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**D E C I S I O N**  
**of 4 June 2004**

**Case Number:** T 0424/00 - 3.3.5

**Application Number:** 91908406.1

**Publication Number:** 0527811

**IPC:** C01G 37/14

**Language of the proceedings:** EN

**Title of invention:**

A process and plant for the preparation of alkaline chromates from chromium minerals

**Patentee:**

Stoppani S.p.A.

**Opponent:**

Bayer Chemicals AG

**Headword:**

Chromates/STOPPANI

**Relevant legal provisions:**

EPC Art. 54, 56, 123(3)

**Keyword:**

"Extension of scope: no"

"Inventive step: yes"

**Decisions cited:**

-

**Catchword:**

-



Case Number: T 0424/00 - 3.3.5

**D E C I S I O N**  
**of the Technical Board of Appeal 3.3.5**  
**of 4 June 2004**

**Appellant:** Bayer Chemicals AG  
(Opponent) Law & Patents Patents and Licensing Geb.  
Q18, R.1457  
D-51368 Leverkusen (DE)

**Representative:** -

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**Decision under appeal:** Interlocutory decision of the Opposition  
Division of the European Patent Office posted  
10 April 2000 concerning maintenance of  
European patent No. 0527811 in amended form.

**Composition of the Board:**

**Chairman:** M. M. Eberhard  
**Members:** B. P. Czech  
J. H. P. Willems

## Summary of Facts and Submissions

I. The appeal is from the decision of the opposition division posted on 10 April 2000 maintaining the European patent No. 0 527 811 in amended form.

The independent claims 1, 11 and 13 of the patent as granted read as follows:

"1. A process for the production of alkaline chromates by means of oxidative disaggregation in a reactor of minerals and/or substances containing trivalent chromium compounds in a mixture with alkali and in the presence of oxidizing gases, characterized in that said oxidative disaggregation is carried out in dry phase by heating and stirring said mixture on the inner wall of said reactor, in the presence of a controlled oxygen content atmosphere by keeping said oxidative gases free from combustion products."

"11. A process for the oxidative disaggregation of materials containing trivalent chromium compounds such as chromite, comprising the steps of:

- feeding a mixture of the said material with alkali to a rotating tubular reactor,
- continuously moving the said mixture inside the said reactor,
- oxidizing the chromium compounds present in the mixture through the introduction, into the said mixture, of one or more oxidizing gases containing oxygen, in countercurrent and in a controlled environment, in the absence of combustion products of burners, in order to control the residence time of the material in said reactor,

- heating the mixture contained within said reactor,
- leaching the oxidized mixture, in order to extract the alkaline chromates in an aqueous solution."

"13. A plant for the oxidative disaggregation of minerals containing trivalent chromium, comprising a reactor to carry out the said oxidative disaggregation by contact with the oxidative atmosphere of reaction and application of heat, characterized in that the said reactor is of the rotating type made inwardly of an unfretted material, and comprises gas-tight means for feeding said minerals mixed with alkali (sic), means for feeding oxidizing gases having a preestablished oxygen percentage, adjusted to control the residence time of the material in said reactor, gas tight means for discharging the oxidized mixture from the said reactor in order to prevent dilution of oxidizing gases, indirect heating means for heating said mixed materials, and in that the said rotating reactor is contained inside a heating chamber."

II. The decision of the opposition division was based on a set of 18 claims presented during the oral proceedings on 27 January 2000. Independent claim 1 and 13 thereof were amended to read as follows (post-grant amendments appear in **bold**):

"1. A process for the production of alkaline chromates by means of oxidative disaggregation in a **rotating tubular** reactor of minerals and/or substances containing trivalent chromium compounds in a mixture with alkali and in the presence of oxidizing gases, characterized in that said oxidative disaggregation is carried out in dry phase by heating and stirring said

mixture on the inner wall of said reactor, **in which heat is supplied separately from the oxidation gases so that the oxidation takes place in a controlled environment in the absence of combustion products of burners.**"

Independent claim 11 has the same wording as granted claim 11.

