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Process for the production of reduced ilmenite

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ABSTRACT

A process for the production of reduced ilmenite from raw ilmenite and solid, grainy fuel in a reduction kiln at temperatures in a range from 1000 to 1400°C, wherein the coal being charred in a charring stage at temperatures from 550 to 900°C in the presence of oxygen-bearing gas generating char which is fed into the reduction kiln, mixture of hydrocarbon-containing gases and vapours being drawn off the charring stage, raw ilmenite being fed to a preheating stage into which at least part of the mixture of gases and vapours and oxygen-containing gas are also fed and the raw ilmenite is preheated to temperatures between 500 and 1100°C, and preheated ilmenite being fed into the reduction kiln.

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COMPLETE SPECIFICATION
STANDARD PATENT

Application Number:

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Invention Title: PROCESS FOR THE PRODUCTION OF REDUCED ILMENITE

The following statement is a full description of this invention, including the best method of performing it known to us :-

PROCESS FOR THE PRODUCTION OF REDUCED ILMENITE

The invention relates to a process for producing reduced ilmenite from raw and solid, grainy fuel in a reduction kiln.

A process of this kind is known from the US patent 5403379 where the reduction is performed in a rotary kiln adding coal to the kiln. The US patent also describes how reduced ilmenite is processed to synthetic rutile (TiO_2).

According to the invention, there is provided a process for the production of reduced ilmenite from raw ilmenite and solid, grainy fuel in a reduction kiln at temperatures in a range from 1000 to 1400°C, wherein the coal being charred in a charring stage at temperatures from 550 to 900°C in the presence of oxygen-bearing gas generating char which is fed into the reduction kiln, mixture of hydrocarbon-containing gases and vapours being drawn off the charring stage, raw ilmenite being fed to a preheating stage into which at least part of the mixture of gases and vapours and oxygen-containing gas are also fed and the raw ilmenite is preheated to temperatures between 500 and 1100°C, and preheated ilmenite being fed into the reduction kiln.

According to the invention, there is also provided a process for the production of reduced ilmenite, the process including:

charring coal in a charring stage at temperatures from 550 to 900°C in the presence of oxygen-bearing gas to generate char;

feeding the char into the reduction kiln;

drawing off a mixture of hydrocarbon-containing gases and vapours from the charring stage;

feeding raw ilmenite to a preheating stage;

feeding at least part of said mixture of gases and vapours into said preheating stage;

preheating the raw ilmenite in said preheating stage to temperatures between 500 and 1100°C; and

feeding the preheated ilmenite into the reduction kiln.

According to exemplary embodiments of the invention, char is added to the reduction kiln beside the preheated ilmenite. Typically, the share of the char in the reducing agent fed to the reduction kiln may be around 80 to 100 percent by

weight (%wt.) and preferably at least 90 %wt. In this way, the energy which is normally needed to remove the volatile components from the coal in the known processes is omitted. The hydrocarbon-containing gases and vapours generated in the charring zone outside of the reduction kiln may have relatively high calorific values and are combusted to preheat the raw ilmenite in the preheating stage. The gases and vapours are thus used in a very advantageous way. Since the raw ilmenite is transferred to the reduction kiln after being preheated to high temperatures, the kiln can be operated at higher throughputs.

An advantage of an exemplary embodiment of the invention is maximum cost-effectiveness and minimized kiln size. At the same time, existing reduction plants are to be allowed to run with higher throughputs.

In order that the invention might be more fully understood, an embodiment of the invention will be described by way of example only with reference to the accompanying drawing which shows a flow diagram of an embodiment of the process.

Referring to the drawing, the raw ilmenite is taken in through line (1) and fed for preheating to a fluidised bed reactor (2) as part of a circulating fluidised bed system. Air, which can be preheated, enters the bottom part of the reactor (2) through line (3). Additionally hydrocarbon-containing gases and

vapours enter through line (4) and are used as fuel. This mixture of gases and vapours is combusted in the reactor (2) in the presence of raw ilmenite with a certain oxygen surplus. The level of oxygen surplus depends in general on the type of raw ilmenite, an intensified oxidation being of advantage in this step. A gas/solid mixture is routed from the upper part of the reactor (2) through the channel (6) to a separating cyclone (7) from which the solids are returned to the lower part of the reactor (2) through line (8). Hot offgas is drawn off through line (9), flows through one or several coolers (10) first and then to a gas cleaning unit (11) before being let off into the stack (12).

In the fluidised bed reactor (2), the raw ilmenite is heated to temperatures between 500 and 1100°C. The ilmenite preheated this way is removed through line (15) and routed to the reduction kiln (16). Through line (17), char is also fed to this kiln and serves as fuel and reducing agent. This char originates from a charring stage embodied as fluidised bed (18). Coal containing volatile components is routed through line (19), fluidising air, which may also be preheated, through line (20) to the fluidised bed. Partial oxidation generates the necessary energy in the fluidised bed, while the coal is charred at temperatures between 550 and 900°C and preferably 600 and 700°C. The mixture of hydrocarbon-containing gases and vapours thus obtained is drawn off through line (21), transferred through a cyclone (22) to remove the solids, the gas and vapour mix being fed to the fluidised bed reactor (2) through line (4). Separated solids are returned to the fluidised bed through line (23).

