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Datasheet for the decision of 22 January 2015

Case Number:	T 2077/10 - 3.3.05
Application Number:	01115090.1
Publication Number:	1178055
IPC:	C08F6/12, C08C2/06
Language of the proceedings:	EN

Title of invention:
Method for recovering a polymer from solution

Patent Proprietor:
JSR Corporation

Opponent:
BASF SE

Headword:
Polymer recovery/ JSR

Relevant legal provisions:
EPC R. 80
EPC Art. 54, 56, 123(2)

Keyword:
Main request, auxiliary requests 2 and 3 -
amendment occasioned by ground for opposition - no
auxiliary request 1 - inventive step - no
auxiliary request 4 - inventive step - yes

Decisions cited:
T 0119/82, T 0127/85, T 0939/92

Catchword:

Case Number: T 2077/10 - 3.3.05

DECISION
of Technical Board of Appeal 3.3.05
of 22 January 2015

Appellant: (Opponent)	BASF SE Carl-Bosch-Strasse 38 67056 Ludwigshafen (DE)
Representative:	Reitstötter Kinzebach Patentanwälte Im Zollhof 1 67061 Ludwigshafen (DE)
Respondent: (Patent Proprietor)	JSR Corporation 6-10, Tsukiji 5-chome, Chuo-ku Tokyo 104-0045 (JP)
Representative:	TBK Bavariaring 4-6 80336 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 12 July 2010 concerning maintenance of the European Patent No. 1178055 in amended form.**

Composition of the Board:

Chairman	G. Raths
Members:	G. Glod
	M. Blasi

Summary of Facts and Submissions

I. The present appeal lies from the decision of the opposition division that European patent EP-B-1 178 055 could be maintained in amended form.

The opposition division found that the **main request** fulfilled the requirements of the EPC. Claim 1 reads as follows:

"*1. A method for recovering a polymer comprising heating a polymer solution obtained by a solution polymerization and comprising a solvent, indirectly in a pipe to evaporate the solvent while forming a gas-liquid mixed phase flow or a gas-liquid-solid mixed phase flow followed by supplying said gas-liquid mixed phase flow or said gas-liquid-solid mixed phase flow into a recovery tank to recover said polymer, wherein water or steam is infused into said polymer solution in said pipe, and the linear velocity of a gas at the outlet of said pipe is 10 m/s or more.*"

II. The documents cited during the opposition proceedings included the following:

E1: WO-A-9967002
E3: DE-A-2719968

III. The opponent (hereinafter: **appellant**) filed an appeal against said decision and submitted the grounds for the appeal. The following prior-art documents were cited (E7 is not state of the art):

E8: J.E. Juvet, F.A. Streiff: Statische Vakuumentgasungsapparate bei der Herstellung und Qualitätserhöhung von Kunststoffen; Vakuum in Forschung und Praxis

(1998) Nr. 4, S. 285-293

E9: US 4 537 954

IV. By letter of 6 June 2011, the patent proprietor (hereinafter: **respondent**) replied to the appeal and submitted auxiliary requests 1 to 4.

V. In its communication under Article 15(1) of the Rules of Procedure of the Boards of Appeal (RPBA), the board expressed its preliminary non-binding opinion that the subject-matter of the claims of the main request was novel and that, starting from E1 as closest prior art, it was questionable whether the problem underlying the patent in suit was solved over the whole range claimed.

VI. In reply to that communication, the respondent submitted new auxiliary requests 1 to 7.

Claim 1 of **auxiliary request 1** is based on claim 1 of the main request with the following amendments:

"1. A method for recovering a polymer comprising heating a polymer solution obtained by a solution polymerization ~~and comprising a solvent,~~ indirectly in a pipe to evaporate ~~the~~ a solvent [...]."

Claim 1 of **auxiliary request 2** is based on claim 1 of the main request with the following amendments:

"1. A method for recovering a polymer comprising heating a polymer solution obtained by a solution polymerization and comprising a solvent, indirectly in a pipe to evaporate the solvent [...], wherein water or steam is infused into said polymer solution in said pipe <u>via the inlet of the pipe</u>, and the linear velocity

of a gas at the outlet of said pipe is 10 m/s or more."

Claim 1 of **auxiliary request 3** is based on claim 1 of the main request with the following amendments:

"1. A method for recovering a polymer comprising heating a polymer solution obtained by a solution polymerization and comprising a solvent, indirectly in a pipe such that the polymer solution is heated to the boiling point of the solvent to evaporate the solvent [...]."

