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D E C I S I O N
of 18 January 2002

Case Number: T 0492/98 - 3.2.2

Application Number: 93921431.8

Publication Number: 0663960

IPC: C22B 43/00

Language of the proceedings: EN

Title of invention:
Method for removing mercury from contaminated soils and industrial wastes and related apparatus

Applicant:
PITTSBURGH MINERAL AND ENVIRONMENTAL TECHNOLOGY, INC.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56, 84

Keyword:
"Clarity, inventive step (yes) after amendment"

Decisions cited:
-

Catchword:
-

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Case Number: T 0492/98 - 3.2.2

D E C I S I O N
of the Technical Board of Appeal 3.2.2
of 18 January 2002

Appellant: PITTSBURGH MINERAL AND ENVIRONMENTAL TECHNOLOGY, INC.
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 7 January 1998 refusing European patent application No. 93 921 431.8 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 appeal is directed against the decision of the Examining Division to refuse European patent application No. 93 921 431.8. The reason given for the refusal was that the claimed subject matter according to the main request and five auxiliary requests lacked an inventive step (Article 56 EPC) and did not meet the requirements for clarity pursuant to Article 84 EPC. Reference was made in the decision to the documents

D1: EP-A1-0 042 509

D2: EP-A2-0 328 990

II. On appeal, the appellant filed amended sets of claims and requested that the decision under appeal be set aside and a patent be granted with these claims.

In support of inventive step, the appellant draws attention to the features which relate to the discharge of the water vapour evaporating from the contaminated material to the atmosphere as opposed to the condensation of water vapour and the discharge of the contaminated condensate. Hence, there is - according to the claimed process - no need to handle and purify a contaminated liquid waste material prior to disposal. As to the claimed apparatus, the appellant points out that the transportable decontamination device represents a relatively simple and inexpensive facility which could be mounted on a self-propelled vehicle or truck so that it can be conveniently transported to a contaminated site by the vehicle, having regard to the fact that it is more efficient to take the

decontamination facility to the site of contamination rather than to take the contaminated soil to a static facility at some distance, as has been done in the prior art.

III. Subsequent to consultations by telephone, the appellant filed, in replacement for all previous requests, an amended set of claims 1 to 10 and an amended description adapted thereto, and requested grant of the patent based thereupon. Oral proceedings were requested, should a negative decision be contemplated by the Board. The wording of method claim 1 and apparatus claim 2 of this request reads as follows:

"1. A method of purifying mercury-contaminated material in an apparatus enclosed within a containment chamber (30), the apparatus comprising a batch furnace (8) having an air inlet (23) and an outlet duct (10) connecting the furnace with a condenser (9) and gas cleaning means (15) and (17), and an air exhaust means (21); the method comprising the steps of:

- maintaining the containment chamber (30) at a negative pressure with respect to the atmosphere during purification;

- drying a batch of contaminated material in the furnace by heating it to a first temperature to vaporise moisture without vaporising the mercury portion thereof and drawing in air into the furnace (8) through the inlet (23) to carry the water vapour through the apparatus to the air exhaust means (21) while maintaining the condenser (9) at a temperature sufficiently high to avoid the removal of water from the air stream;

- subsequently heating the dried contaminated material to a second temperature higher than the first temperature to vaporise said mercury portion and

- condensing the vaporised mercury portion in condenser(9), and

- absorbing any residual mercury-bearing substances and other volatile impurities and filtering submicron particles from the effluent gas stream by cleaning means (15) and (17) and wherein the batch furnace (8), air inlet (23), outlet duct (10), condenser (9) and gas cleaning means (15, 17) are maintained at a pressure of 0.5 to 1.5 atmospheres."

"2. A transportable apparatus for purifying mercury-contaminated material comprising

- a batch-type furnace (8) operable to heat said contaminated material to a first temperature for vaporising moisture contained in said contaminated material without substantial vaporisation of the mercury portion thereof and the furnace (8) being operable to subsequently heat said contaminated material to a second temperature higher than the first temperature to vaporise said mercury portion;

- a condenser (9) connected with the furnace (8) for receiving said vaporised mercury portion and condensing the same into elemental mercury;

- gas cleaning (15, 17) means connected with the

condenser capable of removing residual vapours and submicron particles from the effluent gas stream;

- a containment chamber (30) enclosing said furnace (8), condenser (9) and cleaning means (15, 17), and an air-moving means (32) in communication with the interior of said chamber to maintain a negative pressure within the containment chamber, the apparatus being operable to maintain a pressure of 0.5 to 1.5 atmospheres in the batch furnace (8)."

