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**D E C I S I O N**  
**of 8 January 2002**

**Case Number:** T 1106/98 - 3.2.2

**Application Number:** 91905528.5

**Publication Number:** 0517786

**IPC:** C22B 34/12

**Language of the proceedings:** EN

**Title of invention:**  
Production of synthetic rutile

**Applicant:**  
WIMMERA INDUSTRIAL MINERALS PTY. LTD.

**Opponent:**

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**Headword:**

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**Relevant legal provisions:**

EPC Art. 84, 56

**Keyword:**

"Clarity (yes)"  
"Inventive step (yes) after amendmend"  
"Functional features (admissible)"

**Decisions cited:**

T 0068/85; T 0389/87

**Catchword:**

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Case Number: T 1160/98 - 3.2.2

**D E C I S I O N**  
**of the Technical Board of Appeal 3.2.2**  
**of 8 January 2002**

**Appellant:** WIMMERA INDUSTRIAL MINERALS PTY. LTD.  
Floor 2, 15-29 Bank Street  
South Melbourne, VIC 3205 (AU)

**Representative:** Hucker, Charlotte Jane  
Gill Jennings & Every  
Boardgate House  
7 Eldon Street  
London EC2M 7LH (GB)

**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office posted 9 July 1998  
refusing European patent application  
No. 91 905 528.5 pursuant to Article 97(1) EPC.

**Composition of the Board:**

**Chairman:** W. D. Weiß  
**Members:** R. Ries  
J. C. M. De Preter

## Summary of Facts and Submissions

I. The present appeal is against the decision of the Examining Division to refuse European patent application No. 91 905 528.5 (EP-A-0 517 786). The Examining Division reasoned that the claimed subject matter lacked clarity (Article 84 EPC) and did not involve an inventive step (Article 56 EPC). In the examination procedure the following documents were considered:

D1: AU-B1-28956/77 and

D2: US-A-3 647 414

D3: FR-A-2 077 531

D4: AU-B1-26109/77

II. In a communication dated 21 August 2001 following a summons to attend oral proceedings, the Board expressed its provisional opinion that the claims in the form underlying the impugned decision of the Examining possibly would not satisfy the requirements of Article 84 EPC.

III. Oral proceedings took place on 8 January 2002. The appellant requested that

- the decision under appeal be set aside and
- a patent be granted on the basis of the "main" request submitted at the oral proceedings.

IV. The wording of independent claim 1 according to this

"main" request that was submitted in replacement for all earlier requests reads as follows:

- "1. A process for upgrading the titania content of a titaniferous ore or concentrate which process comprises the steps of:-
  - (i) reducing the titaniferous ore or concentrate using a solid carbonaceous reductant at a temperature of at least 900°C to form, in the reduced product, metallic iron, a major rutile phase and a separate minor impurity-bearing titaniferous phase comprising a metatitanate ( $M_2O_3$ ) structure and/or an anosovite/pseudobrookite ( $M_3O_5$ ) structure, the reduction being carried out under conditions which encourage formation of the metatitanate phase relative to the anosovite/pseudobrookite ( $M_3O_5$ ) phase in the reduced product of step (i);
  - (ii) cooling the reduced product of step (i) in an oxygen-free environment to produce a cooled reduced product;
  - (iii) subjecting the cooled reduced product of step (ii) to a first stage leaching or aeration to convert metallised iron into a readily removable form to produce a leached or aerated product;
  - (iv) removing the readily removable form of the iron from the leached or aerated product of step (iii) to produce an intermediate product;
  - (v) subjecting the intermediate product of step (iv) to leaching with a solution of a strong acid to form a residue and convert other impurity elements to a readily removable

form, said other impurity elements being impurities in the separate minor impurity-bearing titaniferous phase of step (i); and (vi) removing the readily removable form of the other impurity elements from the residue of step (v) to produce a synthetic rutile."

V. The appellant essentially argued as follows:

The key feature of the claimed process for upgrading titaniferous ore or concentrate is to allow in the pyrometallurgical stage the formation of an impurity-bearing titania containing ( $M_2O_3$ ) phase which is readily leachable, rather than to achieve the total separation of titania from the impurities as proposed in the prior art. Once the skilled person is told the inventive concept underlying the present application i.e. that he should encourage a specific titaniferous impurity-bearing phase (= the ilmenite-like metatitanate  $M_2O_3$  structure) and leach that phase, it is adequately and sufficiently clear to him from the detailed description how this  $M_2O_3$  structure could be successfully produced. The selection of the appropriate process parameters essentially depends upon the type of titaniferous concentrate which can vary over a wide range in composition. A restriction in claim 1 to any particular set of conditions in order to produce this titaniferous  $M_2O_3$  phase from a specific type of concentrate is, therefore, unnecessary and would unduly restrict the protection that should be afforded to the claimed process.