Claim 1 of **auxiliary request 4** is based on claim 1 of auxiliary request 1 and reads:

"1. A method for recovering a polymer comprising heating a polymer solution obtained by a solution polymerization indirectly in a pipe to evaporate a solvent while forming a gas-liquid mixed phase flow or a gas-liquid-solid mixed phase flow followed by supplying said gas-liquid mixed phase flow or said gas-liquid-solid mixed phase flow into a recovery tank to recover said polymer, wherein said polymer is at least one selected from the group consisting of butadiene rubber, styrene-butadiene rubber, isoprene rubber, ethylene-propylene rubber, butyl rubber, styrene-butadiene copolymer, styrene-isoprene copolymer and butadiene block polymer, water or steam is infused into said polymer solution in said pipe, and the linear velocity of a gas at the outlet of said pipe is 10 m/s or more."

Claims 2 to 9 represent particular embodiments of the method according to claim 1, on which they depend.

VII. The appellant submitted further arguments and documents with the letters of 20 November 2014 and 1 December 2014.

VIII. Oral proceedings took place on 22 January 2015.

IX. The arguments of the **appellant** can be summarised as follows:

- The expression "and comprising a solvent" was not clear (Article 84 EPC), since it could mean that an extra solvent was added besides the solvent already present in the solution in which the solution polymerisation occurred.

Since said expression was ambiguous it was also not unambiguously derivable from the original application (Article 123(2) EPC).

In particular, this concerned the main request and auxiliary requests 2 and 3.

- E3 disclosed all the features of claim 1 of the request as considered allowable during opposition proceedings (main request) and therefore anticipated the novelty of the claim. The examples showed that the product to be treated was a polymer, namely acrylic resin or polyether. In view of the components present in the composition (unreacted monomers and solvent), the product had to be obtained via solution polymerisation. It was evident from the figure of E3 that steam was added via valve 5 to the polymer solution leaving the reactor 1. The solution then entered the tubular coil 6 that was indirectly heated. A linear and circular flow of the solution was present in the coil so that an exchange between the liquid phase and the gas phase was guaranteed.

- E1 could be considered as closest prior art, since it disclosed a method for isolating polymers from solutions. The difference between the subject-matter of claim 1 and E1 was that water or steam was added into the polymer solution in the pipe.

The problem to be solved was to reduce the amount of steam needed and to improve the devolatilising efficiency.

It was not credible that this problem was solved over the whole range claimed. In addition, it was known that many types of polymer could be hydrolysed, so the addition of water or steam could damage such polymers.

In addition, as shown by calculations, for many solvents it was energetically unfavourable to add water to form an azeotrope in view of the enthalpy of vaporisation of water. This might only be favourable at low solvent concentrations.

Furthermore, the degassing of solutions comprising polymers by the addition of water or steam was energetically favourable only if the polymer concentration was high.

The examples of the patent in suit related only to elastomers, and the example submitted during opposition proceedings did not show any benefit of adding steam and/or water.

Therefore, the problem had to be reformulated as providing a further process.

E3, E8 and E9 taught the addition of steam to polymer solutions for removing solvents.

Therefore, the solution to the problem was obvious.

- In particular, as far as auxiliary request 4 was concerned, the requirements of Article 123(2) EPC were not met, since claim 1 was now limited to elastomeric polymers although the list in the original application comprised two additional polymers, namely butadiene resin, acrylic resin and the like.

Claim 1 did not rule out the possibility that the polymer solution obtained by a solution polymerisation was further purified, so the concentration of the polymer in the solution could be low.

E3 could now be considered the closest prior art. The difference between the subject-matter of claim 1 and E3 was the type of polymer.

It was known that the removal of solvents from elastomers was rather difficult. Since E3 also related to difficult conditions of removal, it was evident that the skilled person would also consider the process for elastomers.

When starting from E1 as closest prior art, the arguments provided for the first auxiliary request were still valid.

X. The **respondent** refuted all the arguments of the appellant.

Its arguments can be summarised as follows:

- Main request, auxiliary requests 2 and 3

The expression "and comprising a solvent" was a double definition of the constituents of the polymer solution that allowed a claim construction providing improved intelligibility.

Rule 80 EPC required only that the amendments were occasioned by a ground for opposition and not that the ground for opposition was overcome.

