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**Datasheet for the decision
of 15 September 2006**

Case Number: T 0916/02 - 3.2.07

Application Number: 97203326.0

Publication Number: 0839919

IPC: C22B 7/02

Language of the proceedings: EN

Title of invention:

Process for treating of flue dusts from electric steelworks

Applicant:

Ecochem Aktiengesellschaft

Opponent:

-

Headword:

-

Relevant legal provisions:

EPC Art. 54, 56, 123(2)

Keyword:

"Extension beyond content of application as filed (no, after amendment); Claim - formulation to include all essential features (yes, after amendment); Novelty (yes); Inventive step (yes) "

Decisions cited:

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Catchword:

-



Case Number: T 0916/02 - 3.2.07

D E C I S I O N
of the Technical Board of Appeal 3.2.07
of 15 September 2006

Appellant:

Ecochem Aktiengesellschaft
FL-9495 Triesen (FL)

Representative:

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Decision under appeal:

Decision of the Examining Division of the
European Patent Office posted 15 March 2002
refusing European application No. 97203326.0
pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: H. Meinders
Members: H. Hahn
C. Holtz

Summary of Facts and Submissions

- I. The applicant lodged an appeal against the decision of the Examining Division to refuse the European patent application No. 97 203 326.0.

The Examining Division held that the subject-matter of claim 1 of the main and auxiliary requests as filed during the oral proceedings on 5 February 2002 although meeting the requirements of Articles 123(2) and 54 EPC did not meet the requirements of Article 84 EPC and lacked an inventive step in view of the closest prior art document D1.

- II. With a communication dated 22 April 2005 the Board presented its preliminary opinion with respect to claims 1 to 8 as filed by fax on 22 July 2002 together with the grounds of appeal. Claim 1 of this single request was considered to not comply with Articles 123(2) and 84 EPC. The Board also remarked that an amended claim 1 - taking account of the objections made by the Board and containing all essential features - appeared to involve an inventive step. The Board remarked that, if a new request comprising such an amended claim 1 and an adapted description were to be filed, the impugned decision would have to be set aside and that the Board would intend to order the grant of a patent on the basis of such a claim 1.

- III. With letter of 28 June 2005 the appellant filed an amended claim 1 and a substitute page 6 of the description. Furthermore, as a precaution, in the event the Board intended to reconsider its express favourable preliminary opinion, oral proceedings were requested.

IV. With fax of 15 July 2005 the appellant filed a slightly amended claim 1 from which the phrase "metal or alloy" was deleted in order to meet an Article 84 objection as a response to a telephone conversation held on the same day with the Rapporteur of the Board.

V. With the grounds of appeal the appellant requested that the decision under appeal be set aside and a patent be granted on the basis of "the application as currently on file", which now implies the following documents:

Description:

pages 1 to 4 and 7 to 13 as originally filed

page 5 as filed on 20 December 1999 with letter of 17 December 1999

page 6 as filed on 29 June 2005 with letter of 28 June 2005

Claims:

claim 1 as filed on 15 July 2005 with fax of 15 July 2005

claims 2 to 7 as filed on 29 June 2005 with letter of 28 June 2005

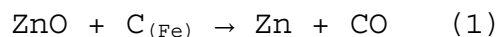
Drawings:

figure 1 as originally filed.

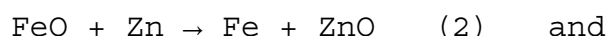
VI. Independent claim 1 under consideration reads as follows:

"1. A process for processing the electric steelworks dusts containing oxidised high-iron, zinc-bearing materials mainly in order to recover iron and zinc from them, comprising feeding said dusts in pellet form, coal and CaCl_2 or CaF_2 to a low-frequency induction furnace of coreless type(10), said process being characterised in that

said low-frequency induction furnace of coreless type (10) is only partially filled with a charge (11) of cast iron, such a charge being contained inside said low-frequency induction furnace (10) in the molten state as a bath under turbulent conditions owing to the effect of the induced currents, said dusts in pellet form coming into contact with the free surface of said turbulent molten bath inside said low-frequency induction furnace of coreless type (10), such that the continuous and fast renewal of cast iron layer wets the pellets, and the zinc oxide contained in the pellets reacts with carbon contained in said cast iron (11) of the bath/pellet contact region of said furnace (10) according to the following reaction (1):



and the metal Zn produced in the reaction (1) vaporises and reacts inside said low frequency induction furnace (10) with iron oxide contained in said dusts according to the following reaction (2):



with oxygen injected by means of a lance inside said low-induction furnace (10), such that the heat generated results in the save of electrical energy."

