BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

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File Number: T 518/90 - 3.2.2

Application No.: 83 870 081.3

Publication No.: 0 107 635

Title of invention: Process for the preparation of thermoplastic elastomers

Classification: B29C 35/00

D E C I S I O N
of 16 December 1991

Proprietor of the patent: Monsanto Company

Opponents: 01) Stamicarbon B.V.
02) Exxon Chemical Patents Inc.

Headword:

EPC Article 56

Keyword: "Inventive step (yes)"

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number : T 518/90 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 16 December 1991

Appellant : (Proprietor of the patent)
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Decision under appeal :
Decision of Opposition Division of the European Patent Office given orally on 8 February 1990 and in writing on 11 May 1990, revoking European patent No. 0 107 635 pursuant to Article 102(1) EPC.

Composition of the Board :

Chairman : G. Szabo
Members : M. Noel
M. Aúz Castro

Summary of Facts and Submissions

I. European patent No. 0 107 635 was granted with ten claims on 23 September 1987 on the basis of European patent application No. 83 870 081.3 filed on 17 August 1983.

Claim 1 read as follows:

"1. A process for preparing a thermoplastic elastomer composition comprising a blend of plastic and cured rubber by dynamic vulcanization, in which a composition comprising a blend of plastic, rubber, and curative for the rubber is masticated at a shear rate of at least 2000 sec^{-1} and the rubber is cured to the extent that no more than 5 weight percent of the rubber is soluble in a rubber solvent."

II. Oppositions were filed against the patent on grounds of lack of novelty and of inventive step under Article 100(1) EPC. In a decision orally announced at the hearing on 8 February 1990, and confirmed in writing on 11 May 1990, the Opposition Division revoked the patent. The following references were considered particularly relevant:

(1) US-A-4 311 628, which is equivalent to GB-A-2 007 683 cited in the search report,
(5) US-A-4 271 049,
(7) US-A-3 963 679,
(8) US-A-4 130 535, and
(10c) W & P brochure on alloying polypropylene (PP with (EPDM rubber).

III. The reasoning in support of the decision was based on document (1) as the closest state of the art. It was considered that the use of the apparatus described in document (7) would have necessarily involved high shear

rates and some improvement in processing times. Furthermore, the increased shear rate itself would not result in any additional effect-whatsoever and could therefore be disregarded.

IV. The Appellant (Proprietor of the patent) filed a Notice of Appeal against the decision on 22 June 1990 together with the payment of the fee. The Statement of Grounds was received on 11 September 1990. The former Opponent 02 withdrew his opposition.

V. Oral proceedings were held on 16 December 1991. During these proceedings the Appellant filed a set of amended claims replacing all earlier requests. The main Claim 1 reads as follows:

"1. A process for preparing a thermoplastic elastomer composition comprising a blend of plastic and cured rubber which comprises 50 weight percent or less of plastic by
a) masticating plastic, rubber and other compounding ingredients in the first third of an extruder to melt the plastic and form an essentially homogenous blend in the absence of a cure activator and
b) dynamically vulcanizing said essentially homogenous blend and a rubber curative in the presence of a cure activator in the last two thirds of the extruder by masticating for a period of 2 minutes or less at a shear rate of at least 2000 sec^{-1} so that the rubber is cured to the extent that no more than 5 weight percent of the rubber is soluble in a rubber solvent."

VI. The Appellant was of the opinion that the added features represented further distinctions vis-à-vis the state of the art. In any case, the primary reference (1) failed to recommend shear rates during dynamic vulcanisation which would have exceeded 2000 sec^{-1} and none of the other

documents cited in the proceedings mentioned such values either. As to quality, the Banbury mixer preferred in document (1), provided material which could not be extruded and pelletized, whilst products according to the claimed process had such capabilities. Moreover, the other properties of products prepared according to the patent, e.g. by the use of the ZSK-53 type of extruder, consistently showed improvements over those provided with the Banbury mixer (cf. Table I in the patent). None of the mixers cited in the proceedings would have enabled the skilled person to achieve vulcanisation in about one-seventh of the time when compared to the usual methods available for the purpose.

VII. In its further submissions, the Appellant filed test reports which suggested that whilst the particle size and homogeneity of the product prepared at a shear rate above 2000 sec^{-1} was the same as that of the product with a Banbury mixer (440 sec^{-1}), the shapes of the particles were significantly different. The former ones were rather elongated or ellipsoid in shape, and the latter more or less spherical. This difference must have been responsible for the unexpected improvements in properties. Any reduction in the time of mastication would have been risky and was not obvious to try.

VIII. Respondent (former Opponent 01) emphasised that the closest state of the art used conventional masticating equipment and there were some available with a working range including higher shear rates. Thus, these were normally available to the skilled operator for use. It was incorrect to say that the cited products of the state of the art were not extrudable. If a certain kind of use was clearly standard and advantageous, as in the present case, the reduction of mastication time, any incidental or unexpected results in consequence should not alter the

fact that the steps taken were already obvious. The skilled person would optimise the operation of the equipment already known for the mixing of thermoplastic polymers (cf. document (7)).

IX. The Appellant requests that the decision under appeal be set aside and the patent be maintained on the basis of Claims 1 to 10 filed during the oral proceedings, and the description as granted with the amendment that the sentence on page 2, lines 31 to 34 be substituted by the sentence filed during the oral proceedings.

The Respondent requests that the appeal be dismissed or that the matter be remitted to the first instance for substantive examination.