- As to novelty, E3 disclosed neither a mixed phase of gas-liquid, nor a polymer solution, but a molten polymer containing at most residual amounts of a solvent. In addition, it was not disclosed that the product was obtained by solution polymerisation. E3 did not disclose infusing water or steam into a polymer solution and indirect heating to evaporate a solvent. In addition, E3 did not disclose that a mixed phase of gas-liquid was supplied to a recovery tank.

The differences of the subject-matter of claim 1 and E1 were the mixed phase flow and the infusion of water or steam into the polymer solution.

- As to inventive step, the problem to be solved as defined by the appellant was solved, since the turbulent flow allowed better removal of solvent from the solution. The high devolatilisation efficiency could not be achieved when following the teaching of E1. In the present invention, solvent removal was achieved by employing a mixed phase, which ensured high thermal conductivity and avoided occlusion of the pipe. In contrast to E1, the present invention was not limited to polymers that can be melted so as to allow formation of a film flow.

Comparison of example 1 with the example submitted during opposition proceedings with the letter of 22 March 2010 showed an improvement in devolatilisation efficiency.

The appellant's calculations were only theoretical, while the method of the invention showed that a devolatilisation efficiency of 0.3 could be achieved compared to 0.7 in the conventional steam stripping process.

Sensitivity to hydrolysis of certain polymers was well known to the skilled person, who would therefore not seriously contemplate that these polymers could be purified by the claimed process.

E3, E8 and E9 mentioned the use of entrainers for removing only low amounts of impurities.

Therefore, a combination of E1 and one of E3, E8 or E9 resulted in a method providing an additional purification step using entrainers after having removed larger amounts of impurities without using entrainers.

The question whether the method could be executed over the whole range claimed was a question of sufficiency rather than inventive step.

- In particular, with regard to auxiliary request 4, E1 was still considered to be the closest prior art. E3 did not disclose a polymer solution obtained by solution polymerisation. The method allowed the polymer to be processed at lower temperatures, since the addition of steam/water ensured formation of a gas-liquid(-solid) mixed phase flow so as to achieve high heat exchange performance. This mixed phase flow prevented the pipes from occluding, reduced the residence times required for solvent removal and led to improved energy efficiency.

XI. Requests:

The **appellant** requests that the decision under appeal be set aside and that the patent be revoked.

The **respondent** requests that the appeal be dismissed, i.e. that the patent be maintained in amended form on the basis of the main request (claims as considered allowable by the opposition division), or alternatively that the patent be maintained in amended form on the basis of the claims of one of auxiliary requests 1 to 7 submitted with the letter of 18 November 2014.

Reasons for the Decision

1. Interpretation of claim 1 as granted

This interpretation is of relevance for the discussion of the objections below.

At stake is the expression "a polymer solution obtained by a solution polymerization".

Claim 1 relates to a method for recovering a polymer wherein a polymer solution obtained by a solution polymerisation is heated. To qualify as such a solution, it has to be possible to obtain the solution by the process of solution polymerisation.

For a skilled person, such "a polymer solution" comprises at least a solvent, (unreacted) monomers, a catalyst and the polymer obtained by polymerisation.

The expression "a polymer solution" cannot be interpreted in such a way that it is a solution obtained after isolation and purification steps. If that were the case, it could be argued that a purified viscous polymer comprising residual amounts of solvent was still to be considered "a polymer solution" obtained by a solution polymerisation. Such an interpretation would go against the technical understanding of a skilled person.

For the board, "a solution obtained by a solution polymerization" contains a significant amount of solvent. The solution is indirectly heated, whereby a mixed phase flow is formed, which is supplied to the recovery tank in order to recover the polymer. The mixed phase flow is interpreted as a turbulent flow of a mixture of the gas phase and the liquid phase. Water or steam is added to the polymer solution in the pipe at an undefined point (before or after the formation of gas-liquid mixed phase flow). At the outlet of the pipe the linear gas velocity is 10 m/s or more.

2. Main request, auxiliary requests 2 and 3

2.1 Amendments under Rule 80 EPC

The expression "a polymer solution obtained by a solution polymerization" and the amendment of this expression by incorporation of "and comprising a solvent" gave rise to objections under Rule 80 EPC in combination with comments under Articles 84 and 83 EPC.

According to Rule 80 EPC amendments have to be occasioned by a ground for opposition under Article 100

EPC.

(a) Article 84 EPC

Amendments made to overcome a lack of clarity are not allowable (see also T 127/85, Reasons 7.1).

