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Datasheet for the decision of 5 December 2024

Case Number: T 2246/22 - 3.3.02

Application Number: 16810434.7

Publication Number: 3408334

IPC: C09D5/00, C08K3/00

Language of the proceedings: EN

Title of invention:
METHOD TO PROTECT HEAT TREATED STEEL PRODUCTS AGAINST OXIDATION AND DECARBURISATION

Patent Proprietor:
Tata Steel UK Limited

Opponent:
ArcelorMittal

Headword:

Relevant legal provisions:
EPC Art. 56, 83
RPBA 2020 Art. 12(4), 12(6)

Keyword:
Sufficiency of disclosure
Inventive step - non-obvious alternative
Late-filed request

Decisions cited:
G 0003/14

Catchword:

Europäisches Patentamt
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Case Number: T 2246/22 - 3.3.02

D E C I S I O N
of Technical Board of Appeal 3.3.02
of 5 December 2024

Appellant: (Opponent)	ArcelorMittal 24-26, Boulevard d'Avranches 1160 Luxembourg (LU)
Representative:	Lavoix 2, place d'Estienne d'Orves 75441 Paris Cedex 09 (FR)
Respondent: (Patent Proprietor)	Tata Steel UK Limited 30 Millbank London SW1P 4WY (GB)
Representative:	Wynne-Jones IP Limited Southgate House Southgate Street Gloucester, Gloucestershire GL1 1UB (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 4 August 2022 concerning maintenance of the European Patent No. 3408334 in amended form.**

Composition of the Board:

Chairman	M. O. Müller
Members:	S. Bertrand
	M. Blasi

Summary of Facts and Submissions

I. The appeal by the opponent ("appellant") is against the opposition division's interlocutory decision finding that European patent No. 3 408 334 as amended in the form of auxiliary request 1, comprising the set of claims filed during the oral proceedings on 21 June 2022, met the requirements of the EPC.

II. The patent is concerned with the provision of a method to prevent or limit oxidation and/or decarburisation of a steel product when subjected to a heat treatment, the method comprising applying a graphene-based coating to the steel product.

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

D1 US 2010/0098956 A1

D2 WO 2015/160764 A1

D10 K. S. Aneja *et al.*, "Graphene based anticorrosive coatings for Cr(VI) replacement", Nanoscale, 2015, 17 879-17 888

D11 EP 2 886 616 A1

D12 Graphenea, "Differences Between Graphene and Graphite", May 2014

A13 G. E. Totten, "Steel Heat Treatment, Metallurgy and Technologies", Steel Heat Treatment Handbook, second edition, 2006, paragraphs 6.1.1 and 6.1.5

IV. In the impugned decision, the opposition division's conclusions included the following.

- The invention defined in the claims of auxiliary request 1 was sufficiently disclosed (Article 83 EPC).
- The subject-matter of claim 1 of auxiliary request 1 involved an inventive step starting from D1.
- The subject-matter of claim 14 of auxiliary request 1 involved an inventive step starting from D11.
- D10 and D12 were not admitted into the proceedings.

V. In its statement of grounds of appeal, the appellant contested the opposition division's decision. It raised objections of, *inter alia*, sufficiency of disclosure and inventive step against the claims of the request held allowable by the opposition division. It also submitted document A13 (as D13).

VI. In its reply to the grounds of appeal, the patent proprietor ("respondent") provided counter-arguments to the appellant's submissions and filed the set of claims of the request considered allowable by the opposition division as its main request as well as sets of claims according to auxiliary requests 1 to 19.

VII. In a further letter, the appellant replied to the respondent's submissions regarding its main request and argued against the allowability of auxiliary requests 1 to 19.

VIII. The board summoned the parties to oral proceedings as per their requests and issued a communication under Article 15(1) RPBA.

IX. Oral proceedings before the board were held by videoconference on 5 December 2024.

X. The parties' requests, where relevant to this decision, were as follows.

The appellant requested:

- that the decision under appeal be set aside and that the patent be revoked in its entirety,

- that D10 and D12 be admitted into the proceedings, and

- that auxiliary requests 1 to 4, 6 to 16 and 19 as filed with the reply to the grounds of appeal not be admitted into the proceedings.