In comparison to its granted version, claim 13 was amended to specify that the heating chamber was "**stationary**".

In the impugned decision, the opposition division considered inter alia the following documents:

D1: US-A-3 733 389

D2: GB-A-288 250

D3: US-A-4 244 925

D4: SA-A-88/7881

D5: US-A-3 295 954

The opposition division concluded that the claims "did not contravene Article 123(2) and (3) EPC" and that the claimed subject-matter was novel and inventive in view of the said documents.

III. With its notice of appeal, the appellant (opponent) filed document

D6: Ullmanns Encyclopädie der technischen Chemie,  
Vol.1, "Chemischer Apparatebau und  
Verfahrenstechnik", 1951, pages 177, 837 and 845.

Referring to D2, D3 and D5, it contested some of the conclusions drawn by the opposition division and argued that the claimed process was at least rendered obvious by the prior art considered. The appellant also submitted that the subject-matter of claim 13 lacked novelty in view of prior art illustrated in D6, and also in view of the prior art referred to on page 2, upper half of D4.

IV. In its reply, the respondent (proprietor of the patent) commented on the disclosures of D2 to D5 and on differences with respect to the claimed subject-matter, and rejected the objections of the appellant.

V. In its letter dated 16 February 2004, the appellant raised an objection under Article 123(3) EPC against claim 1. It also raised novelty objections against claims 1 and 11 in view of D1 and D2. Referring to D1, it argued that the claimed method was obvious for the skilled person.

VI. Oral proceedings took place on 4 June 2004.

During the oral proceedings, the respondent filed a new claim 1 which differs from claim 1 of 27 January 2000 by the addition of the expression "**and in the presence of a controlled oxygen content atmosphere**" at the end of the claim. It also filed a modified description page 4.

VII. The written and oral submissions of the parties, as far as they are relevant for the present decision, can be summarised as follows:

According to the appellant even claim 1 as amended during the oral proceedings did not meet the requirements of Article 123(3) EPC due to the replacement of the phrase "in the presence of a controlled oxygen content atmosphere by keeping said oxidative gases free from combustion products" by the phrase "in which heat is supplied separately from the oxidation gases so that the oxidation phase takes place in a controlled environment in the absence of combustion products". In its view, the first of these wordings implied that the oxygen present in the entire reactor must not contact combustion products, or, in other words, that the entire gas volume within the reactor must be free of combustion products. On the other hand, the second wording only required that no combustion products are present in a localised oxidation zone. Hence oxygen may be mixed with combustion products and even react at other locations within the reactor. Since the latter possibility was excluded by the first wording, the scope of claim 1 had been extended.

The appellant argued that the alleged extension of scope was more apparent in view of D1 since the method of D1 did not fall under the terms of claim 1 as granted but fell under the terms of present claim 1. In particular, D1 locally fulfilled the requirement concerning the "absence of combustion products" due to the pressure of the injected oxidant gas as illustrated by Figure 2. According to D2, the mixture was heated by

being moved along externally heated walls of a stationary muffle furnace. Hence, the expression "rotating tubular reactor" in present claim 1 was to be considered as a "semantic synonym" of a muffle furnace with agitating means as disclosed in D2. Since D1 and D2 disclosed all the features of claims 1 and 11, they were novelty-destroying for the subject-matter of these claims. Concerning independent claim 13, the appellant argued that Figures 1283 and 317 of D6 both showed an indirectly heated tubular furnace rotating within a stationary heating chamber and that it could not be gathered from these figures that combustion gases were led to the interior of the furnaces. During the oral proceedings, although being questioned by the board, the appellant did not wish to further elaborate on the novelty objections raised in writing on the basis of D4 and D6.