VII. The most relevant documents of the prior art are considered to be:

D1 = EP-A-0 174 641

D2 = DE-A-37 11 353

VIII. The appellant argued essentially as follows:

The amendments made to claim 1 are based on claims 1, 2 and 5 of the application as originally filed. The further feature of claim 1 "coal and CaCl_2 and CaF_2 " is based on page 8, lines 20 to 23 and page 9, line 24 to page 10, line 1 and on examples 1 and 2; the feature "induction furnace of coreless type" is based on page 7, lines 5 to 7, the feature "the continuous and fast renewal of cast iron wets the pellets" is based on page 8, lines 27 to 30, the feature "the bath/pellet contact region of the furnace" is based on page 9, lines 13 to 18 while the feature concerning the reaction of the metal Zn "reacts inside said furnace (10)" is derivable from page 9, lines 11 to 12. The feature "the oxygen is injected by means of a lance inside the low-induction furnace (10) such that the heat generated in said oxidation reactions results in the save of electrical energy and process consumption" is derivable from example 2, specifically from page 12, lines 24 to 25, from the figure and from page 9, lines 21 to 23; all citations are with respect to the application as originally filed. Therefore claim 1 meets the requirements of Article 123(2) EPC.

The feature of the oxidation of Zn to ZnO makes the claimed subject-matter novel over the prior art.

The invention aims at providing an efficient recovery of valuable metals, in particular ZnO, from the dusts generated in the electrical furnaces during the production of stainless steel by lowering the costs for the recovery of ZnO. The closest prior art is represented by D1. According to D1 the dusts are supplied in pellet form into an induction furnace together with carbonaceous solid reductant and the zinc oxide is melted and reduced with said solid reductant so that the reduced zinc is vaporized and sent to a condenser where it is separated as crude zinc. The technical problem to be solved over D1 resides in the reduction of the process consumption of energy and costs for recovering ZnO from the electric steelworks. The saving of energy is an extremely important factor for industrial success and applicability. The solution is achieved by performing in a low frequency induction furnace oxidative reactions which generate heat that keeps the high temperature value of the bath whereby the consumption of energy required maintaining the high temperature of the molten bath is reduced. Specifically, the oxidation of Zn within the furnace according to reaction (2) and the injection of oxygen inside the furnace (10) contribute synergistically to the complete oxidation of zinc and generate the required heat thus reducing the need of supplying electric energy. Document D1 fails to disclose the oxidation reaction (2) but also fails to acknowledge and exploit the correlation existing between the oxidation of zinc, achieved by reaction (2) and the injection of oxygen inside the furnace (10), and the save of energy of the process. D1 also does not suggest the injection of oxygen directly inside the furnace but only into the

"preheating zone" of the furnace where the oxidation heat is useless.

Document D2 does not describe or suggest forming vapours containing zinc that, while rising above the bath are oxidized in order to generate heat and reduce the energy consumption. D2 does also not provide any motivation to do so. The process according to D2 merely removes volatile metals before reaching the melting furnace which acts as a reducing zone. Furthermore, D2 does not suggest using a low frequency induction furnace. Consequently, the subject-matter of claim 1 involves an inventive step.

Reasons for the Decision

1. *Admissibility of amendments (Article 123(2) EPC)*
 - 1.1 Claim 1 is based on claims 1, 2 and 5 as originally filed. The additional feature "low-frequency induction furnace of coreless type" has a basis on page 7, lines 5 to 9; on page 10, lines 10 to 12; on page 11, lines 25 to 26; and on page 12, line 10 of the application as originally filed. The further feature "reacts with carbon contained in said cast iron of the bath/pellet contact region" has a basis on page 8, line 24 to page 9, line 2 and lines 13 to 17. The further added feature "... oxygen injected by means of a lance inside said low-induction furnace (10)" can be derived from the figure in combination with the examples 1 and 2 where oxygen has been used and which according to page 12, lines 24 to 25 "was injected" while the feature "such that the heat generated results

in the save of electrical energy" can be derived from page 12, lines 24 to 25 in combination with page 13, lines 12 to 28 of the application as originally filed.

Claim 1 therefore meets the requirements of Article 123(2) EPC.

- 1.2 The dependent claims 2 to 7 are based on claims 3 to 4, on page 8, lines 14 to 16, on claim 6 and page 8, lines 20 to 21, on claim 7, and on page 8, lines 17 to 19, respectively, of the application as originally filed.

Hence claims 2 to 7 likewise meet the requirements of Article 123(2) EPC.

Pages 5 and 6 of the description have only been amended in order to incorporate a short description of the closest prior art D1 and to provide a clear counterpart to claim 1, necessary for compliance with Rule 27(1)b) and Article 84 EPC without being at odds with the requirements of Article 123(2) EPC.

2. *Clarity (Article 84 EPC)*

- 2.1 The inconsistency existing between the feature "**charge of metal or alloy such as** cast iron" of claim 1 as decided upon by the Examining Division and as filed together with the grounds of appeal and the subsequently following features thereof, which only referred to cast iron, rendered this claim 1 unclear.

