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(54) **Titre : PROCEDE DE PRODUCTION D'UN PRODUIT DE FERRONICKEL DUR**
(54) **Title: PROCESS TO PRODUCE ROUGH FERRO-NICKEL PRODUCT**

(57) **Abrégé/Abstract:**
The present invention refers to a MHP process do produce rough ferro- nickel product. The process comprises the steps of: mixing nickel hydroxide with an iron source and slagging agents; putting the mixture in contact with a reducing agent producing a ferronickel alloy; and producing a roasted product that has disseminated ferronickel alloy inside the structure.

ABSTRACT

The present invention refers to a MHP process do produce rough ferro- nickel product. The process comprises the steps of: mixing nickel hydroxide with an iron source and slagging agents; putting the mixture in contact with a reducing agent producing a ferronickel alloy; and producing a roasted product that has disseminated ferronickel alloy inside the structure.

"PROCESS TO PRODUCE ROUGH FERRO-NICKEL PRODUCT"

The present invention refers to a MHP process do produce rough ferro-nickel product.

BACKGROUND OF THE INVENTION

Nickel electro-winning is a very expensive process and may not be available for any existing nickel deposits; specially small or low grade ones. The alternatives are, among others, producing intermediate products like MSP (nickel/cobalt sulphide precipitation) or MHP (Ni/Co mixed hydroxide precipitation). While the first process has a good market, production of H_2S or NaHS is expensive and not trivial, the second one is easy to operate but has a very restricted market.

SUMMARY OF THE INVENTION

In its preferred embodiment the invention refers to a process to produce rough Ferro-Nickel product, comprising the steps of: mixing nickel hydroxide with an iron source and slagging agents; putting the mixture in contact with a reducing agent producing a ferronickel alloy; and producing a roasted product that has disseminated ferronickel alloy inside the structure.

The iron source is preferably iron ore or metallic agent, the slagging agent is preferably one or more selected from the group consisting of MgO, SiO_2, $CaCO_3$, CaF_2 and CaO, the reducing agent is preferably selected from the group consisting of carbon, natural gas or hydrogen.

In the preferred embodiment of the invention, the total amount of slagging agent is between 5 and 500% of the ferronickel mass, more preferably between 10% and 30%. Still in the preferred embodiment, the reducing agent is selected from the group consisting of carbon, natural gas or hydrogen, and the amount of reducing agent is between 50 and 500% the stoichiometric amount for producing metallic ferronickel.

The step of producing a roasted product is preferably performed in a furnace with a temperature ranging from 500 to 2000°C, preferably between 700 and 1200°C, with a residence time of approximately 6 hours.

DETAILED DESCRIPTION OF THE INVENTION

After removing cobalt from nickel from MHP or from any other nickel and cobalt source, a final pure nickel hydroxide precipitate is formed (this precipitate can also contain iron hydroxides). That nickel hydroxide is mixed with an iron source as iron ore or metallic iron and slagging agents such as, but not limited to MgO, SiO_2, $CaCO_3$, CaF_2 and/or CaO. The amount of nickel and iron added depends on the ferronickel desired, ranging from 1 to 99% nickel (99 to 1% iron). Preferably, a ferronickel in the range of 20% and 60% nickel. The slagging agent used depends on local availability and on the final ferronickel process, but the total amount of slagging agent may vary from 5 to 500% of the ferronickel mass, preferably between 10 and 30%.

Putting this mixture in contact with a reducing agent such as, but not limited to, carbon, natural gas or hydrogen, a ferronickel alloy will be produced. The amount of reducing agent depends on the amount of iron and nickel, as well as the form of iron (metallic or oxide). Usually the amount of reducing agent used is between 50 to 500% the stoichiometric amount for producing metallic ferronickel.

The furnace is kept in a temperature high enough to produce the alloy but not enough to melt the slag or the alloy, producing a roasted product that has disseminated ferronickel alloy inside the structure. Temperatures ranging from 500 to 2000°C are known to work, preferably between 700 to 1200°C. Residence time can take as much as 12 hours, but up to 6 hours is preferred. This intermediate product can be sent to a ferronickel furnace for final processing. If the ferronickel produced is magnetic, this structure can be grinded and the ferronickel can be separated using magnetic field.

This final product can ~~be used in a ferronickel furnace~~ for further processing, sent to a blast furnace reactor or any other application known by those skilled in the art.

Some advantages of the present process are:

- Production of a cheap, easy to handle and transport, intermediate nickel product (Rough FerroNickel, or Rofeni);

- Increase ferronickel furnace production by adding a high ferronickel raw material;
- Increase synergies with other areas within Vale;
- Reduces costs of downstream processing of nickel;
- Exploit low-grade or small nickel deposits.

CLAIMS

1. Process to produce a rough ferro-nickel product, comprising the steps of:

(i) mixing nickel hydroxide with an iron source, selected between iron ore and metallic agent, and slagging agents;

(ii) putting the mixture in contact with a reducing agent in a furnace;

(iii) roasting the mixture maintaining the temperature of the furnace at a range between 500°C and 2000°C to a maximum period of time of 12 hours, allowing the production of a ferronickel alloy, and

(iv) obtaining a roasted product impregnated with the ferronickel alloy.

2. The process, according to claim 1, wherein the slagging agent is selected from the group consisting of: MgO, SiO_2, $CaCO_3$, CaF_2, CaO and combinations thereof.

3. The process, according to claim 2, wherein the total amount of slagging agent is between 5% and 500% of the ferronickel mass.

4. The process, according to claim 2, wherein the total amount of slagging agent is between 10% and 30% of the ferronickel mass.

5. The process, according to anyone of claims 1 to 4, wherein the reducing agent is selected from the group consisting of: coal, charcoal, coke, natural gas and hydrogen.

6. The process, according to claim 5, wherein the amount of reducing agent is between 50% and 500% the stoichiometric amount for producing metallic ferronickel.

7. The process, according to anyone of claims 1 to 6, wherein in step (iii) the temperature of the furnace is maintained at a range between 700°C and 1200°C.

8. The process, according to anyone of claims 1 to 6, wherein in step (iii) the mixture is maintained in the furnace for a period of time of 6 hours.