Neither document D1 nor document D4 mention the existence of a readily leachable titaniferous  $M_2O_3$  phase in which the impurities such as manganese, magnesium

and aluminium are concentrated. Hence, these documents could not inspire the skilled reader to promote the formation of this phase by selecting the appropriate reducing conditions. Consequently, the claimed process was not obvious therefrom and involves an inventive step.

## **Reasons for the Decision**

1. The appeal complies with Rule 65(1) EPC and is, therefore, admissible.
2. *Amendments*

Claim 1 derives from original claims 1, 2 and 10 and from the subject matter present on page 5, lines 10 to 18 of the description.

Claims 2, 18 to 21, 23 to 26 find support in original claims 2 to 9 and 16, respectively.

Claims 3 and 4 derive from the subject matter on page 8, line 32 to page 9, line 4.

Claims 5 and 6 have a basis in the subject matter given on page 6, lines 6/7 of the description.

Claims 7 to 10 find support from original claim 11 read in combination with the parts of the description on page 5, lines 19 to 29.

Claims 11 and 13 are based on the description, page 1, lines 4 to 7 and page 7, paragraph 2, 3, respectively. Claims 12 and 14 derive from the subject matter present

on page 5, lines 8 to 18 of the description.

Claims 15 to 17 are based on the description page 8, lines 8 to 10.

The requirements of Article 123(2) EPC are, therefore, satisfied.

2. *Clarity*

Having regard to the clarity objections raised by the Examining Division, claim 1 now specifies that the separate impurity-bearing titaniferous phase comprises (a) an ilmenite-like metatitanate ( $M_2O_3$ ) structure and/or (b) an anosovite/pseudobrookite ( $M_3O_5$ ) structure. In addition thereto, claim 1 makes clear that the reducing conditions in step (i) are to be selected in order to promote effectively the formation of the readily leachable metatitanate ( $M_2O_3$ ) structure vis-à-vis the unleachable ( $M_3O_5$ ) structure. In particular this "functional" feature which defines the technical result aimed at in the reducing step has been objected to by the Examining Division as being unallowable. In this context the Examining Division correctly pointed out that the area defined by the claims should be as precise as the invention allows and therefore, as a general rule, claims which comprise technical terms which are "functional", i.e. defined in terms of the result to achieved, should not be allowed.

Notwithstanding this general rule, the circumstances seen objectively may justify the adoption of defining a feature in terms of the result. In decision T 68/85 OJ EPO 1987, 228, Headnote, it was already decided that the definition of features in "functional" terms in a

claim is admissible if:

- (a) from an objective viewpoint such features cannot be otherwise defined without unduly restricting the scope of the invention, and
- (b) these features provide instructions which are sufficiently clear for the expert to reduce them to practice without undue burden, if necessary with reasonable experiments (see also: T 389/87, point 3 of the reasons).

In the Board's view, these prerequisites are met in the present case. As it is evident from the specification, the basic inventive concept underlying the claimed process for upgrading titaniferous concentrates resides in the perception that, upon reducing the concentrate, the undesirable impurities such as Mn, Mg, Al and also Fe are essentially concentrated in two different titaniferous structures, one phase being readily leachable and the other phase being not. In order to have the impurities effectively removed, the expert is, therefore, told to create favourable reducing conditions to promote the formation of the readily leachable metatitanate ( $M_2O_3$ ) structure and to minimize the formation of the anosovite/pseudobrookite ( $M_3O_5$ ) structure which according to the prior art cannot be leached even in strong acids. This inventive concept once being known, the metallurgist would, upon reading the application as a whole, in particular in conjunction with the specific examples, and using his basic technical knowledge, be aware of the considerations that need to be taken into account when attempting to upgrade a wide variety of titaniferous concentrates. The criteria to pay attention to include



inter alia the types and levels of the impurities in the concentrate, the reduction temperature and/or the degree of metallisation that is achieved during reduction. The type and amount of the crystallographic structures formed in the reduced concentrate can be readily determined e.g. by X-ray diffraction measurements which are no more than routine for the metallurgical expert. It is, therefore, a straightforward matter for a skilled person to optimise without undue burden the process parameters in the reducing step in order to achieve the claimed result i.e. to encourage the formation of the metatitanate ( $M_2O_3$ ) structure.