The respondent requested:

- that the appeal be dismissed and that the patent be maintained as amended in the form held allowable by the opposition division (main request), or, alternatively, on the basis of the set of claims of any of auxiliary requests 1 to 19 as filed with its reply to the grounds of appeal, and

- that A13 not be admitted into the proceedings.

XI. The arguments of both the appellant and respondent, where relevant to the present decision, are summarised below.

Reasons for the Decision

Main request

1. Inventive step - claim 14 - Article 56 EPC

1.1 Claim 14 of the main request reads as follows:

"*14. Graphene based coating composition comprising 0.5 - 10 wt% graphene, 0.01 - 0.5 wt% of a corrosion inhibitor and 2 - 40 wt% of an organofunctional silane and optionally 0.1 - 1.0 wt% of a siloxane containing additive and/or 0.1 - 1.0 wt% of an additive to maintain the adhesion and to stabilize viscosity of the graphene based coating, the balance being polyurethane primer, wherein said organofunctional silane is comprised in a coupling agent which facilitates the chemical bonding of the graphene based coating on the steel product, and wherein said organofunctional silane is crosslinking the graphene sheets to the polyurethane matrix.*"

Claim 14 of the main request thus requires that the claimed composition comprises the following mandatory components:

- 0.5 - 10 wt% graphene,
- 0.01 - 0.5 wt% of a corrosion inhibitor,
- 2 - 40 wt% of an organofunctional silane, and
- the balance being a polyurethane primer.

1.2 The appellant contested the inventive step of the subject-matter of claim 14 of the main request starting from D11.

1.3 Disclosure of D11

D11 discloses (in paragraph [0054], lines 51 to 55) a composition comprising graphene, an organosilane, cerium acetate (as a corrosion inhibitor, see paragraph [0021] of D11) and a polyurethane primer. This composition comprises the four mandatory components required by claim 14 of the main request. This composition is applied on a steel product (see paragraph [0001] of D11).

In the decision under appeal, D11 was taken as the starting point for assessing the inventive step of the subject-matter of claim 14 of the main request. That D11 should be considered the starting point for assessing inventive step was common ground between the parties on appeal.

1.4 Distinguishing features

It was also common ground between the parties that the the distinguishing features of claim 14 of the main request over D11 are the content ranges of the graphene, corrosion inhibitor and organofunctional silane.

1.5 Objective technical problem

The respondent submitted that the objective technical problem was to provide a composition which was suitable for use in the method of claim 1 and was therefore capable of providing the effect of this claim, namely to prevent or limit oxidation and/or decarburisation of a steel product when subjected to a heat treatment.

The board does not agree.

In the examples of the patent and the application as filed, three compositions are used (see Table 1) comprising graphene (about 5 wt.%), cerium acetate (as a corrosion inhibitor, about 0.01 to 0.015 wt.%, see paragraph [0026] of the patent), SIVO 110 or Glymo (both organofunctional silanes, about 20 wt.%, see paragraphs [0036] and [0037] of the patent), and the balance of a polyurethane primer. These compositions are in accordance with claim 14 of the main request and can be used to prepare the graphene-based coatings of figures 3a, 3b, 4a, 4b, 5a, 5b, 6a, 6b, 7a, 7b and 8a to 8c of the patent.

As submitted by the appellant and as shown in the table on page 2 of its statement of grounds of appeal, the coatings used in figures 7a and 7b and figures 8a to 8c of the patent achieve the prevention or limitation of oxidation and/or decarburisation of steel when subjected to a heat treatment. These coatings have a top coat layer (see paragraph [0051] of the patent).

As is further shown by the appellant in the table on page 2 of its statement of grounds of appeal, the coatings used in figures 3a, 3b, 4a, 4b, 5a, 5b, 6a and 6b of the patent do not achieve the prevention or limitation of oxidation and/or decarburisation of steel when subjected to a heat treatment, despite also having compositions as defined in claim 14. The coatings of these figures do not have a top coat layer. This was not disputed by the respondent.

Thus, to prevent or limit oxidation and/or decarburisation of steel when subjected to a heat treatment, the presence of a top coat is required. Such a top coat does not, however, form part of claim 14.