D1 related to the same type of reaction and the same type of reactor as the contested patent. Like the contested patent, D1 addressed the improvement of the yield of the oxidation reaction and the avoidance of fouling. If it was considered that the condition concerning the absence of combustion products was not fulfilled, D1 could thus be considered as the closest prior art. It was known from D1 that the available oxygen concentration had an impact on the yield of the reaction. In order to improve said yield, the skilled person only had two possibilities: further increasing the oxygen content of the atmosphere in the furnace in the way shown in D1 or removing the sole oxygen-consuming item, i.e. the burner, from the inside of the furnace in order to be able to add the required amount of oxygen in a controlled manner, independently from



the heating. The latter possibility was thus the sole possibility available (one-way street situation). A subsequent leaching step was the usual measure for recovering the chromate produced, as shown e.g. by D2 or D3. The features necessary to solve the problem of fouling were not comprised in present claim 1. Hence, the processes of claims 1 and 11 lacked an inventive step in view of D1 taken alone, or in view of a combination of D1 with D2 or D3. The method of claims 1 and 11 also lacked an inventive step over D3 taken alone, or in combination with D1. Starting from D3 as closest prior art, the problem merely consisted in providing an alternative process. It had not been convincingly demonstrated that the features of the method of claim 1 actually led to an improvement in terms of yield under comparable circumstances. D3 mentioned rotary kilns and considered direct heating by combustion as preferable. The skilled person would thus consider opting for a less preferred alternative covered by D3, i.e. for indirect heating in a rotary kiln, as an obvious measure for solving this problem, in particular in view of D1 which taught that better yields could be obtained by adding more oxygen to the reaction zone in a rotating furnace.

The respondent stated during the oral proceedings that the present wording of claim 1 still meant that the entire gas space within reactor was free of combustion products and that the oxidation occurred along the entire inner surface of the reactor. Hence, the scope of claim 1 had not been extended. However, it also stated that the oxidation reaction started at 850°C and could thus already be carried out at a distance of about 1 meter from the feed end of the reactor.

In the method according to D1, the material under treatment was scattered by the impacting stream of oxidising gas. Hence, the oxidation reaction was not restricted to the oxygen feeding zone, where it was more intense, but also occurred to a certain degree throughout the entire kiln. Moreover, considering the way the oxygen containing gas was fed to the kiln, a mixing of oxygen with combustion products would even occur in this localised zone. D2 did not disclose the use of a rotating tubular furnace. Hence, the processes of claim 1 and 11 were novel. Concerning D4 and D6 it pointed out that these documents did not relate to the oxidative disaggregation of chromite, while the furnaces disclosed did not include sealing means against the reaction gases. Moreover, the novelty objection raised on the basis of D4 had not been substantiated and it was unclear on which prior art it relied.

The respondent pointed out that D1 had been published in 1973, i.e. many years before the filing (in 1991) of the contested patent and that the technology of the type disclosed in D1 did not permit to have a relative amount of more than 12% oxygen of the total amount of gases fed to the kiln. According to the claimed invention, it was possible to control the required oxygen concentration and the residence time independently of the heating means, i.e. of the quantity of combustion gas produced by the burner, thereby obtaining higher oxidation yields. Without hind-sight, a skilled person would not take from D1 any suggestion to arrange burners at the outside of an unfettled rotary kiln in order to permit a fast and

high-yield oxidation. A combination of D1 with D2 was not possible since D2 did not relate to rotating tubular reactors. D3 related to the problem of avoiding alumina in the chromate product, and not to the problem of achieving higher yields. Moreover, the teaching of D3 led in the direction of directly heated furnaces. Hence, D3 did not suggest the indirect heating of a tubular rotating reactor with the oxidation taking place in the presence of a controlled oxygen content atmosphere but in the absence of combustion products of burners.

VIII. The appellant requested that the decision under appeal be set aside and the patent be revoked.

The respondent requested that the patent be maintained with claim 1 and description page 4 as filed during the oral proceedings, claims 2 to 18 as maintained by the opposition division, description page 7 as filed on 27 January 2000, description pages 2, 3, 5 and 6 as granted and Figures 1 to 3 as granted.