This clarity objection has been overcome by deleting the wording "**charge of metal or alloy such as**" from claim 1 now under consideration.

2.2 Claim 1 has been amended to additionally define the addition of coal to the furnace (see page 7, line 24 to page 8, line 23) which represents an essential feature of the process since the original carbon level in the cast iron should be restored and because the carbon is necessary for the reduction of the ZnO (see page 9, lines 3 to 23).

Additionally, claim 1 now specifies the addition of CaCl_2 or CaF_2 in order to assist the volatilization of the lead through the formation of low-boiling PbCl_2 (see page 9, line 27 to page 10, line 1; and examples 1 and 2) which represents another essential feature. Claim 1 specifies now in addition to the reaction of carbon and zinc oxide according to reaction equations (1) and (2) that oxygen is injected by means of a lance inside said furnace, such that the heat generated results in the save of electrical energy. These definitions of claim 1 ensure that these reactions (1) and (2) actually take place.

Consequently, all the objections raised by the Examining Division (see reasons of decision, point 2.2) have been overcome.

2.3 Hence claim 1 has been clarified and involves the features essential to the invention and is therefore considered to meet the requirements of Article 84 EPC.

3. *Novelty*

3.1 Document D1 discloses a process for recovering valuable metals from the dust of electric arc steel manufacture which includes (emphasis added by the Board):

- a) pelletizing said dust,
- b) preheating and pre-reducing said pellets by charging a hot gas to remove water, loss on ignition and carbonaceous materials contained therein, and in case of need, the conditions of gas charged are set up so as to reduce selectively iron oxide while controlling the reduction of zinc oxide practically at zero level,
- c) melting and reducing zinc oxide, iron oxide and lead oxide in said pellets together with a carbonaceous solid reductant (coke) to melt and reduce in an induction furnace and **to separate (metallic) zinc** and a part of lead by vaporization and iron and lead by means of the difference in their specific gravities, and collecting zinc and lead as crude ones, iron as molten pig iron and **lead as crude one**, respectively (see abstract; and page 2, lines 9 to 26; page 5, lines 14 to 22; page 6, line 28 to page 7, line 5; examples 1 and 2; and claim 1). Furthermore, document D1 only suggests the addition of air or oxygen enriched air into the preheating furnace.

Thus the process of claim 1 is distinguished from that according to D1 in that the zinc is recovered as ZnO in vaporized form, in that lead is recovered as volatilized (low-boiling) lead compound, in that preheated pellets of the steelwork dusts, coal and CaCl₂ or CaF₂ are fed into a low-frequency induction furnace of coreless type, which is partially filled with a molten bath of cast iron and into which furnace oxygen

is injected by means of a lance whereby the ZnO comprised in said pellets is reduced by the carbon contained in said cast iron to Zn which then reacts with FeO comprised in said dusts thereby producing Fe and ZnO.

- 3.2 Document D2 discloses a process for the treatment of heavy metal containing **metal dross** from the metal producing industry wherein the dross material is heated together with carbon material and oxygen. Thereby said dross material is reacted to form a rest dross melt which is poured as liquid melt 20 into an induction furnace 10 comprising **a filter 5 made from carbonaceous material**; said filter is swimming on a liquid iron melt bath 30 (see figure; and abstract). The said rest dross melt 20 passes through said filter 5 whereby the components of compounds of said toxic heavy metals are reduced. The reduction reaction is supported by the injection of reducing gas such as CO or H₂ into said filter. The reduction products are taken into the melt while the non-reduced components of said rest melt are drossed and recycled (see column 1, lines 49 to 53; column 2, lines 8 to 23 and lines 37 to 63; column 3, lines 1 to 27 and lines 43 to column 4, line 3 and lines 21 to 27; example; figure). The **lead is recovered in metallic form** (see column 3, lines 22 to 27 and column 4, lines 1 to 3)

The process according to claim 1 thus differs from D2 in that electric steel work dusts containing oxidised high-iron, zinc-bearing materials in the form of pellets with coal and CaCl₂ or CaF₂ are introduced into a low-frequency coreless type induction furnace, in that oxygen gas is introduced via a lance into said

induction furnace whereby the ZnO comprised in said pellets is reduced by the carbon contained in said cast iron to Zn which then reacts with FeO comprised in said dusts thereby producing Fe and ZnO, and in that the lead is recovered as volatilized (low-boiling) lead compound.

3.3 The other two documents cited in the search report are less relevant than documents D1 and D2.

3.4 For the above reasons the subject-matter of claim 1 is novel (Article 54 EPC).

4. *Inventive step*

4.1 *Closest prior art*

In accordance with the appealed decision document D1 is considered to represent the closest prior art with respect to the processing/recycling of iron and zinc containing electric steelworks dusts as claimed in claim 1.

