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(54) **Title:** METHOD FOR HANDLING OF TITANIA SLAG FOR FURTHER PROCESSING

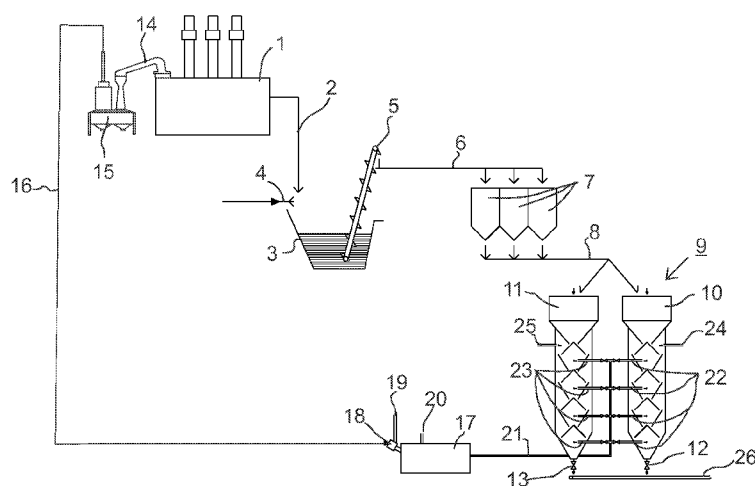


Fig. 1

(57) **Abstract:** The present invention relates to a method for granulation of titania slag for further processing. In the method titania slag is produced by smelting ilmenite in a closed electric furnace (1) to form liquid slag (2). Liquid slag (2) is tapped from the electric furnace (1) into a granulation pit (3), and during tapping the liquid slag (2) is impacted by high-pressure water jets (4) to get the slag stream fragmented into small granules. The slag granules are fed into a granule dryer (9) in which the slag granules are dried for further use.

## **METHOD FOR HANDLING OF TITANIA SLAG FOR FURTHER PROCESSING**

### **TECHNICAL FIELD OF THE INVENTION**

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The present invention relates to a method for granulation of titania slag for further processing.

### **BACKGROUND ART**

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Titania slag is used as feed material for the production of pigments and it is produced by smelting ilmenite and a suitable carbonaceous reductant in electric furnaces. After smelting of ilmenite the titania slag is in molten or liquid form from which it has to be solificated for further processing. Previously the solification of titania slag was carried out by casting liquid slag into large bowls or pots in which it was cooled down for a long period of time before crushing and grinding to small granules. This kind of process has several disadvantages. It is slow and complex, and further, it is expensive e.g. because of high consumption of energy. A further disadvantage is the fact that a great amount of fine product, i.e. dust is formed when large blocks of cooled titania are crushed or ground. This kind of fine product, the particle size of which is under 0,1 mm is a lower value product and for further processing for the production of pigments it demands a different route compared to a higher value coarse product the aimed particle size of which is about 1 mm more precisely 0,1 - 0,85 mm.

### **SUMMARY OF THE INVENTION**

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The object of the present invention is to provide a method for granulation of titania slag for further processing by which method the problems relating to

prior art technique are avoided or at least minimized. The object of the invention is achieved by the method characterized in the appended claims.

5 According to an aspect, the invention provides a method for granulation of titania slag for further processing. In the method titania slag is produced by smelting ilmenite in an electric furnace to form liquid slag. According to the invention liquid slag is  
10 tapped from the electric furnace into a granulation pit; during tapping the liquid slag is impacted by high-pressure water jets to get the slag stream fragmented into small granules; and the slag granules are fed into a granule dryer in which the slag granules  
15 are dried for further use.

In an embodiment of the method, CO-gas produced during smelting of ilmenite in the closed electric furnace is used for drying of granules in the granule dryer.

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In an embodiment of the method, CO-gas produced in the closed electric furnace is used as fuel to form drying gas to be used in the granule dryer.