Reasons for the Decision

1. The appeal is admissible.

2. Amendments

The features added to the main claim are fully supported by the application as filed. The limitation to "50 weight percent or less of plastic" was disclosed on page 3, last line, the manner of using the cure activator on page 6, lines 20 to 30, and the time limit for mastication on page 4, lines 16 to 18 of the original text. The sentence to be substituted for page 2, lines 31 to 34 of the description merely repeats the new wording of the main claim. The amendments are therefore properly supported and limit the scope of protection, and therefore comply with Article 123 EPC in both respects.

3. The closest state of the art and the technical problem

It was generally agreed that document (1) represents the closest state of the art. The disclosure therein relates to a process for the preparation of thermoplastic elastomers comprising a blend of plastic and cured rubber by dynamic vulcanisation under the influence of shear forces which are below 2000 sec^{-1}.

It appears that the relevant and objectively recognisable technical problem in respect of this state of the art is to achieve higher efficacy whilst at least maintaining or improving the qualities of the product, including extrudability and fabricability.

4. The solution

The solution of the technical problem according to the main claim of the patent in suit involves the provision of a process not only using an increased shear rate but also involving a selection of a composition with no more plastic than rubber as well as a particular manner of feeding the activator to the mixture. The time for mastication during vulcanisation is reduced to no more than two minutes.

It can be recognised that such processing conditions provide significant improvements in a number of physical properties in comparison with the use of a slower, low shear rate process (cf. Table 1).

5. Inventive step

5.1 Since no objection on the ground of lack of novelty was pursued and also the Board sees no reason either to raise the matter, the only issue was that of the inventive step.

The primary question was whether or not the skilled person, seeking improvements in efficiency and quality, would find the particular features for modifying the basic process according to document (1) in order to solve the technical problem, in other sources in the state of the art.

As regards the most relevant distinction, the substantially increased shear rate, document (7) also discloses the use of the "ZSK 53" extruder for the purpose of a shear rate of more than 2000 sec^{-1}. The purpose of the relatively high rate is to free the products there from "gel particles and lumps". However, this process uses polyurethane rubber in a chain-extension step, whilst the process in the patent in suit is concerned with the cross-linking of rubber when dispersed in a plastic matrix. By eliminating lumps in the cited art, a single phase product is sought, whilst the process in the present case is rather aiming at a particulate rubber phase, not unlike lumps, within a plastic envelope phase. Neither the chemistry nor the physics of the processes are analogous. The cited art provides soluble products whilst the solubility is expressly limited in the claimed subject-matter to a low value. Different products imply that the processing conditions must appropriately be quite different.

5.2 The other reference raised in order to demonstrate the possibility of operating the process at high shear rates was document (10c). This is part of a brochure showing a flow diagram about the mixing of PP with EPDM in a ZSK 53 extruder. There is no suggestion that vulcanisation is involved or any interaction with curing agents at certain phases of the process. No reason to doubt that for the purpose indicated in the reference, high shear rates may be employed, but there is no reason to assume either that

the same should be applied to vulcanisation merely on the basis of the maximum capabilities of the equipment. The choice of shear rate is then rather governed by the physical conditions appropriate to the skilled person's knowledge about the chemical interactions involved in the given case. In view of the circumstances hereinbefore described, there would be no obvious reason to try higher speeds in the absence of any hint of an advantage in such direction and contrary to the established trend.

5.3 None of the other cited references, including documents (5) and (8), recommend a high shear rate in the given context. Thus the trend in the closest art concerned with thermoplastic elastomers was to proceed at a lower rate. The pressure to run the system faster was not as great as to justify risks. In view of no guidance in the published documents or according to common general knowledge as to the consequences of substantially increased shear forces, the quality of the result was uncertain, let alone predictable as far as improvements are concerned.

5.4 In such a situation the actual reduction of mastication time was not a one-way-street situation in which the expectation of improvement in economies was overwhelming and clearly without any risk as to its effects. This is particularly so in view of the absence of encouragement since the only example for mere mixing polyurethane in document (7) at higher speeds, was clearly of no relevance.

5.5 Actually, the modification of the process did create changes in the micro-structure of the material, according to the evidence submitted on behalf of the Appellant. The changes in shape of the encapsulated rubber particles, being elongated rather than globular, could well be responsible for the differences and improvements in the

physical properties of the product. The actual location and phase, where the activator is added is also understood to be relevant to the results, and structural effects and consequent advantages are thereby properly ascertained.

5.6 The beneficial effects are also correlated with the amended definition of the material compositions (i.e. increased proportion of rubber). This may be surprising, since it was assumed that the increase of rubber content leads to less fabricable poor extrudate or to no capability of being extruded at all. Apart from that, the superior tensile properties and advantages on extension (cf. increased draw-down ratio) could not be predicted in advance in the given circumstances. These effects are not mere "bonus effects" to be disregarded because of some obvious and inevitably necessary change in the processing conditions. There were no analogous teachings in the direction of high speed handling in the particular area of thermoplastic processing.

5.7 Whilst the skilled person had access to general purpose masticators with capabilities to run any mixing at high speeds, the fact that he could employ such conditions under other circumstances does not imply that he would necessarily do the same in the given circumstances of the present patent in suit. The subject-matter of the main claim is now limited to the conditions which provide the desired improved results.

5.8 For the foregoing reasons the Board is satisfied that the subject-matter of Claim 1, and those of the fully dependent set of Claims 2 to 10, comply with Articles 52 and 56 EPC and are therefore inventive.

Order

For these reasons, it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the first instance with the order to maintain the patent on the basis of Claims 1 to 10 filed during the oral proceedings and of the description as granted with the amendment that the sentence on page 2, lines 31 to 34 be substituted by the sentence filed during the oral proceedings.

The Registrar: The Chairman:

S. Fabiani G. Szabo