Reasons for the Decision

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

2. *Amendments*

Method claim 1 derives from original claims 1, 17, 18, 24, 25, and 29 as originally filed in combination with the technical features given on page 12, lines 20 to 23; page 13, lines 7 to 10;, page 16 lines 8 to 12, 24 to 28; page 17, lines 5 to 12; page 19, lines 26 to 32; page 20, lines 4 to 19 of the description and Figure 1 as filed. Dependent method claims 3 to 7 are based on claims 5, 6, 9 together with page 15, second and third paragraph, and claims 20 and 21 as originally filed, respectively.

Apparatus claim 2 is based on original claims 25, 26, 29, 30, and technical information given on page 15, lines 17 to 23; page 16, lines 16 to 19, 24 to 32 and page 18, lines 25 to 32; page 20, lines 4 to 19 of the

documents as filed.

Dependent apparatus claim 8 derives from page 19, lines 26 to 30 in combination with originally filed Figures 1, 3 and 4; claim 9 derives from page 21, lines 10 to 20; page 22, line 8 and Figure 1; claim 10 corresponds to former claims 27, 33 and 39 in combination with the technical information given on page 20, lines 20 to 28 as filed.

In order to satisfy Rule 29(7) EPC and to improve the intelligibility of the claims, the structural features are followed by reference signs corresponding to those given in Figures 1 to 3 and their counterpart in the description. The amendment to the description, in particular to the preferred embodiment including step (d) of heating the contaminated material at a pressure of 0.5 to 0.995 atmospheres, derives from pages 12, lines 20 to page 13, line 25 and combination of the lower limit of 0.5 atmospheres (see page 12, line 22) and the upper limit of 0.995 atmospheres (see page 18, line 23) of the sub-atmospheric pressure

The amendments to the claims and the description, therefore, satisfy the requirements of Articles 123(2) EPC.

3. *Clarity (Article 84 EPC)*

Method claim 1 enumerates a distinct sequence of steps defining the claimed process and specifying that, on the one hand, the containment chamber (30) is kept at a negative pressure with respect to the atmosphere, while, on the other hand, the pressure within the batch furnace (8), air inlet (23), outlet duct (10),

condenser (9) and gas cleaning means (15, 17) (which components are summarized in the description, page 18, lines 17 to 21 in combination with page 12, lines 20 to 23 under the term "the three-stage mercury removal/recovery system") could vary from 0.5 to 1.5 atmospheres.

The same statement is true for independent claim 2 which additionally states the apparatus to be "transportable" rather than stationary.

The claims are supported by the description which has been brought into strict alignment with the revised wording of the claims and also includes a short acknowledgement of the closest prior art represented by documents D1 and D2.

The requirements of Article 84 EPC are, therefore, met.

4. *The closest prior art*

Like the application, document D1 is concerned with a method and apparatus for recovering mercury from contaminated wastes discharged e.g. from a mercury-cell process for producing chlorine (cf. D1, page 2, 2nd paragraph). Since the waste products are collected at several points, their mercury concentrations vary considerably. Thus, in a first step, they are mixed and homogenized to constitute a slurry which can be purified in a continuous process rather than in a batch processor. After drying to reduce the moisture content of the sludge to about 5% liquid (cf. D1, page 2, last line to page 3, line 5; page 7, lines 22 to 26), it is supplied to a muffle oven and roasted at a temperature between 675°F to 1000°F (357°F to 538°C) (cf. D1,

page 3, second paragraph). The dryer and the roaster are maintained at a slightly negative pressure (cf. D1, page 10, lines 8 to 14). The water vapour generated in the dryer and the vaporized mercury coming from the roaster are both condensed in a quench tower for further processing (cf. D1, page 9, third paragraph).

According to document D2, mercury contaminated humid clayey soil is - in a first step - granulated by treating it with hot gas to vaporise water (see D2, column 2, line 52 to column 3, first line; column 7, lines 13 to 26). The wastes are then transferred into a cyclone furnace (6), where the granules are heated to a second temperature ranging from 360 to 450°C in order to vaporize mercury, mercury containing compounds, hydrocarbons and residual water (cf. D2, column 3, lines 12 to 25; column 6, lines 32 to 52; column 7, lines 13 to 26). All vapours are condensed in the collector (15) including a scrubber and a condenser, where the different immiscible condensates separate in layers (cf. D2, Figure 1; column 6, lines 1 to 14; column 7, lines 53 to 55). In order to prevent leaking of toxic substances into the environment, the whole interior of the apparatus is maintained under a slightly negative pressure (cf. D2, column 5, lines 42 to 45). Also this method permits the effective removal of mercury, mercury compounds and hydrocarbons from the contaminated wastes.

Given that the processes according to D1 and D2 specifically mention a drying step before roasting the Hg-contaminated waste material, as does the claimed method, and that document D2 is concerned explicitly with the purification of Hg-contaminated clayey soils, either document D1 or D2 could be considered as

representing the closest prior art.