25 In an embodiment of the method, before feeding the slag granules from the granulation pit into the granule dryer the slag granules are fed into granule bin or bins for dewatering the granules.

30 In an embodiment of the method, at least one drying equipment is used as the granule dryer.

In an embodiment of the method, drying equipment is a drying tower, a stationary drying tower, a drying  
35 drum, flash dryer or dryer or alike.

In an embodiment of the method, the method utilizes CO-gas as a drying gas.

5 In an embodiment of the method, the drying equipment is used as the granule dryer, into which drying towers the drying gas is fed in several height positions to increase the drying efficiency.

10 Several advantages over prior art are attainable by the present invention. The inventive method is cost effective compared to any other prior art method. This is due to the fact that in the invention granulated titania slag is dried with CO-gas which is produced by the same closed electric furnace in which ilmenite is  
15 smelted. CO-gas is formed in the smelting process, so it is free energy fuel. In the environmental point of view the recycling of CO-gas is important so emissions of CO-gas are lower. In prior art it is common practice to use heavy fuel oil for drying purposes, and  
20 this is quite costly.

Further advantages, characteristic features and embodiments of the invention will come out in more detail in the following description of the invention, in  
25 which the invention is described by way of examples with reference to the accompanying drawing figure.

#### **BRIEF DESCRIPTION OF THE DRAWING**

30 Fig. 1 is a schematic view of various steps of the inventive handling of titania slag.

#### **DESCRIPTION OF THE EMBODIMENT OF THE INVENTION**

35 In the method for granulation of titania slag as shown in Fig. 1, ilmenite and a suitable carbonaceous reductant is smelted in an electric furnace 1. After

smelting of ilmenite the titania slag is in molten and liquid form, and liquid slag 2 is tapped from the electric furnace 1 into a granulation pit 3. Simultaneously with the tapping the liquid slag is impacted by water flow 4. This water flow can also be water jet, spray, nozzle, shower, a plate with holes, mist or alike, there can be one or several ones, the pressure of the water can be high or low. The slag stream is fragmented by the water flow 4 into small particles, i.e. granules, that at this stage are very wet and in fact they are suspended in the granulation pit 3. Therefore the granules must be dewatered and dried before further processing.

As Fig. 1 shows, wet granules are transferred from the granulation pit 3 to at least one granule bin 7, in which excess water is drained from the granules. The system shown in Fig. 1 comprises three granule bins 7. Wet granules are transferred from the granulation pit 3 into the bins 7 by a granule conveyor 6. The granulation pit 3 is provided with a granule elevator 5 by which the granules are taken from the granulation pit 3 and lifted onto the granule conveyor 6. Instead of elevator can also be a de-watering apparatus, a separator, a screw hoist, a drum or alike or even a bucket loader which collects a stack wherein the dewatering happen and after that the material is transferred to further process. When excess water has been drained from the granules they are fed into a granule dryer 9 which comprises at least one drying towers 10, 11 in the example shown in Fig. 1. Instead of tower can be used a drying tower, a stationary drying tower, a drying drum or alike. The granules are fed from the granule bins 7 via a granule feeder and collecting conveyor 8 to the top of the drying towers 10, 11 from where they run downwards to the bottom of the drying towers 10, 11. While running downwards in the drying towers

10, 11 the granules are dried by drying gas fed into the drying towers 10, 11.