The technical effect relied on by the respondent, i.e. the prevention or limitation of oxidation and/or decarburisation of steel when subjected to a heat treatment, therefore cannot be taken into account when formulating the objective technical problem.

As a consequence, the objective technical problem can only be seen to be the provision of an alternative composition.

1.6 Obviousness

As submitted by the appellant, in the absence of any effect, the content ranges of claim 14 of the main request constitute arbitrarily selections. Such arbitrary selections form part of the skilled person's routine actions and for this reason cannot support the presence of an inventive step.

1.7 Therefore, the subject-matter of claim 14 of the main request does not involve an inventive step over D11.

2. Consequently, the main request is not allowable.

Auxiliary request 1

3. The claims of auxiliary request 1 are identical to those of the main request, except that composition claims 14 and 15 have been deleted.

4. Admittance of auxiliary request 1

4.1 The appellant objected to the admittance of auxiliary request 1.

4.2 Auxiliary request 1 was submitted with the reply to the grounds of appeal.

The admittance of the auxiliary request is governed by, *inter alia*, Article 12(4) and (6) RPBA.

The appellant argued that auxiliary request 1 was filed in response to the objection of a lack of inventive step starting from D11. It also argued that auxiliary request 1 should have been filed before the opposition division since the objection of a lack of inventive step starting from D11 had been raised before the opposition division.

The appellant's argument is based on Article 12(6), second sentence, RPBA 2020, according to which the board shall not admit, *inter alia*, requests which should have been submitted in the proceedings leading to the decision under appeal, unless the circumstances of the appeal case justify their admittance.

The board agrees that the deletion of composition claims 14 and 15 in auxiliary request 1 overcomes the objection of a lack of inventive step of the subject-matter of claim 14 of the main request starting from D11 and thus auxiliary request 1 was filed in response to the objection of a lack of inventive step starting from D11. As submitted by the respondent, and this was acknowledged by the appellant, document D11 and the objection of a lack of inventive step based on this document were only submitted by the appellant two months prior to the oral proceedings before the opposition division. During those oral proceedings, the opposition division held that the subject-matter of claim 14 of what was then auxiliary request 1 (the current main request) involved an inventive step over D11 (see point 4.4.2 of the minutes). The respondent could not reasonably and fairly have been expected to have replied to this objection based on D11 before the oral proceedings in view of the late filing of that document, and there was no need to do so during the oral proceedings in view of the opposition division's conclusion acknowledging the inventive step of the

subject-matter of claim 14 of what was then auxiliary request 1.

It was thus legitimate under Article 12(6) RPBA for the respondent to submit auxiliary request 1 with its reply to the grounds of appeal.

As set out above, the amendment made in this request compared to the main request was the mere deletion of claims. This is a straightforward amendment, which can also be admitted in view of the criteria contained in Article 12(4) RPBA, which have not been invoked by the appellant.

For these reasons, the board admitted auxiliary request 1 into the proceedings in accordance with Article 12 RPBA.

5. Added subject-matter - Article 123(2) EPC

5.1 The appellant contended that claim 14 of the main request, which relates to a graphene-based coating composition (1.1, *supra*), added subject-matter extending beyond the content of the application as filed. As set out above, the claims relating to a graphene-based coating composition (claims 14 and 15 of the main request) have been deleted in auxiliary request 1, thus rendering the appellant's objection moot.

6. Sufficiency of disclosure - Article 83 EPC

6.1 The appellant argued that the invention as defined in claim 1 of auxiliary request 1 was not sufficiently disclosed.

6.2 Claim 1 of auxiliary request 1 reads as follows:

"*1. Method to prevent or limit oxidation and/or decarburisation of a steel product when subjected to a heat treatment, characterised in that before subjecting the steel product to the heat treatment a graphene based coating is applied on the steel product and wherein the heat treatment comprises that the steel product is subjected to a hot forming step, wherein the heat treatment comprises that the steel product reaches a temperature in the range of 600 - 1000°C, wherein a top coat layer is applied on the graphene based coating.*"

6.3 The appellant raised two insufficiency objections, as set out below.

- Hot forming could not be implemented at a temperature of 600°C to at least 800°C.