In the present case, the expression "and comprising a solvent" was apparently added in order to overcome an ambiguity and to emphasise that a solvent was present in the polymer solution. According to the respondent, the amendment should improve the intelligibility of the claim, which means that the amendment was made to improve the clarity of the claim (Article 84 EPC).

The trigger for the amendment was not a ground for opposition.

(b) Article 83 EPC

An argument dealing with the amendment as a precautionary measure against an objection under Article 83 EPC or dealing with the amendment as a means of directly overcoming a lack of sufficiency of disclosure is not accepted.

Sufficiency is determined on the basis of the whole patent application and not only on the basis of the claims.

The board recalls that Article 83 EPC requires answers to the question whether information gaps can be identified. Such information gaps can result from a lack of guidance in general, a lack of guidance in case of failure or the absence of criteria for selection rules or purpose-related instructions.

The board cannot identify a lack of sufficiency in the present case. This is in line with the fact that the appellant at no time invoked a ground for opposition under Article 100(b) EPC in conjunction with Article 83 EPC.

(c) Conclusion

Since the trigger for the amendment "and comprising a solvent" was not a ground for opposition, claim 1 does not fulfill the requirements of Rule 80 EPC. Since the amendment is present in claim 1 of the main request and of auxiliary requests 2 and 3, those requests are to be refused.

3. Auxiliary request 1

3.1 Article 123(2) EPC

Claim 1 is a combination of claims 1, 2 and 10 as originally filed.

The requirements of Article 123(2) EPC are met.

3.2 Article 54 EPC

E3 is the only document that the appellant considered relevant for the question of novelty.

E3 discloses a process for removing residual constituents from a liquid product such as monomers remaining after polymerisation, solvents or contaminants (E3: page 2, paragraphs 1 and 2). The process allows these residuals to be removed even from highly viscous product liquids (E3: page 4, lines 5 to

7).

One specific embodiment is shown in the figure. The product to be evaporated is delivered by the gear pump 2 to the tubular coil 6. Steam is introduced via valve 5. The pressure upstream of the tubular coil may be adjusted by the throttle valve 4 in such a way that evaporation begins after the valve. A two-phase flow thus develops in the tubular coil 6. The liquid flows along the wall of the tube in the form of a ring flow and is transported by the steam (gas) flowing at high velocity inside the tube. A circular flow between the wall of the tube and the surface of the liquid is developed transversely thereof. Vapour and evaporated product are separated in the separation vessel 7. The vapour is deposited in the condenser 9 and the product is brought to normal pressure through the discharge vessel 8 (E3: page 5 and figure).

It is not unambiguously derivable from E3 that the polymer solution is obtained by solution polymerisation, especially in view of the expression "residual constituents" and the concentration of volatiles given in the examples (E3: table, page 6), which are not really indicative of significant amounts of solvent present in solution polymerisation.

In addition, E3 indicates a two-phase flow whereby there is some exchange between the gas phase and the liquid phase, but it is not entirely clear that the heating of the pipe is such that it leads to a gas-liquid mixed phase flow. The liquid flow along the wall with a steam flow inside the tube cannot be considered as a gas-liquid mixed phase flow although some exchange between the gas and liquid phases occurs. It rather appears that the two-phase flow is a laminar flow, especially in view of the flow along the wall. This means that there is also no unambiguous disclosure of a gas-liquid mixed flow that is supplied to a recovery tank.

The exact process conditions are not described in E3, so the Reynolds number cannot be determined. Therefore, the presence of turbulent flow cannot be unambiguously derived.

The subject-matter of claim 1 is not directly and unambiguously derivable from E3, and the requirements of Article 54 EPC are met.

3.3 Article 56 EPC - inventive step

3.3.1 Invention

The invention concerns a method for recovering a polymer efficiently from a polymer solution obtained by solution polymerisation.

3.3.2 Closest prior art

The parties considered E1 to be the closest prior art. The board agrees. E1 can be considered the closest prior art since it also relates to the concentration of polymers and the removal of solvents from polymer solutions (E1: page 3, lines 1 to 3).

E1 discloses a process of evaporating a viscous polymer solution comprising at least 30 wt. % of solvents and monomers, wherein said viscous polymer solution is introduced into a heated helix, said heated helix having a vapour exit velocity of 200 to 300 m/s, a film flow comprising a **two-phase mixture** of polymer melt, and solvent vapours and monomer vapours being formed within said helix, said film flow being forwarded from said helix into a heated vapour separator, and expanding the two-phase mixture of polymer melt, and solvent vapours and monomer vapours of said film flow within said vapour separator at an absolute pressure of 10 mbar to 800 mbar (claim 1).