It is convenient to utilise part of the offgas (9) heat to preheat the fluidising air of lines (3) and (20). For the sake of clarity, this option is not shown in the drawing. Offgas from the reduction kiln (16), which may be a rotary kiln, for example, can be added to the offgas in line (9) through a route not shown and be processed together with the offgas in line(9). Reduced ilmenite is drawn off the kiln (16) through line (24) and cooled in known manner. We know from US patent 5403379, for example, ilmenite is further processed to synthetic rutile.

Example:

In the plant shown in the drawing raw ilmenite is processed being added at a flow rate of 50 t/h through line (1). The fluidised bed reactor (18) with a diameter of 3.3 m, receives 16.7 t/h grainy coal and 3 t/h returned char. The dry components of the coal are 63.0 %wt C (fixed), 28.4 %wt volatile components and 7.8 %wt ash; the water content of the coal is 12.5 %wt.

The quantities and temperatures in the various lines are as follows:

Line	3	4	15	17	20
Rate	9000 Nm^3/h	16700 Nm^3/h	50 t/h	13.7 t/h	7930 Nm^3/h
Temperature	500 °C	750 °C	950 °C	750 °C	600 °C

The solids mixture drawn off the rotary kiln through line (24) has a temperature of 1150°C and consists of 85 %wt. reduced ilmenite and 15 %wt. char which is removed and partly returned to the fluidised bed reactor (18).

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A process for the production of reduced ilmenite from raw ilmenite and solid, grainy fuel in a reduction kiln at temperatures in a range from 1000 to 1400°C, wherein the coal being charred in a charring stage at temperatures from 550 to 900°C in the presence of oxygen-bearing gas generating char which is fed into the reduction kiln, mixture of hydrocarbon-containing gases and vapours being drawn off the charring stage, raw ilmenite being fed to a preheating stage into which at least part of the mixture of gases and vapours and oxygen-containing gas are also fed and the raw ilmenite is preheated to temperatures between 500 and 1100°C, and preheated ilmenite being fed into the reduction kiln.

2. A process for the production of reduced ilmenite, the process including:

charring coal in a charring stage at temperatures from 550 to 900°C in the presence of oxygen-bearing gas to generate char;

feeding the char into the reduction kiln;

drawing off a mixture of hydrocarbon-containing gases and vapours from the charring stage;

feeding raw ilmenite to a preheating stage;

feeding at least part of said mixture of gases and vapours into said preheating stage;

preheating the raw ilmenite in said preheating stage to temperatures between 500 and 1100°C; and

feeding the preheated ilmenite into the reduction kiln.

3. A process as claimed in either claim 1 or 2, wherein a rotary kiln is used as the reduction kiln.

4. A process as claimed in either claim 1 or 2, wherein the charring stage is embodied as a fluidised bed.

5. A process as claimed in either claim 1 or 2, wherein the preheating zone is embodied as a circulating fluidised bed.

6. A process for the production of reduced ilmenite substantially as hereinbefore described and illustrated with reference to the accompanying drawing.

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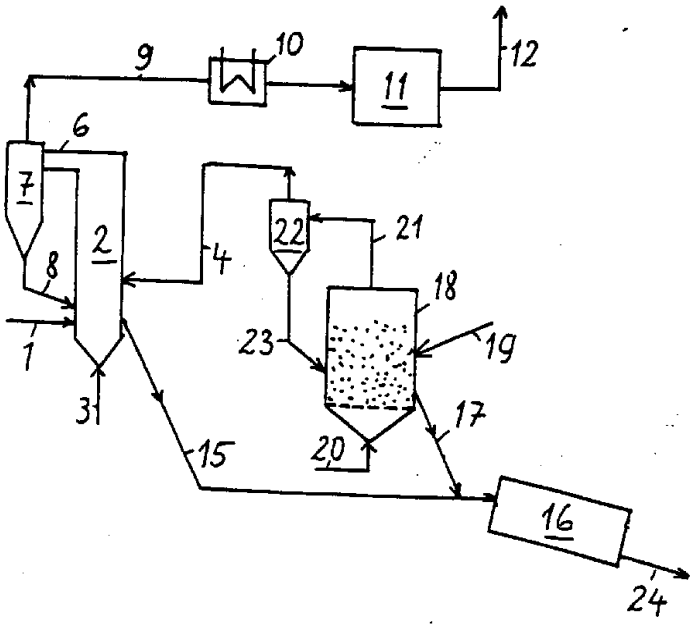
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