BESCHWERDEKAMMERN DES EUROPÄISCHEN PATENTAMTS

BOARDS OF APPEAL OF THE EUROPEAN PATENT OFFICE

CHAMBRES DE RECOURS DE L'OFFICE EUROPEEN DES BREVETS

Internal distribution code:
(A) [ ] Publication in OJ
(B) [ ] To Chairmen and Members
(C) [ ] To Chairmen
(D) [X] No distribution

Datasheet for the decision of 11 December 2007

Case Number: T 0722/05 - 3.2.02

Application Number: 98964569.2

Publication Number: 1038039

IPC: C21C 1/10

Language of the proceedings: EN

Title of invention:
Cast iron inoculant and method for production of cast iron inoculant

Patentee:
Elkem AS

Opponent:
PECHINEY

Headword:
-

Relevant legal provisions:
-

Relevant legal provisions (EPC 1973):
EPC Art. 56, 123(2)

Keyword:
"Inventive step (yes)"

Decisions cited:
-

Catchword:
-

Europäisches Patentamt | European Patent Office | Office européen des brevets

Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0722/05 - 3.2.02

D E C I S I O N
of the Technical Board of Appeal 3.2.02
of 11 December 2007

Appellant: (Patent Proprietor)
Elkem AS
Hoffsveien 65 B
NO-0377 Oslo (NO)

Representative:
Rees, David Christopher
Kilburn & Strode
20 Red Lion Street
London WC1R 4PJ (GB)

Respondent: (Opponent)
PECHINEY
7, Place du Chancelier Adenauer
F-75218 Paris Cedex 16 (FR)

Representative:
Maureau, Philippe
Cabinet Germain & Maureau
12, rue Boileau
BP 6153
F-69466 Lyon Cedex 06 (FR)

Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 18 April 2005 revoking European patent No. 1038039 pursuant to Article 102(1) EPC.

Composition of the Board:

Chairman: T. Kriner
Members: R. Ries
E. Dufrasne

Summary of Facts and Submissions

I. Opposition was filed against European patent No. EP 1 038 039 as a whole and based on Article 100(a) EPC in conjunction with Article 52(1) and 56 EPC.

In its decision posted on 18 April 2005, the opposition division held that the subject matter of claim 1 of the main and the auxiliary request then on file did not involve an inventive step and revoked the patent.

II. Against this decision the appellant (patent proprietor) lodged an appeal, received at the EPO on 8 June 2005, and paid the appeal fee on 17 June 2005. The statement setting out the grounds of appeal was received on 18 August 2005.

III. In the appeal proceedings, essentially the following documents have played a major role:

D1 WO-A-95/24508

D2 GB-A-2 093 071

D3 M. Chisamera et al.: "The influence on the morphology of the graphite of S, O, Ti and Al inoculation after Mg-treatment", Sci. Bull. P. U. B. Series B, Vol. 55, 1 - 2, 1993, pages 235 to 247

$D3_{bis}$ M. Chisamera et al.: "S-inoculation of Mg-treated cast iron to obtain CG cast iron and improve graphite nucleation in DI", AFS Transactions 96-151, pages 581 to 588

MV1 Product Data Sheet ULTRASEED® inoculant Revised September 2004, Elkem ASA, pages 1/2 and 2/2

IV. Oral proceedings before the Board took place on 11 December 2007. At the end of the oral proceeding, the following requests were made:

- The appellant (patent proprietor) requested that the decision under appeal be set aside and the patent be maintained on the basis of the claims as granted or, in the alternative, on the basis of the auxiliary request filed before the opposition division.

- The respondent (opponent) requested that the appeal be dismissed.

Independent claims 1 and 6 of the main request read as follows:

"1. An inoculant for the manufacture of cast iron with lamellar, compacted or spheroidal graphite, said inoculant comprises: between 40 and 80 % by weight of silicon, between 0.5 and 10 % by weight of calcium and/or strontium and/or barium, between 0 and 10 % by weight of cerium and/or lanthanum, between 0 and 5 % by weight of magnesium, less than 5% by weight of aluminium, between 0 and 10 % by weight of manganese and/or titanium and/or zirconium, between 0.5 and 10 % by weight of oxygen in the form of one or more metal oxides, between 0.1 and 10% by weight of sulphur in the form of one or more metal sulphides, and the balance being iron."

"6. A method for producing an inoculant for the manufacture of cast iron with lamellar, compacted or spheroidal graphite, comprising: providing a base alloy comprising 40 to 80 % by weight of silicon, between 0.5 and 10 % by weight of calcium and/or strontium and/or barium, between 0 and 10 % by weight of cerium and/or lanthanum, between 0 and 5 % by weight of magnesium, less than 5% by weight of aluminium, between 0 and 10 % by weight of manganese and/or titanium and/or zirconium, the balance being iron, and adding to said base alloy 0.5 and 10 % by weight of oxygen in the form of one or more metal oxides, and between 0.1 to 10% of sulphur in the form of one or more metal sulphides to produce said inoculant."

Dependent claims 2 to 5 and 7 to 8 relate to preferred embodiments of the inoculant set out in claim 1 or of the method according to claim 6, respectively.