The drying gas is CO-gas produced by the electric furnace 1 during smelting of ilmenite. The smelting process produces gases which are collected by at least one gas collector 14 and led to a gas scrubber or gas cooling and/or cleaning apparatus 15 which cools CO-gas from the gas mixture and erases the dust particles or purifies it, whereby purified CO-gas is led from the gas -scrubber or cool and/or cleaning apparatus 15 to a burner 18 of a combustion chamber 17 via a conduit 16. Combustion air is fed to the burner 18, the burner can also be a drum dryer and possible if needed secondary air to the combustion chamber 17 via conduits 19, 20. From the combustion chamber 17 drying gas is fed to the drying towers 10, 11 of the granule dryer 9 via a drying gas ductwork 21 which can be divided in several gas inlets 22 and 23 through which drying gas is fed into the drying towers 10, 11 in several height positions to increase the drying efficiency. Exhaust gases are led out of the drying towers 10, 11 through exhausts 24, 25. Dried titania granules are discharged from the lower part of the drying towers 10, 11 by discharge feeders 12, 13 to a discharge conveyor 26 which transfers titania granules for further processing.

The drying equipment can be a drying tower, a stationary drying tower, a drying drum or alike.

Tower can be replaced by drying drum, flash dryer or dryer which utilizes CO-gas as a drying gas.

If needed, dried slag granules are further crushed and screened, grinded, and classified to fine and coarse

product. Titania slag granules are further used in pigment plant to produce  $\text{TiO}_2$  pigment.

5 Above, the invention has been described by way of examples with reference to the exemplifying embodiment illustrated in the accompanying drawing. The invention is, however, not confined to the exemplifying embodiment shown in the drawing alone, but the invention may vary within the scope of the inventive idea defined in  
10 the accompanying claims.

**CLAIMS**

1. A method for granulation of titania slag for further processing, in which method

5           a) titania slag is produced by smelting ilmenite in an electric furnace to form liquid slag, characterized in that

          b) liquid slag is tapped from the electric furnace into a granulation pit,

10           c) during tapping the liquid slag is impacted by high-pressure water jets to get the slag stream fragmented into small granules, and

          d) the slag granules are fed into a granule dryer in which the slag granules are dried for further  
15 use.

2. Method for granulation of titania slag as claimed in claim 1, characterized in that CO-gas produced during smelting of ilmenite in the closed electric  
20 furnace is used for drying of granules in the granule dryer.

3. Method for granulation of titania slag as claimed in claim 1 or 2, characterized in that CO-gas  
25 produced in the closed electric furnace is used as fuel to form drying gas to be used in the granule dryer.

4. Method for granulation of titania slag as claimed  
30 in any of the preceding claims, characterized in that before feeding the slag granules from the granulation pit into the granule dryer the slag granules are fed into granule bin or bins for dewatering the granules.

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5. Method for granulation of titania slag as claimed in any of the preceding claims, characterized in that at least one drying equipment is used as the granule dryer.

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6. Method for granulation of titania slag as claimed in any of the preceding claims, characterized in that drying equipment is a drying tower, a stationary drying tower, a drying drum, flash dryer or dryer or alike.