- No information on the nature of the top coat layer or the total thickness of the top coat layer and the graphene coating in the examples of figures 7a-b/8a-c was provided in the corresponding parts of the description.

These objections are considered in the following.

6.4 Hot forming at a temperature of 600°C to at least 800°C

Claim 1 of auxiliary request 1 requires, *inter alia*, that "*the heat treatment comprises that the steel product is subjected to a hot forming step*" and "*the heat treatment comprises that the steel product reaches a temperature in the range of 600 - 1000°C.*"

The appellant submitted that the invention defined in claim 1 of the main request was insufficiently disclosed since hot forming could not be implemented at

a temperature of 600°C to at least 800°C. According to the appellant, paragraph [0004] of the patent (corresponding to the passage on page 1, lines 22 to 28, of the application as filed) taught that the heat treatment comprising a hot-forming step as defined in claim 1 of the main request had to be implemented at a temperature of around 900°C or above to ensure that an austenite microstructure (a more malleable and ductile phase) was achieved. Thus, the hot-forming step of claim 1 of the main request could not be implemented at a temperature of 600°C to at least 800°C.

The board does not agree.

As submitted by the respondent, according to the wording of claim 1 of auxiliary request 1, the heat treatment comprises hot forming the steel product. It follows that, according to the method of claim 1 of auxiliary request 1, the heat treatment comprising the hot-forming step (rather than the hot-forming step *per se*) occurs at 600°C to 1000°C. This means, in turn, that claim 1 of auxiliary request 1 does not require the hot-forming step to occur at a temperature of 600°C to at least 800°C. Hence, the appellant's argument that hot forming cannot be implemented at a temperature of 600°C to at least 800°C does not imply insufficiency of disclosure.

Moreover, even if claim 1 did require a hot-forming step at a temperature of 600°C to at least 800°C, the resulting discrepancy between such a hot-forming step and the teaching of the passage of the application as filed relied upon by the appellant would in fact be an issue of clarity under Article 84 EPC, which is not a ground for opposition and cannot be invoked in the

present case according to G 3/14 (OJ EPO 2015, A102, order).

6.5 Nature of the top coat layer and thickness of the top coat layer and the graphene coating in the examples of figures 7a-b/8a-c

Claim 1 of auxiliary request 1 requires that "*a top coat layer is applied on the graphene based coating*".

The appellant submitted that the application as filed did not provide any information on the nature or thickness of the top coat layer applied on the graphene-based coating in the examples of figures 7a-b/ 8a-c. The graphene coating and the top coat layer could have, for example, a thickness of 1 nm. With such a low thickness, however, the graphene coating and the top coat layer would have disappeared immediately during the heat treatment and could not have provided the claimed effect.

The board is not convinced by the appellant's argument.

The board acknowledges that the claimed effect cannot be obtained by a 1 nm thick coating, as argued by the appellant. However, this represents common general knowledge, as the board noted at the oral proceedings - and this was not disputed by the appellant. Irrespective of this, the application as filed does provide guidance on the total thickness of the graphene coating and top coat layer when it refers to a thickness of 132 microns in the examples of figures 7a and b (see page 9, lines 16 to 18, of the application as filed), which suggests the thickness should be far above 1 nm. Furthermore, the application as filed refers (on page 6, lines 28 and 29) to a polyurethane top coat and thus provides guidance to the skilled person on the nature of the top coat layer. Thus, in

the absence of serious doubts substantiated by verifiable facts, the application as filed can be considered to contain the required information on how to put the claimed invention into practice.

6.6 Thus, the board concludes that the invention defined by claim 1 of auxiliary request 1 is sufficiently disclosed.

7. Inventive step - claim 1 - Article 56 EPC

7.1 Starting from D1

As set out above, claim 1 of auxiliary request 1 relates to a method to prevent or limit oxidation and/or decarburisation of a steel product, the steel product comprising a graphene-based coating and a top coat layer applied on the graphene-based coating.

D1 discloses a method for protecting against corrosion/scaling of a steel product which is subjected to hot forming (paragraphs [0001] and [0002] of D1). The hot forming includes a heating step at a temperature of between 840°C and 1 000°C (paragraph [0044] of D1). The method comprises applying a coating material to the steel product before the hot forming (claim 1 of D1). The coating material may comprise graphite (see claim 4 of D1). An electrically conducting primer can be applied on top of the coating (paragraph [0023] of D1).

