 and 6 of claim 1.

This argument is not convincing. Firstly, as explained above, it is not only stripper 7 of D1 that is construed as the "tank" of claim 1, but the *system* comprising primary and secondary steam strippers 7 and 8 as well. Secondly, it is explained above why criteria 2.2 and 6 of claim 1 are considered fulfilled by Example 1 of D1.

- 2.2.6 The parties see in D1 a suitable starting point for the problem-solution approach. Since D1 deals with the removal of a solvent from a polymer solution and addresses the efficiency of the solvent removal, there is no reason to deviate from this view.

- 2.3 Technical problem to be solved

According to the contested patent, the problem to be solved is to achieve an efficient removal of solvent from a polymer solution (paragraph [5]).

2.4 Solution

The contested patent suggests solving this problem by means of the method according to claim 1.

This involves, *inter alia*, the premixing of a portion of the stripping steam with the polymer-solvent solution upstream of a tank and feeding the *entire* portion of the stripping steam and the entire polymer solution to the tank.

2.5 Success of the solution

According to Example 1 of D1, overhead stream 5 from the primary steam stripper 7 contains 8163 kg/hr of solvent. This is identical to the amount in the primary steam stripper feed stream 4. This means in turn that stream 16 has to be entirely free of solvent. Consequently, the problem of efficiently removing the solvent from the polymer solution is already solved in D1.

2.6 Reformulation of the technical problem

Since the problem of efficiently removing the solvent from the polymer solution is already solved in D1, the problem to be solved has to be reformulated and is merely the provision of an *alternative*.

2.7 Obviousness

It is precisely the central idea of D1 (abstract) and rather *advantageous* to remove a portion of the solvent together with a portion of the steam already at the prestripping stage 6 of D1 (*via* overhead stream 3). The

third paragraph in column 1 of D1 stresses this advantage compared to "conventional steam stripping".

This removal at the prestripping stage decreases the solvent concentration in the gas phase of the subsequent tank system 7/8 and thus increases the driving force resulting from the gas-liquid phase equilibrium. Hence, more solvent is "sucked" from the polymer solution into the gas phase 5.

By contrast, in the conventional steam stripping, i.e. without such a prestripping stage, the gaseous phase in tank 7/8 would contain the entire vaporised solvent. Hence, the concentration of the solvent in the gas phase would be higher and the driving force of solvent from the liquid into the gas phase reduced.

Thus, starting from the improved solvent removal process according to D1, the return to the "conventional steam stripping" cannot justify an inventive step.

This argument was already expressed in the communication under Article 15(1) RPBA and has not been contested by the parties.

Consequently, the subject-matter of claim 1 of the main request does not fulfil the requirements of Article 56 EPC.

3. Auxiliary request M II: Amendments

- 3.1 As compared to the claims as granted, the claims of auxiliary request M II no longer comprise any method, only apparatus claims.

Independent apparatus claim 1 is based on claims 11, 12, 24, 25, 28 as originally filed, as well as on page 15, paragraphs 2 and 3, page 16, paragraph 2, and page 30, paragraph 3 as originally filed.

The dependent claims are based on:

- claims 13 and 17 as well as on page 21, last paragraph, as originally filed
- claim 17 as originally filed
- claim 16 as originally filed
- claim 26 as originally filed and page 21, last paragraph

For these reasons, the requirements of Article 123(2) EPC are fulfilled.

For the sake of completeness, it is noted that the compliance of the apparatus claims with Article 123 EPC has not been disputed at the appeal stage, neither with regard to the claims as granted nor with regard to the claims of any of the auxiliary requests.

- 3.2 Independent apparatus claim 3 as granted referred back to claim 1 as granted and after the deletion of the method claims in auxiliary request M II, all structural features that were implied by the method claim and which have an impact on the properties of the apparatus are comprised in the independent apparatus claim.

Moreover, as compared to claim 3 as granted, several alternatives of the "member" have been deleted in claim 1 of auxiliary request M II, namely the "partition member", the "sprinkler", and the "flush nozzle structures" in the form of a "cylinder" or of a "curve tube".

Consequently, the requirements of Article 123(3) EPC are also met.

4. Auxiliary request M II: Sufficiency of disclosure

The objections raised under point L of the grounds of appeal with regard to Article 83 EPC only referred to the method claims, which are no longer present in auxiliary request M II.

5. Auxiliary request M II: Novelty and inventive step

Claim 1 of auxiliary request M II relates to an apparatus for separating solvent from a polymer solution. The apparatus comprises, *inter alia*, a "member" to be selected from three alternatives, the purpose of which is to suppress crumb dispersion (see paragraph [38] of the contested patent).

As compared to apparatus claim 3 as granted, several alternatives of the "member" have been deleted in claim 1 of auxiliary request M II. The deleted alternatives, i.e. alternatives (1) "partition member", (2) "sprinkler", (3b) "cylinder" and (3e) "curve tube", correspond to those that had been objected to by the appellant vis-à-vis D2 (see pages 22-27 of the grounds of appeal).

By contrast, the remaining options for the "member" in independent apparatus claim 1 of auxiliary request M II, namely "members" (3a) "branch tube", (3c) "spiral tube" and (3d) "large diameter tube with baffle", have

not been objected to, neither at the opposition stage nor at the appeal stage.

In view of the available submissions by the parties, the board sees no reason for a different assessment.

6. Further remark

Given the fact that Figure A on page 7 of the grounds of appeal is of no relevance for this decision, a discussion of the admissibility of this figure is dispensable.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The case is remitted to the department of first instance with the order to maintain the patent on the basis of auxiliary request M II as filed with submission of 6 August 2019, and the description and drawings to be adapted.

The Registrar:

The Chairman:



C. Vodz

E. Bendl

Decision electronically authenticated