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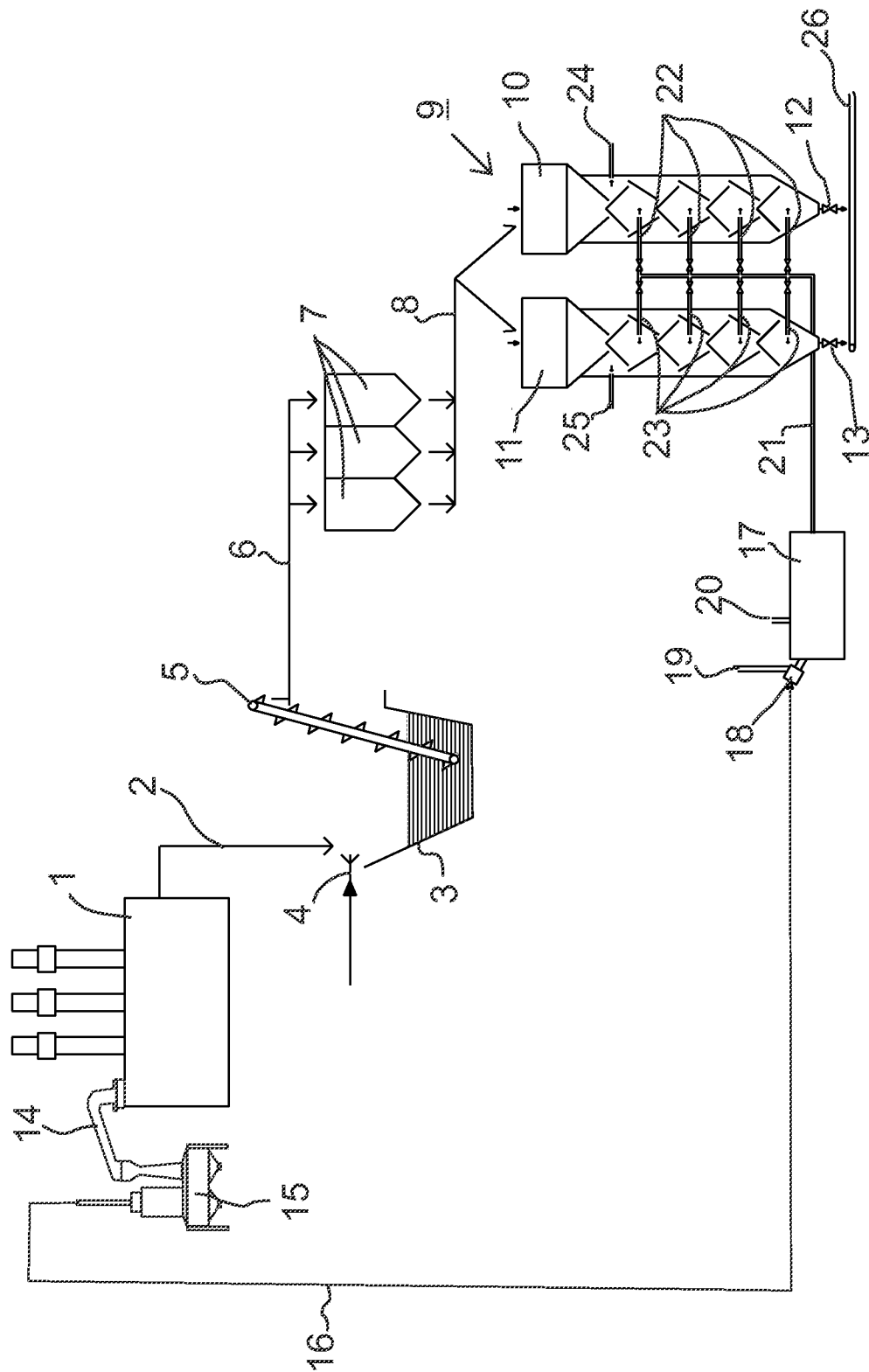
7. Method for granulation of titania slag as claimed in any of the preceding claims, characterized in that the method utilizes CO-gas as a drying gas.

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8. Method for granulation of titania slag as claimed in any of the preceding claims, characterized in that the drying equipment is used as the granule dryer, into which drying towers the drying gas is fed in several height positions to increase the drying efficiency.

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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/FI2013/051176

## A. CLASSIFICATION OF SUBJECT MATTER

See extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: C21B, C22B, F26B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
FI, SE, NO, DK

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI, XPTK, COMPDX, INSPEC, PUBCOMP, PUBSUBS, INTERNET

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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| Y         | WO 03013694 A1 (SHELL INT RESEARCH [NL])<br>20 February 2003 (20.02.2003)<br>abstract; page 1, lines 5-7; page 2, lines 31-34; page 9, line 15-page 10, line 11                                                                                                                                                                                                                           | 2, 3, 7, 8            |
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☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

\* Special categories of cited documents:

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"P" document published prior to the international filing date but later than the priority date claimed

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| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |                                                                                                                     |                       |
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**INTERNATIONAL SEARCH REPORT**  
**Information on patent family members**

International application No.  
PCT/FI2013/051176

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