In the decision under appeal, D1 was taken as the closest prior art for assessing the inventive step of the subject-matter of claim 1 of auxiliary request 1. That D1 should be considered the closest prior art was common ground between the parties on appeal.

7.2 Distinguishing feature

It was also common ground between the parties that the distinguishing feature of claim 1 of the main request over D1 was that the coating composition comprises graphene.

7.3 Objective technical problem

The appellant relied on A13 and argued that since in D1 the antioxidation coating remained in place after the hot forming, full protection against oxidation and/or decarburisation during a heat treatment was necessarily achieved. The board accepts this.

As discussed during the oral proceedings, it follows that the objective technical problem is the provision of an alternative coating on a steel product which limits oxidation and/or decarburisation during heat treatment.

7.4 Obviousness

The appellant relied on documents D2, D10 and D12, and argued that the solution proposed by claim 1 of auxiliary request 1 was obvious.

The board does not agree.

D2 is concerned with the provision of coatings comprising functionalised graphene and polymers to protect, *inter alia*, roll steels (see the abstract). D2 teaches (on page 5, lines 16 to 18) that coating compositions comprising functionalised graphene exhibit corrosion-resistant properties.

D10 is concerned with anti-corrosive coatings for steel (abstract). Different coatings were tested and compared. In particular, the anti-corrosive

performances of a graphene-based coating are improved when compared with a coating containing graphite (table 1 on page 17885).

D12 is a document summarising the common general knowledge on graphene. D12 teaches (see the third full paragraph on page 2 of D12) that graphene has stiffness ("strong material") and electrical conductivity properties exceeding those of graphite.

However, none of these documents teaches that the type of coating disclosed in these documents would be suitable for use in heat treatments including hot forming. Indeed, as was submitted by the respondent - and this was not contested by the appellant - the corrosion tests in D2 are conducted at room temperature (see tables (1) and (2) on pages 22 and 23 of D2). There are no examples of performance at high temperatures and oxidising conditions, as required by claim 1 of auxiliary request 1. The same observation applies with respect to D10, in which corrosion performance was tested at 25°C and 35°C (see the second paragraph of point 2.5 on page 17881). Finally, as set out above, D12 refers (on page 2, under the heading "Graphene: Wonder Material") to the stiffness and electrical conductivity properties of graphene. D12 makes no mention of using graphene to achieve a limitation of oxidation and/or decarburisation at high temperatures.

Therefore, the skilled person would not transfer the teaching of these secondary documents to D1 in order to solve the objective technical problem. The appellant has not identified any teaching in D2, D10 or D12 that would lead to a different conclusion.

7.5 Consequently, the subject-matter of claim 1 of auxiliary request 1, and by the same token of dependent claims 2 to 13, does involve an inventive step over D1 in combination with D2, D10 or D12.

8. It follows that auxiliary request 1 is allowable.

9. Admittance of D10, D12 and A13

D10, D12 and A13 are documents submitted by the appellant. D10 and D12 were filed before the opposition division, after the nine-month opposition period. A13 was filed with the statement of grounds of appeal.

The opposition division did not admit D10 or D12 into the proceedings (see "Admittance and non-admittance of late filed documents" on page 11 of its decision). The appellant requested that D10 and D12 be admitted into the appeal proceedings. The respondent requested that A13 not be admitted into the appeal proceedings.

During the oral proceedings, the board admitted D10, D12 and A13 into the proceedings.

In arriving at the above conclusion on the inventive step of the subject-matter of claim 1 of auxiliary request 1, the board took into consideration D10, D12 (7.4, *supra*) and A13 (7.3, *supra*).

Since the decision is in the respondent's favour, there is no need for the board to set out its reasons for admitting D10, D12 and A13.

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 with:

   - claims 1 to 13 of auxiliary request 1 as filed with the reply to the statement of grounds of appeal, and

   - a description and drawings to be adapted thereto, if appropriate.

The Registrar: The Chairman:

U. Bultmann M. O. Müller

Decision electronically authenticated