The two-phase **mixture** means that the gas and liquid are mixed. The temperature in the helix has to be high to allow melting of the polymer (E1: page 4, lines 27 to 30). At such high temperatures the solvent inevitably evaporates and leads to the formation of a gas-liquid mixed phase flow within the meaning of the patent in suit.

3.3.3 Problem

According to the patent in suit the problem underlying the patent in suit is to provide a method for recovering a polymer with sufficient **devolatilising efficiency** (see paragraph [0006] of the patent in suit).

3.3.4 Solution

As a solution to this problem the patent in suit proposes a method according to claim 1 characterised in that water or steam is infused into the polymer solution in the pipe.

3.3.5 Success of the solution

As to the success of the solution, it needs to be determined whether the problem is solved over the whole range claimed (see also T 939/92, reasons 2.6).

In particular, it has to be assessed whether the degree of efficiency is such that an improvement over the closest prior art can be acknowledged.

According to the patent in suit [0008], "*an infusion of water or steam serves...to increase the flow rate in the pipe, [t]hereby ensuring the prevention of the occlusion of a pipe and facilitating the operation. In addition, a substantial reduction in the steam consumption allows the operation at a lower cost.*"

In particular, the board scrutinised three aspects:

(a) occlusion of the pipe,
(b) the energy balance and
(c) the polymer type.

E1 seems also to teach an efficient process with a high **devolatilising efficiency**, which allows the amount of polymers to be reduced to less than 1 wt. % (E1: page 4, line 24 to page 5, line 6).

(a) Occlusion of the pipe

It is evident from the description that the problem of pipe occlusion occurs with elastomers and not with all types of polymer. Elastomers cause a rapid increase in the solution viscosity at a higher concentration that is not reduced even when the temperature is elevated (paragraph [0004]). The addition of water which is taught to help to prevent occlusion of the pipes (paragraph [0024], column 5, lines 50 to 52) is thus beneficial for those polymers. The addition of water or steam cannot be recognised as having any advantage for polymers that are well soluble in the solvent and do not cause a rapid increase in viscosity. An improvement in the flow and occlusion prevention in a pipe cannot be recognised and has not been convincingly shown for such polymers.

(b) Energy balance

The examples present in the patent in suit are all conducted with elastomers and do not allow it to be concluded that the same benefit is obtained with other polymers. With a focus on energy consumption, the board's comments are as follows:

The addition of water or steam to the polymer solution containing a different type of polymer will not help with volatilisation, since the evaporation of water requires a considerable amount of heat (paragraph [0025], column 6, lines 15 to 17). This energy need is only partially compensated by the formation of an azeotrope solvent/water.

(c) Polymer type

Furthermore, it is known by the skilled person that some types of polymer are prone to hydrolyse in the presence of water. In view of the comments made above, it is not certain that a benefit is obtained for such polymers by the addition of water. But, more importantly, the addition of water can lead to the degradation of such polymers, with the result that the process allows less undamaged polymer to be recovered than a process according to E1.

It is not credible that an improvement with respect to E1 is obtained for all types of polymer solution obtainable by solution polymerisation. The expression "solution obtained by a solution polymerization" includes many different solutions with different solvents and polymers, since neither the polymer nor the catalyst, solvent and degree of polymerisation are specified.

It may be true that the skilled person recognises that the process claimed is not really suitable for highly hydrolysable polymers. However, claim 1 does not require any specific degree of recovery, so the process *per se* does not exclude any specific polymers and places no limit on the type of polymer to be used. Therefore, the question that needs to be answered is whether the process is beneficial to all the polymers covered by claim 1 with respect to the closest prior art. As indicated above, the answer to this question is negative.

(d) Conclusion

Therefore the problem cannot be considered to be solved over the whole range.

3.3.6 Redefinition of the problem

The problem needs to be reformulated in less ambitious terms. It can be seen as providing a further process for recovering polymers.

3.3.7 Obviousness

It is accepted that this problem is solved.

However, as already set out in the section on the success of the solution, for many types of polymer the addition of water would complicate the process. The addition of water or steam would not provide any benefit with respect to devolatilisation, but would lead to an increase in the energy needed for recovering the polymer. Therefore, the skilled person knows that for polymers not causing a rapid increase in solution viscosity, the addition of steam or water to the solution is disadvantageous.