## **Reasons for the Decision**

### 1. *Amendments*

1.1 The appellant did not raise objections under Article 123(2) EPC against the amended claims. The board is also satisfied that the amendments find a sufficient basis in the following parts of the application as filed (and the corresponding parts of the patent as granted):

1.1.1 Concerning claim 1 see e.g. examples 7 to 11, page 19, 2nd paragraph, page 20, line 20 and Figure 1 for the features "rotating tubular reactor", and page 8, 2nd paragraph and Figure 1 for the features "heat supplied separately from the oxidation gases so that the oxidation phase takes place in a controlled environment in the absence of combustion products of burners".

1.1.2 Concerning claim 13 see e.g. Figure 1, reference number 5 ("stationary heating chamber") and page 20, line 20 to page 21, line 17.

1.2 Alleged extension of the scope of claim 1

1.2.1 A comparison of the wordings of the **entire** characterising parts of claim 1 as granted and of claim 1 as amended, shows that both formulations express that the **oxidative disaggregation** of the ore/minerals is carried out by means of an atmosphere containing a **controlled oxygen** amount but containing **no combustion products**. In the board's view, this means that, according to both formulations, no combustion products may be present in the reactor at those locations where the conditions (temperature and presence of gaseous oxygen) are such that the oxidation reaction occurs. Neither granted claim 1 nor amended claim 1 states whether or not the oxidative disaggregation takes place over the entire length of the reactor. Therefore, the appellant's arguments in this respect cannot be accepted.

1.2.2 As it will appear more clearly from point 2.1 below, a method such as disclosed in D1 neither falls under the terms of claim 1 as granted nor under the terms of

present claim 1. Hence, the comparison of the method of D1 with the respective methods according to present claim 1 and claim 1 as granted cannot support the appellant's objection.

1.2.3 The board is thus not convinced that the amendments to claim 1 lead to an extension of its scope.

1.3 The board therefore concludes that the amendments to the claims meet the requirements of Article 123(2) and (3) EPC.

## 2. *Novelty*

2.1 D1 discloses a process for producing alkali chromate from a chrome ore and alkali comprising mixture comprising charging the mixture in an inclined rotary kiln and directly heating it by the flame of a burner axially arranged within the kiln near the outlet end (for the treated mixture) thereof. The mixture is moved through the rotating kiln and passed through a roasting zone thereof where it is oxidised by oxygen containing products comprising the combustion gases issuing from the burner. At a location below the flame, and by means separate from the burner, a blast of air or oxygen enriched air is directed against the mixture while it is in said roasting zone, thereby scattering the mixture and increasing its residence time in the said zone. See claim 1, Figures 1 and 2, column 2, lines 24 to column 3, line 17, and column 3, lines 28 to 58.

2.1.1 The board accepts the argument of the appellant that due to the pressure of the oxygen fed into the reactor, it can be assumed that the zone near to the blast

nozzle outlet will be essentially free of combustion products. However, considering that no constructive measures are taken to avoid a mixing of the gases emanating respectively from the burner nozzle and from the blast nozzle, these will necessarily mix at a certain distance from their respective outlets into the furnace. D1 does not indicate and it is not plausible that the entire oxygen supply is consumed by the intended reaction before any remaining gas components from the blast nozzle come into contact and mix with the combustion gases from the burner. In other words, it is not plausible that no oxidation reaction would take place between available oxygen and the heated mixture at locations where some gas mixing has already occurred. This view is supported by Figure 2 of D1 which, although of merely schematical nature, not only shows a somewhat localised scattering of the mixture by the gas injected by the blast nozzle, but also a contact of the lower part of the flame, and hence of gaseous combustion products, with the turbulent region comprising the scattered material. The two gaseous streams will thus necessarily mix to some extent at least in this contact region where the scattered material will be oxidised in the presence of combustion products of burners, in contrast to what is required by present claims 1 and 11. Moreover, D1 discloses the step of recovering the chromate produced, but does not explicitly mention the leaching as required by present claim 11.