V. The appellant essentially argued as follows:

Document D1 as the closest prior art represented the starting point for the present invention in reality. At that time the inoculant set out in D1 in itself resulted in a significant increase in the nucleation effect over the conventional inoculants, but because of its lack of reproducibility, it was not accepted by the foundries. This fundamental disadvantage of the known inoculant was dealt with in the patent specification on page 2, paragraph [0012]. Moreover it was stressed in paragraph [0014] that the reproducibility shown in the invention was more important than the increase in the number of nuclei. It was, therefore, undisputable that

the problem underlying the patent was to improve the reproducibility with respect to the formation of nuclei rather than to simply increase the number of nuclei. The positive effect of sulphur or a sulphide when added to an inoculant on increasing the number of nucleation sites was also known, as the specification acknowledged in paragraph [0013]. However, it was never disclosed nor suggested that a sulphide, when used in combination with an oxide, would provide an increased reproducibility. Consequently, it could not have been obvious to the skilled person to adopt this concept.

D2 simply tried to make the inoculation of low sulphur iron melts possible by adding an elemental source of sulphur and FeS to a melt to form with a reactant a sulphide. The treatment according to D2 merely allowed nucleation but did not provide for an improved reproducibility.

D3 and $D3_{bis}$ both taught that the graphite growth morphology was influenced when adding sulphur, oxygen, aluminium and titanium individually. The problem of reproducibility however was not contemplated in any way in any of these documents and neither was the concept of adding oxides and sulphides in combination which, after all, was found to give rise to the formation of oxy-sulphides in the melt. The claimed inoculant therefore involved an inventive step.

VI. The arguments of the respondent are summarized as follows:

The patent addressed two effects which were closely linked: the increase of the number of nuclei formed

when adding the inoculant and the reproducibility with respect to the formation of nuclei. The improvement of these effects was however always the solution of the same problem, i.e. to provide reliably a sufficient number of nuclei. Although D3 and $D3_{bis}$ considered the influence of oxygen and sulphur separately on the inoculation of cast iron, the effect is beneficial in both cases, as can be seen from $D3_{bis}$ page 584, second column, last paragraph, page 583, right hand column, 1 paragraph and 586, right hand column last paragraph.

Moreover, D2 suggests that sulphur played an important role in increasing the number of nucleation sites in a cast iron melt and to this end the document proposed the addition of sulphides (cf. D2, page 1, lines 27, 37 and 53). The same conclusion could be drawn from the disclosure of document D3, point 4 on page 246. Given that a better reproducibility was merely a consequence of improved nucleation in the melt, it was not the main effect. This assessment was corroborated by the explanations given in the patentee's ULTRASEED paper (document MV1) which did not at all mention the reproducibility but only reported higher nodule counts that were provided by the claimed inoculant.

Starting from the inoculant disclosed in document D1 and faced with the problem of increasing the number of nucleation sites, the skilled person would be led by the technical disclosure of documents D2 or D3 or $D3_{bis}$ to add sulphur in the form of sulphides. If that first aspect of the technical problem was solved, the second aspect of the problem, i.e. an improved reproducibility, was automatically solved. The subject matter of claim 1 therefore did not involve an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Novelty:*

The Board concurs with the parties in the assessment that none of the cited documents discloses all the technical features of claim 1. Novelty not being in dispute, there is no need to deal with this issue in more detail.

3. *The closest prior art:*

It has been common ground to the parties and the Board that document D1, which has been amply acknowledged in paragraph [0012] of the patent specification, qualifies as representing the closest prior art. Except for the metal sulphide component the claimed inoculant is to include and is calculated as including 0.1 to 10 % by weight of sulphur, the mixture known from D1 comprises all the constituents of the inoculant set out in claim 1 of the patent at issue. Although the known inoculant was already found to produce an increased and satisfactory nucleation rate, the reproducibility of the number of nuclei formed when using the inoculant in a cast iron melt was poor, given that in some cases a high number of nuclei in cast iron was formed, but in other cases the number of nuclei was rather low. Therefore, this composition found little use in practice.

4. *Problem and solution:*

Starting from this prior art, the problem underlying the patent at issue is therefore seen in providing an inoculant which makes the cast iron melt to respond consistently to the inoculation by forming substantially the same number of nuclei from batch to batch of the same cast iron melt, as set out in paragraph [0012] of the patent specification.

The solution to this problem resides in the inoculant set out in claim 1 and comprising, in addition to the composition known from D1, specific amounts of metal sulphides. As a secondary effect, an increased number of nuclei formed when adding the inoculant to the cast iron has been observed (cf. paragraph [0014] of the patent specification).

5. *Inventive step:*

5.1 The evaluation of the contents of the prior art shows that none of the cited documents specifically addresses the problem of reproducibility of the nucleation effect referred to above.

Contrary to the opponent's allegation, the problem does not reside in merely increasing the number of nuclei, as may be deduced from paragraph [0014] of the specification, since an acceptable number of nuclei was already obtained according to D1, in some cases. Apart from the better reproducibility, the increased number of nuclei formed is to be considered as a bonus effect when adding the claimed inoculant.