As set out in T 119/82 (reasons 16), obviousness is at hand not only when the skilled person would have seen all the advantages of acting in a certain manner, but also when he could clearly see why he should not act in a certain manner in view of its predictable disadvantages. In the present case, the addition of water has a negative effect for some of the polymers falling within the process of claim 1.

Since such a disadvantageous modification cannot involve an inventive step, claim 1 of the first auxiliary request does not fulfill the requirements of Article 56 EPC.

4. Auxiliary request 4

4.1 Article 123(2) EPC

Claim 1 is a combination of claims 1, 2, 8 and 10 as originally filed. The deletion of two types of polymer, namely butadiene resin and acryl resin, originally present in claim 8 is acceptable under Article 123(2) EPC.

It is evident from the application as originally filed that the process of the invention is especially suited to elastomers (paragraph [0004]), since such polymers are described as posing a special challenge, since they cause a rapid increase in solution viscosity. Possible polymers are listed in the original application (column 3, lines 44 to 48). This list corresponds to the list of claim 8 of the original application.

The skilled person immediately recognises that this list includes elastomers and two additional types of polymer, to wit butadiene resin and acryl resin. The skilled reader understands from paragraph [0004] in combination with the list of polymers that the process of the invention is especially beneficial for all the elastomers present in that list. Therefore it is unambiguous that the process is especially suited to such polymers, and a process limited to the recovery of such polymers is directly and unambiguously derivable from the application as filed.

4.2 Article 54 EPC

Claim 1 has been further restricted, so the arguments provided for the first auxiliary request also apply here. In addition E3 does not disclose the polymers listed in claim 1 of this request.

The board is satisfied that the requirements of Article 54 EPC are met.

5. Article 56 EPC

5.1.1 Invention

The invention concerns a method for recovering a polymer efficiently from a polymer solution obtained by solution polymerisation.

5.1.2 Closest prior art

The question arose whether E1 or E3 would qualify as the most suitable starting point for assessing inventive step.

E1 is still considered to be the closest prior art since it relates to the removal of solvents from polymer solutions having at least 30 wt. % of solvents and monomers (see 3.3.2).

E3 is not a suitable starting point for the question of inventive step, since it does not relate to a polymer solution obtained by solution polymerisation. Therefore, the concentration of solvents present in the solutions to be purified in E3 is lower than what is expected in polymer solutions according to the process of claim 1. E3 mentions highly viscous product liquids, but it does not appear that these products were obtained by solution polymerisation. It cannot be recognised that E3 concerns the same problems as those that the skilled person would encounter during solution polymerisation. The skilled person trying to recover a polymer from a solution that contains a considerable amount of solvent, which is certainly above 10 wt. %, would turn to a document that also deals with the removal of high amounts of solvent.

Therefore, for the board, E1 rather than E3 qualifies as the most promising springboard towards the invention.

5.1.3 Problem

According to the patent in suit the underlying problem is to provide a method for recovering with sufficient

devolatilising efficiency a polymer that causes a rapid increase in solution viscosity at higher concentrations (see paragraphs [0004] and [0006] of the patent in suit).

5.1.4 Solution

As a solution to this problem the patent in suit proposes a method according to claim 1 characterised in that water or steam is infused into the polymer solution in the pipe and the polymer is at least one selected from the group consisting of butadiene rubber, styrene-butadiene rubber, isoprene rubber, ethylene-propylene rubber, butyl rubber, styrene-butadiene copolymer, styrene-isoprene copolymer and butadiene block polymer.

5.1.5 Success of the solution

As indicated above (3.3.5, 3rd paragraph) a reduction in steam consumption is regarded as efficient devolatilisation.

In particular, it has to be assessed whether the degree of efficiency is such that an improvement over the closest prior art can be acknowledged.

The polymer to be recovered is at least one from the list given above. All these polymers are elastomers that cause a rapid increase in the solution viscosity at a higher concentration which is not reduced correspondingly even when the temperature is elevated (paragraph [0004], column 1, lines 41 to 45).

The addition of water or steam to the solution
(a) ensures occlusion prevention in a pipe,

(b) reduces the viscosity of the polymer solution and
(c) helps to improve the devolatilisation performance (paragraph [0024], column 5, line 50, to column 6, line 1).