- 2.1.2 Since it cannot be clearly and unambiguously concluded from the information given in D1 that combustion products of burners will be absent at any point of the reactor where the oxidation takes place, and that a

subsequent leaching is carried out, the claimed process is novel over D1.

2.2 D2 relates to the thermal disintegration of chrome ores or minerals containing chromium by means of alkali or alkaline agents. The disintegration process comprises treating a mixture of chrome ores or minerals, alkali and optionally diluents in a mechanical furnace with a stationary hearth and having a plurality of stages. The product under treatment, which is extended over a large surface, is distributed and continually mixed by suitable mechanical agitating means of the type of rotating arms or the like. The mixture under treatment can either be heated directly (with the combustible in contact with the mixture) or indirectly by externally heated muffles containing the mixture. The sodium chromate obtained can easily be recovered from the treated mixture by means of customary solvents. See claims 1 to 4 and page 1, lines 90 to 102.

2.2.1 The use of a rotating tubular reactor as referred to in claims 1 and 11 is not disclosed or envisaged in D2. On the contrary, although D2 mentions rotating furnaces in its introductory part referring to the prior art, their use is generally considered to be less economical than the furnace used in D2 (see page 1, lines 79 to 82). In any case, also according to the embodiment of D2 involving external heating of muffles, the mixture is moved within the furnace by agitating means of the rotating arms type and not by a moving, i.e. rotating wall. No other moving furnace parts being mentioned in D2, the combination of muffles and agitating arms cannot be considered as a "semantic synonym" of the expression "rotating tubular reactor", as alleged by

the appellant. Moreover, D2 does not describe in detail the furnace to be used when indirectly heating the material by means of externally heated muffles and does not mention any precautions to be taken for avoiding the entry of combustion gases into the muffles and for avoiding the contact of these gases with the material under treatment.

2.2.2 The method of claims 1 and 11 is thus also new in view of D2.

2.3 The board considers that the claimed methods are also new with respect to the disclosures of each of the remaining documents cited by the appellant. This was not in dispute.

2.4 Document D4 discloses a tubular rotating furnace for indirectly heating and treating materials. Combustion of fuels is used to heat the furnace in a way excluding a chemical influence of the combustion gas upon the treatment. The furnace comprises a plurality of heating gas chambers arranged around a central core chamber for the material and isolated therefrom by means of heat resistant ceramic members. The heating gas chambers (and burners) rotate with the central core chamber. Possible applications of the reactor mentioned in D4 include the reduction of chrome ores with coal, cokes conversion of coal, high-temperature firing of alumina, silicon carbide or zirconium oxide, and high-temperature dry plating. See Figures 1 to 7, page 1 lines 3 to 5, page 3, line 29, page 4, line 14, page 5, line 33 to page 6, line 19.



- 2.4.1 D4 does not address the oxidative disaggregation of chrome minerals and neither discloses a stationary heating chamber nor means for feeding and withdrawing solid materials which are gas-tight.
- 2.4.2 The plant of present claim 13 is thus novel over the disclosure of D4.
- 2.4.3 Even upon being questioned by the board, the appellant has not substantiated his objection against claim 13 which was based on the allegedly novelty-destroying prior art "referred to in the upper half of page 2 of D4". The appellant has neither identified nor filed the patent document cited in this passage. The quoted passage does not by itself represent a novelty-destroying disclosure of all the features of claim 13. Under these circumstances, the appellant's objection is not examined any further and cannot, therefore succeed.
- 2.5 Figure 1283 of D6 discloses a rotating tubular calcination kiln for the soda industry, whereas Figure 317 discloses a rotary drier, see the corresponding text on pages 845 and 177. In both cases, a rotating tubular member is arranged inside a stationary heating chamber and the material within the said tubular member is heated by means of hot combustion gases flowing through said chamber and around the rotating tube.
- 2.5.1 However, D6 does not disclose gas-tight sealing means for feeding (Figures 1283 and 317) and discharging the solid materials treated therein, let alone in connection with any distinct means for feeding oxidising gases. Moreover, considering the envisaged

applications of the devices disclosed in D6 (calcination of soda; drying), they are not necessarily suitable for carrying out reactions at the high temperatures required for the oxidative disaggregation of chromite ores.