Although the application actually recommends preferred reduction temperature ranges and favourable degrees of metallisation, a limitation to these ranges in claim 1 would, in the Board's view, be an unjustified restriction of the scope of protection in view of the wide variety of types of titaniferous concentrate that could be upgraded by the claimed process.

Consequently, the requirements of Article 84 EPC are met.

### 3. *Novelty*

Document D1 discloses a process for upgrading titaniferous concentrates which attempts to minimizing the very stable (and therefore considered as being "unleachable") anosovite/pseudobrookite ( $M_3O_5$ ) phase during the reducing step by adding chlorides and sulphur to the concentrate. Given that the added sulphur essentially reacts with manganese to form MnS, this impurity is not removed in the form of a

"impurity-bearing titaniferous phase" as stipulated in claim 1 of the present application. Moreover, the process according to document D1 does not mention cooling of the reduced concentrate in an oxygen-free atmosphere and neither do the processes disclosed in documents D2 and D3. Document D4 proposes a process of reducing titaniferous concentrate in a fluidized bed reactor generally below 900°C in a hydrogen containing atmosphere rather than by using a solid carbonaceous reductant at 900°C or more as stipulated in claim 1 of the present application (see D4, page 9, lines 5 to 16). Finally, none of the processes known from documents D1 to D4 envisages to effectively promote the formation of the  $M_2O_3$  structure.

Consequently, the subject matter of claim 1 is novel.

4. *The closest prior art; problem and solution*

Given that among the cited prior art only document D1 places a great emphasis on the consideration of the phase structures formed in the concentrate after reduction that is carried out by using a solid carbonaceous reductant, this document represents the closest prior art.

Starting from this prior art, the problem underlying the present application resides in providing a process of upgrading titaniferous ore which enables the effective removal of impurities, essentially iron and, more particularly, of manganese, magnesium and aluminium without the need of using large quantities and highly aggressive leachate liquors and thus reducing the cost associated therewith.

The solution to this problem consists in concentrating the impurities manganese, magnesium, aluminium and non-reduced iron in a specific titaniferous phase which is readily leachable due its  $M_2O_3$  structure by selecting the appropriate reducing conditions which encourage the formation of this phase.

5. *Inventive step*

This solution is neither mentioned nor envisaged in the any of the prior art processes. As is apparent from document D1, page 3, line 20 to page 4, line 6, the desired high degree of metallisation (corresponding to the removal of iron) when reducing ilmenite cannot be achieved without specific manganese binding additives since the anosovite/pseudobrookite ( $M_3O_5$ ) structure containing iron is stabilized by manganese. To this end, document D1 teaches the addition of chlorides and sulphur containing compounds to the titaniferous concentrate in order to minimise the amount of manganese generally comprised therein. The added sulphur is likely to react at least in part with manganese to form MnS which can be readily removed by aeration or acid leaching from the concentrate while the other impurities (Mg, Al, residual parts of Mn and Fe) are contained in the smaller titaniferous anosovite/pseudobrookite ( $M_3O_5$ ) structure which is, however, regarded as being unleachable (see D1, page 4, lines 2 to 5; lines 27 to 31). Consequently, this upgrading process does not propose to leach the ( $M_3O_5$ ) structure and hence falls short of removing impurities other than iron and manganese, in particular magnesium and aluminium confined therein from the titaniferous concentrate. The most important aspect, however, is that the reader of document D1 or any of documents D2

to D4 would not understand or expect that the undesirable impurities of a titaniferous ore or concentrate can be effectively accumulated in a second, readily leachable metatitanate ( $M_2O_3$ ) phase rather than in an unleachable anosovite/pseudobrookite ( $M_3O_5$ ) structure, the more so since the existence of the metatitanate phase is not even remotely mentioned in these documents.

In view of the foregoing and given that there is no prior art pointing to the claimed approach, the concept of allowing the impurities to enter this metatitanate ( $M_2O_3$ ) phase and then attacking and removing this phase by leaching involves an inventive step.

## **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 grant a patent on the basis of claims 1 to 26 according to the "main" request submitted at the oral proceedings of 8 January 2002 and a description still to be adapted.

The Registrar:

The Chairman:

V. Commare

W. D. Weiß