(d) As to the energy balance, a comparison of the example ("new example") submitted during opposition proceedings with the letter of 22 March 2010 with example 1 of the patent in suit shows that the devolatilisation efficiency was improved due to the addition of steam in the pipe (0.28 vs 0.30) when recovering styrene-butadiene copolymer, which is one of the polymers to be recovered by the process according to claim 1. The residual solvent level was the same (500 ppm) in both examples.

This indicates that the addition of water/steam to the polymer solution provides a benefit as compared to a process without such addition.

The argument that the steam consumption in the new example (28 parts by mass per 100 parts by mass of the solvent) related only to the steam consumption for indirect heating cannot be accepted, since it is evident that the skilled person would consider the overall steam consumption in calculating the devolatilisation efficiency. It is accepted that the value of 0.28 is based on the overall steam consumption and not only on the steam consumption for indirect heating.

The direct injection of steam/water into the polymer solution thus allows the same low level of residual solvent to be obtained in the recovered polymer with a reduced amount of steam.

There is no convincing evidence and no other serious reason that gives rise to doubt that the result obtained for the recovery of styrene-butadiene copolymer does not apply to the other polymers covered by the process of claim 1. The injection of steam/water into the polymer solution in the pipe brings about an advantage for the recovery of the elastomers listed.

Therefore, it is accepted that the problem is solved over the whole range of claim 1.

Since the method according to the patent in suit has been improved over that of E1 as far as elastomers are concerned, the problem does not need to be reformulated.

5.1.6 Obviousness

It has to be determined whether the proposed solution is derivable from the cited prior art.

E1 itself is completely silent about the injection of water or steam. E1 relates mainly to thermoplastics (page 4, lines 9 to 12) and teaches heating above the melting temperature of the polymer (page 4, lines 25 to 29).

As indicated above (5.1.2, third paragraph), **E3** does not relate to solution polymerisation and to the high concentrations of solvents present in the solution treated in E1. The skilled person trying to solve the posed problem would not turn to E3, since E3 deals only with the removal of residual amounts of solvent from the product. In addition, E3 indicates that foaming should be avoided (E3: page 4, line 18), which is a clear indication that there is only limited contact between the liquid and the gas and that the concentration of the solvent is rather limited. Addition of steam or water to a solution comprising a high amount of solvents as in E1 would lead to foaming, meaning that the teaching of E3 cannot be applied to E1.

E8 discloses the use of water as entrainer for the purification of polystyrene, but it is clear from the ratio of entrainer to solvent that this teaching applies to solutions containing an already reduced amount of solvent (E8: figures 11 and 12). This also applies to the degasification of polyethylene wherein the water is added only in a second step after the amount of solvent has already been reduced in a previous step (E8: chapter 10). E8 does not teach that the recovery of elastomers obtained by solution polymerisation can be efficiently obtained by the addition of steam or water directly to the polymer solution. It rather teaches first removing the solvent and next using water as an entrainer to further diminish the solvent present. Such a teaching is not appropriate for improving polymer devolatilisation that causes a rapid increase in solution viscosity at higher concentrations. Therefore, E8 does not point towards the solution of the present invention.

E9 discloses a continuous process for the preparation of polymer compositions having low volatile content which comprises passing a styrene polymer-containing polymerisation fluid composition obtained by solution polymerisation or bulk polymerisation through a volatile component separator comprising vertical foaming preheaters and vacuum vessels directly connected therewith and thereby removing volatile components continuously from the polymerisation fluid composition in **three** stages to obtain a polymer composition having low volatile content (E9: claim 1). The addition of an entrainer such as water is taught only for the third stage (E9: column 4, lines 7 to 12), which means that the concentration of solvent has already been considerably diminished at that stage. The skilled person does not find any incentive in E9 to add steam or water directly to the polymer solution obtained by solution polymerisation. E9 rather teaches additional purification steps prior to the addition of water. Therefore E9 does not teach the solution of the present invention.

No other prior art is known that teaches the addition of steam or water to the polymer solution obtained by solution polymerisation for recovering the polymers defined in claim 1.

The solution of the problem is therefore not obvious.

Claim 1 of auxiliary request 4 meets the requirements of Article 56 EPC.

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 in amended form on the basis of claims 1 to 9 of auxiliary request 4 filed together with the letter of 18 November 2014 and a description and drawings to be adapted where necessary.

The Registrar: The Chairman:

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

C. Vodz G. Raths

Decision electronically authenticated