2.5.2 The plant according to present claim 13 is thus novel over the devices shown in Figures 1283 and 317 of D6.

2.6 The board considers that the claimed plants are also novel over the disclosures of each of the remaining prior art documents cited by the appellant. This was not in dispute.

### 3. *Inventive step*

3.1 The board concurs with the parties in that the disclosure of D1 represents the closest prior art, since it also relates to the production of chromates by oxidation with gaseous oxygen in a rotating tubular kiln and addresses the problem of enhancing the oxidation yield whilst avoiding fouling in the reactor. See e.g. column 2, lines 17 to 21 and lines 35 to 60.

3.2 D1 foresees no other heating means than a burner arranged within the rotating tubular furnace. Depending on the throughput of the burner required for heating the material to the desired extent, corresponding amounts of hot off-gases produced are led through the furnace and occupy a large proportion of its volume. Throughout most of the internal volume of the furnace, the gaseous oxidant will thus contact and be mixed with the combustion off-gases and hence "diluted". The addition of a same oxidant feed gas having a given

composition will thus lead to a lower proportion of oxygen in a kiln as disclosed in D1 than in a reactor as used according to the invention. Hence, it is plausible that for an oxidant gas of a given composition and at otherwise similar conditions, higher oxidation yields and oxidation speeds (i.e. shorter residence times) than according to D1 are possible when using the process of the invention due to the necessarily higher proportion of oxygen of the entire gas stream present in the reactor.

- 3.3 The technical problem can thus be seen in the provision of a process which permits to obtain higher yields than the one of D1 with a given oxygen containing gas within a short residence time. See the contested patent, patent, column 3, lines 28 to 37 and column 3, line 58 to column 4, line 4. In the absence of evidence to the contrary, it is credible that this technical problem has been solved by the invention as claimed. Hence, it remains to be seen whether the claimed solution is suggested by the cited prior art.
- 3.4 In the discussion of even earlier prior art processes it is acknowledged in D1 that a higher concentration of oxygen in the combustion gas within the kiln remarkably promotes the oxidation reaction (see column 2, lines 9 to 11). D1 nevertheless prescribes the use of an internal burner and of a separate oxidant gas injection. Alternative ways of heating and oxidising the material are not envisaged. Hence, D1 taken alone could not induce the skilled person to replace the internal burner by heating means not leading to a "dilution" of the oxidising gas by combustion products in order to solve the stated technical problem. It is evident in

the knowledge of the claimed process that for a given oxidant gas composition, the removal of the burner from the inside of the furnace leads to a higher proportion of oxygen in the kiln, and hence to higher yields. However, in the absence of any indication towards the use of a different heating method in D1, the board does not consider the radical change from the well-established technique based on the use of a burner arranged inside of the tubular rotating kiln to the use of external burners or electric resistance heating as an obvious solution in a one-way street situation. Hence, without the application of ex-post facto considerations, the solution according to present claims 1 and 11 was not obvious.

3.5 D2 explicitly discourages the skilled person to use rotating furnaces because of their drawbacks compared to the furnace with stationary hearth and rotating arms as disclosed D2 (see point 2.2.1 above). Hence, a skilled person confronted with the stated technical problem would not consider this document, isolate the feature "external heating", and apply it to the rotating furnace of D1. The claimed methods are thus also non-obvious in view of D2.