The remaining documents mentioned in the European search report

D3 US-A-4 701 212
D4 EP-A-0 341 580

D5 US-A-4 087 276

are more remote. Document D3 differs from the claimed subject matter since it relates to the recovery of mercury from a spent activated carbon absorbent by treating it in a fluidised bed containing dispersed sulfur (cf. D3, column 1, paragraph 1), whereas document D4 discloses a continuous distillation process for recovering mercury from an atomised solid-liquid-suspension or solution (cf. page 5, lines 41 to 47).

The method for removing mercury from sludge disclosed in document D5 comprises a continuous type oven for heating the sludge. The vapours emerging from the dome of the oven contain almost entirely superheated steam and mercury vapours which are condensed to water and liquid mercury in condenser 18 (cf. D5, column 1, lines 49 to 61; column 2, line 9; column 3, lines 31 to 50).

5. *Novelty*

The claimed process differs from those given in documents D1 and D2 in that (i) the water vapour removed from the wastes in the drying step is discharged through exhaust means to the environment **without** re-condensing it to water and (ii) in that it

uses a purifying apparatus which, as set out in claim 2 of the application,

- has the active components enclosed within a containment chamber (30), and

- which works in a batch-wise manner.

The apparatus claimed in claim 2 is distinguished from the prior art D1 and D2 by comprising a containment chamber (30) around the active parts of the apparatus which makes the device transportable on a vehicle to the contaminated sites.

Consequently, the method given in claim 1 and the apparatus defined in claim 2 are novel with respect to the embodiments given in documents D1 and D2.

6. *The problem to be solved*

Starting from the technical teaching given in document D2 (or alternatively from that given in document D1) as closest prior art, the problem underlying the present application, therefore, resides in providing a method and an apparatus for economically decontaminating mercury-containing soils or materials which avoids the production of contaminated condensed water as a by-product of the vaporisation-condensation process, and which further eliminates the need to transport large volumes of contaminated soil to a remote treatment facility in order to remove the mercury therefrom.

The solution to this problem consists in vaporising the water vapour from the contaminated material and carrying the water vapour through the apparatus to the

air exhaust means at a temperature sufficiently high to avoid water, and - having regard to the apparatus - enclosing the components of the apparatus for carrying out the process within a containment chamber around the active parts of the apparatus to enhance its reliability against pollution and to make it transportable to the contaminated soil.

7. *Inventive step*

None of the cited documents discloses a two-stage process wherein in the first water evaporating (drying) step the condenser is maintained at a temperature sufficiently high to avoid removing the water vapour from the carrier air-stream so that the water vapour may be completely evacuated from the system prior to vaporising the mercury, as proposed by the claimed process. Thereby, the production of Hg-contaminated water as an undesirable by-product is avoided.

By contrast, as shown in document D1, Figure 2, the vapour products emerging from the dryer (65) (water vapour) and the roaster (70) (mercury vapour) are passed together to the quench scrubber (92) for condensation (cf. also D1, page 10, second paragraph). As is similarly set out in document D2, the water vapour resulting from the hot-air treatment (h) and the mercury vapours (m) and gaseous hydrocarbons emerging from the firing in the cyclone furnace (6) are condensed and collected **simultaneously** in a single condensation unit (15), where they separate into layers of the different liquids hydrocarbons, water and mercury. Moreover, the methods and types of equipment shown in either documents D1 and D2 aim at working continuously rather than in a batch-wise manner as

claimed in the application. A further significant distinction to the known processes and apparatuses is seen in the fact that the claimed mercury recovery apparatus is enclosed completely in a containment chamber (30) from which air is continuously drawn in order to exhaust and purify any contaminated air that might leak from the system into the containment chamber (see page 18, lines 25 to 30 of the description). No incentive is given either in documents D1 or D2 or in any other document to enclose the whole facility in a containment chamber as a safety measure to guard against leakage and toxic pollution by the Hg-recovery apparatus and - having regard to the claimed apparatus - to make it transportable on a vehicle to reduce cost.

8. For the above reasons, the process according to claim 1 and the apparatus claimed in independent claim 2 involve an inventive step.

8. The dependent method claims 2 to 7 and apparatus claims 8 to 10 relate to preferred embodiments of the claimed process claimed in claim 1 or of the apparatus according to claim 2, respectively. Therefore, these claims are also allowable.

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 the following

documents:

Claims: 1 to 10 submitted on 16 November 2001 with telefax of 16 November 2001

Description: pages 1 to 8, 14, 17, 23 to 29 as originally filed
pages 9 to 13, 13a, 15, 16, 18 to 22, 30 submitted on 5 June 2001 with letter of 1 June 2001

Figures: Figures 1, 3 and 4 as originally filed (renumbered as Figures 1 to 3 as requested in the letter of 1 June 2001

The Registrar: The Chairman:

V. Commare W. D. Weiß