The process according to claim 1 differs from the process according to document D1 that pellets of the steelwork dusts, coal and CaCl_2 or CaF_2 are fed into a low-frequency induction furnace of coreless type, which is partially filled with a molten bath of cast iron and into which furnace oxygen is injected by means of a lance whereby the ZnO comprised in said pellets is reduced by the carbon contained in said cast iron to Zn which then reacts with FeO comprised in said dusts thereby producing Fe and ZnO. If lead is comprised in said pellets this additionally results in volatilized

(low-boiling) lead compound through reaction with said added CaCl_2 or CaF_2 .

4.2 *Problem to be solved*

The objective technical problem is considered to be the provision of a more economical process for recovering Fe in metal form and separating and concentrating without losses Zn and Pb oxides from electric steelworks dusts (see application, page 5, line 23 to page 6, line 11).

4.3 *Solution to the problem*

The problem is solved by the process for processing electric steelwork dusts as defined in claim 1.

It is credible that a large amount of electrical energy is saved by the process of claim 1. Based on the consumption values according to the examples of the application the intermediately produced Zn - through its oxidation reaction $\text{Zn} + 1/2 \text{O}_2 \rightarrow \text{ZnO}$ (whereby the FeO contained in said pellets is reduced to Fe) - provides almost as much heat energy as the coal charged into said induction furnace through its oxidation reaction $\text{C} + 1/2 \text{O}_2 \rightarrow \text{CO}$.

4.4 The Board considers that the subject-matter of independent claim 1 is not obvious to the person skilled in the art for the following reasons:

Neither document D1 nor D2 suggests this solution of claim 1 to the skilled person nor do these documents contain any hint or incentive to do so.

4.5 Particularly, document D1 clearly teaches to recover the zinc in metallic form and not as ZnO and the iron comprised in the pellets is already pre-reduced when charged into the induction furnace for the melting thereof. There is no suggestion to use a molten pool of iron into which the pellets are charged, let alone to use the heat of formation of ZnO for maintaining the temperature of said molten bath of iron. Thus the skilled person would have to completely change the concept underlying the process of D1, but without knowing whether advantages can be expected.

4.6 Similarly, document D2 teaches to melt the waste material together with carbonaceous material in an oxygen atmosphere whereby zinc and lead are predominantly vaporized and thereafter condensed as solid ZnO and PbO while the resulting molten dross is treated within a filter of coke which is swimming on a molten pool of iron, whereby the remaining oxides are reduced to metals and either vaporized or taken up by the said molten pool of iron and whereby a layer of slag is formed between said filter and said molten pool of iron. Lead is partly recovered in metallic form from the molten iron (see column 3, lines 22 to 27).

Consequently, the skilled person would also have to completely change the concept underlying the process of D2, without having any reason to do so.

4.7 Furthermore, the teachings of documents D1 and D2 cannot be combined in an obvious manner since the concepts underlying them are totally different (compare points 3.1 and 3.2 above). Finally, none of them

- discloses or suggests to add CaCl_2 or CaF_2 to obtain a low boiling lead compound from the lead comprised in the used pellets and/or the used waste material.
- 4.8 The objections of the Examining Division (see reasons of decision, points 2.3 and 2.4) are no longer applicable as claim 1 has been restricted compared to the claims underlying the impugned decision and they are also not shared by the Board. This is due because according to the process of document D1 the iron contained in the pellets is already pre-reduced when these pre-heated pellets are charged together with coke into an induction furnace to reduce the oxides of iron, zinc and lead and to melt the same and which teaches to recover the zinc in its metallic form. There is, however, no suggestion in D1 to use a molten pool of iron into which the pre-heated pellets should be charged and that oxygen should be introduced into the induction furnace, let alone that the heat of formation of ZnO for maintaining the temperature of said molten bath of iron could be used to save energy costs.
- 4.9 Therefore, the subject-matter of process claim 1 is considered to involve an inventive step within the meaning of Article 56 EPC.
- 4.10 The same applies to the subject-matter of the dependent claims 2 to 7 which define further preferred embodiments of the process according to claim 1.

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 in the following version:

Description:

pages 1 to 4 and 7 to 13 as originally filed
page 5 as filed on 20 December 1999 with letter of 17
December 1999
page 6 as filed on 29 June 2005 with letter of 28 June
2005

Claims:

claim 1 as filed on 15 July 2005 with fax of 15 July
2005
claims 2 to 7 as filed on 29 June 2005 with letter of
28 June 2005

Drawings:

figure 1 as originally filed.

The Registrar:

The Chairman:

G. Nachtigall

H. Meinders