3.6 According to another line of argument of the appellant, the claimed process was also obvious in view of D3.

3.6.1 D3 discloses a method for producing alkali metal chromates having a low alumina content, comprising reacting a mixture of chromium ore, a diluent and an alkali metal salt in an oxygen containing atmosphere at temperatures of from 900°C to 1200°C, and leaching the roast mixture to recover the formed alkali chromate. D3

acknowledges previously known processes carried out in rotary kilns or rotary hearth furnaces. D3 also indicates that "the roasting is normally carried out in rotary kilns or hearth furnaces of various types" and that "the material to be roasted will normally be passed through the furnaces counter-currently to hot oxygen-containing gases and the furnaces are preferably directly heated by the combustion of carbon-containing materials". See claim 1, column 1, lines 23 to 28 and lines column 4, lines 49 to 62. Furnaces heated in another manner are neither explicitly mentioned in the quoted passages nor in the examples of D3.

3.6.2 D3 aims at providing a process wherein the extraction of alumina into the leach liquor is avoided despite the omission of an addition of calcium oxide to the roasting mix. This aim is achieved by controlling a number of process variables. However, it is stated in D3 that similar results are obtained when either air or pure oxygen is taken as the oxygen-containing atmosphere in a kiln, hearth furnace or the like. Moreover, relatively long residence times (at least 30 minutes and preferably from 45 to 360 minutes) are considered necessary to achieve low levels of alumina in the final product chromates. See column 1, lines 15 to 20, column 2, line 42 to column 3, line 12, column 5, line 59 to column 6, line 24, and column 7, lines 33 to 60.

3.6.3 D3 is not primarily concerned with obtaining high chromate yields in short residence times, let alone in connection with a process carried out in a rotating tubular furnace. Therefore, the board does not consider D3 to represent the closest prior art for the purpose

of assessing whether the process of present claims 1 and 11 is based on an inventive step. Moreover, considering the very general teaching of D3 with respect to the furnaces and kilns to be used, the board is not convinced that a skilled person starting from D3 and simply wanting to provide an alternative **process** would opt for the use of a less preferred type of heating (indirect heating) in connection with a particular tubular rotating kiln, thereby precluding the presence of combustion products of burners in the oxidation zone, i.e. for the use of a **device** not previously used or disclosed in the context of the oxidative disaggregation of chromite ore.

- 3.6.4 Furthermore, considering the different aim of D3, the skilled person starting from the closest prior art as disclosed by D1 and confronted with the stated technical problem would not have expected to find in D3 any suggestions concerning measures for modifying the process of D1 in order to obtain higher yields. The skilled person would therefore have disregarded D3. Even assuming for the sake of argument that the skilled person would have considered D3, the passages quoted above would have directed him towards the preferred use of a directly heated type of furnace, e.g. of the type shown in D1. Moreover, D3 neither attaches a particular importance to the concentration of oxygen in the roasting gas, nor suggests any kind of measures for further increasing and for controlling the oxygen content in the reaction zone of the furnace. Hence, D3 cannot, without the application of ex-post facto considerations, suggest those modifications of D1 which are necessary to arrive at the claimed process.

3.7 For the above reasons, the methods of independent claims 1 and 11, and hence of dependent claims 2 to 10 and 12 are not obvious in view of the documents, and combinations thereof, relied upon by the appellant in attacking inventive step of the process of claim 1. The board is also convinced that the subject-matter of these claims is based on an inventive step in view of each of the other documents cited by the appellant, whether taken alone or in combination. Since this was not in dispute at the appeal stage, further considerations are not necessary.

3.8 As regards claim 13 and claims 14 to 18 dependent thereon, the appellant did not present any arguments concerning the issue of inventive step at the appeal stage. In the board's judgement the subject-matter of these claims also involves an inventive step. Taking into account that this was not disputed at the appeal stage further considerations in this respect are not necessary.

## 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 the following documents:
  - claim 1 as filed during the oral proceedings;
  - claims 2 to 18 as maintained by the opposition division;
  - description page 4 as filed during the oral proceedings;
  - description page 7 as filed on 27 January 2000;
  - description pages 2, 3, 5 and 6 as granted, and
  - Figures 1 to 3 as granted.

The Registrar:

The Chairman:

A. Wallrodt

M. Eberhard