5.2 The opponent has pointed to the examples given in the patent specification in Tables 3 and 4 which solely disclose the number of graphite nodules per mm^2 formed in the final product as a measure of the inoculation performance, but do not comprise any information about the reproducibility. He also referred in this context to the patentee's product data sheet MV1 describing the claimed inoculant as providing fresh nucleation sites especially in low sulphur ductile iron rather than bringing about a better reproducibility.

This is not disputed. However, such observations have little if any bearing on what is disclosed in the patent. The specification makes it clear that treating the cast iron melt with the claimed inoculant eliminates the variability of the inoculation effect when using the agent known from D1 and gives reproducible inoculation effects every time. The Board also notes that the opponent has not produced any evidence putting into doubt that the improvement on the reproducibility of the inoculation effect is actually not obtained by the claimed inoculant. As to the data sheet, this document was published in 2004, i.e. almost seven years after the priority date of the patent. This document includes further research results not known at the priority date of the patent and, therefore, has to be disregarded.

5.3 Document D2 is concerned with the inoculation of grey cast iron melts which are very low in sulphur. The document notes that molten iron comprising sulphur contents lower than 0.04% S is difficult to inoculate and that only very few inoculants are effective, such as those containing Ca, Mg, Ce, Sr etc (cf. D2, page 1,

lines 13 to 17). The problem D2 tries to solve is therefore to render low-sulphur cast iron melts more responsive to inoculation. In a first attempt, iron sulphide (FeS) has been added to the melt to increase its sulphur content and thus to improve its response to inoculation. However, this practice has been found only partially effective and induced undesirable side effects (cf. D2, page 1, lines 7 to 31). To solve the problem and solely for the purpose of increasing the sulphur content of the molten cast iron, document D2 thus proposes a mixture of a source of sulphur (such as granular or powdered elemental sulphur, sulphide minerals e.g. chalcolcite, bornite, chalco-pyrite, iron sulphide etc) and a reactant which forms a sulphide therewith which is capable of acting to provide nuclei in the formation of graphite when added to the melt. (cf. D2, page 1, lines 32 to 55). It is noted in this context that all the examples of D2 actually include elemental sulphur, preferably in amounts between 20 to 30%, whereas the claimed inoculant does not. Moreover, D2 neither discloses nor suggests that the sulphide mixture could be used in combination with oxides, a practice which runs the risk of adversely affecting the melt by slag formation and contaminating the castings. The document does not include any hint either that the reproducibility of the number of nuclei formed by the inoculant according to D1 could be significantly improved.

In document D3 the effect of sulphur, oxygen, titanium and aluminium on the morphology of graphite when inoculating Mg-treated cast iron has been investigated. The authors of D3 stress that sulphur has a strong influence on the morphology of the graphite (cf. D3,

page 241, paragraph 2.2.4, in particular Figure 7, Table 2) and that only relatively small quantities of sulphur are necessary to produce important changes in the morphology. This particular influence of sulphur is found useful when making compact graphite (CG) iron, without having to use other denodularizing elements such as Ti, Al etc.

Oxygen, on the other hand, is said to interact with many other elements in the melt and therefore is difficult to use in order to control the ratio of nodular graphite (NG) to compact graphite (CG) (cf. D3, page 240, paragraph 2.2.3, in particular Figure 5 and 6). Although the addition of oxygen and sulphur independently has been investigated, D3 fails to disclose that sulphur (FeS_2) and oxygen (Fe_2O_3) could be added in combination to increase the inoculation performance, let alone to improve the reproducibility of the inoculation effect from one batch of iron to the next.

Turning to document $D3_{bis}$, the opponent pointed to page 583, left hand column, first paragraph stating that low additions of sulphur (usually under 0.015% S as FeS) make it possible to obtain standard CG under reproducible conditions.

The object of $D3_{bis}$ was to investigate the influence of inoculation treatments including additions of Ti, Al, S and O (cf. $D3_{bis,}$ page 581, column 2, Experimental Procedure). The addition of FeS in combination with SiCa has been found to produce the greatest and consistent inoculation effect and, therefore, $D3_{bis}$ provides for adding a mixture comprising these

constituents to improve the graphite nucleation process in ductile iron (cf. $D3_{bis}$, page 584, column 2, last paragraph; page 585, first column, last paragraph; page 586, second column, last paragraph; page 587, first column, second paragraph; page 588, first column, points 2 and 4). However, no suggestion can be found anywhere in $D3_{bis}$ that the two components oxygen and sulphur in the form of oxides and sulphides could be used together. It is further noted that the amount of 0.015% S proposed in $D3_{bis}$ is far below the lower limit of 0.1% S claimed in the patent.

5.4 If follows from the above considerations that the technical teaching given in document D1 and read in combination with that given in any of documents D2, D3 or $D3_{bis}$ did not lead the skilled person in obvious way to the inoculant set out in claim 1 of the patent. The subject matter of claim 1 therefore involves an inventive step.

5.5 The same statement applies to independent claim 6 which relates to a method for producing the inoculant according to claim 1.

6. Given this situation, the patent has to be maintained as granted.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

V. Commare T. Kriner