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[54] **PROCESS FOR PRODUCING PELLETS WITH CEMENT**

[75] Inventors: **Shunsaku Shimada; Tadahiro Inazumi,** both of Tokai, Japan

[73] Assignee: **Nippon Steel Corporation,** Tokyo, Japan

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[52] **U.S. Cl.** **75/3;** 106/89; 106/104

[51] **Int. Cl.²** **C21B 1/24;** C04B 7/22

[58] **Field of Search** 75/3–5; 106/89, 104

[56] **References Cited**

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Primary Examiner—Allen B. Curtis
Attorney, Agent, or Firm—Toren, McGeady and Stanger

[57] **ABSTRACT**

A process for producing pellets, which comprises blending 98 to 60% by weight of iron ores and 2 to 40% by weight of a mixture, comprising 95 to 15% by weight of cement and 5 to 85% by weight of iron containing powders smaller than 100 meshes and with addition of 9 to 20% by weight of water on the basis of the mixture.

2 Claims, 3 Drawing Figures

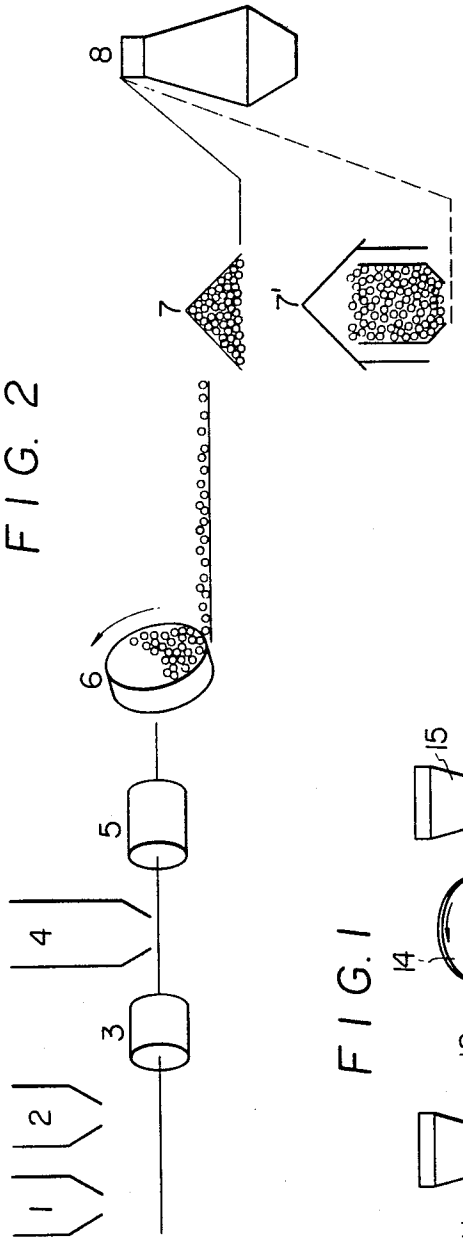


FIG. 2

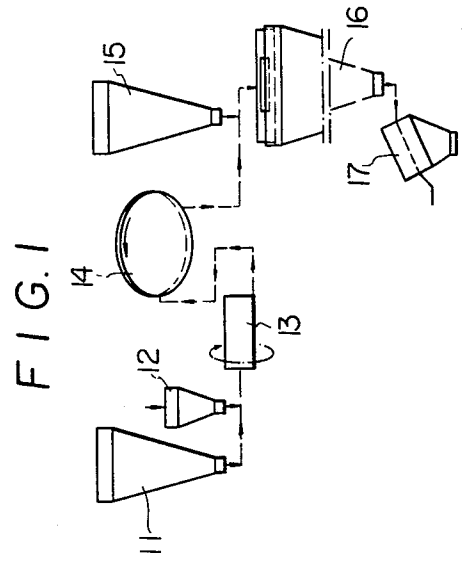
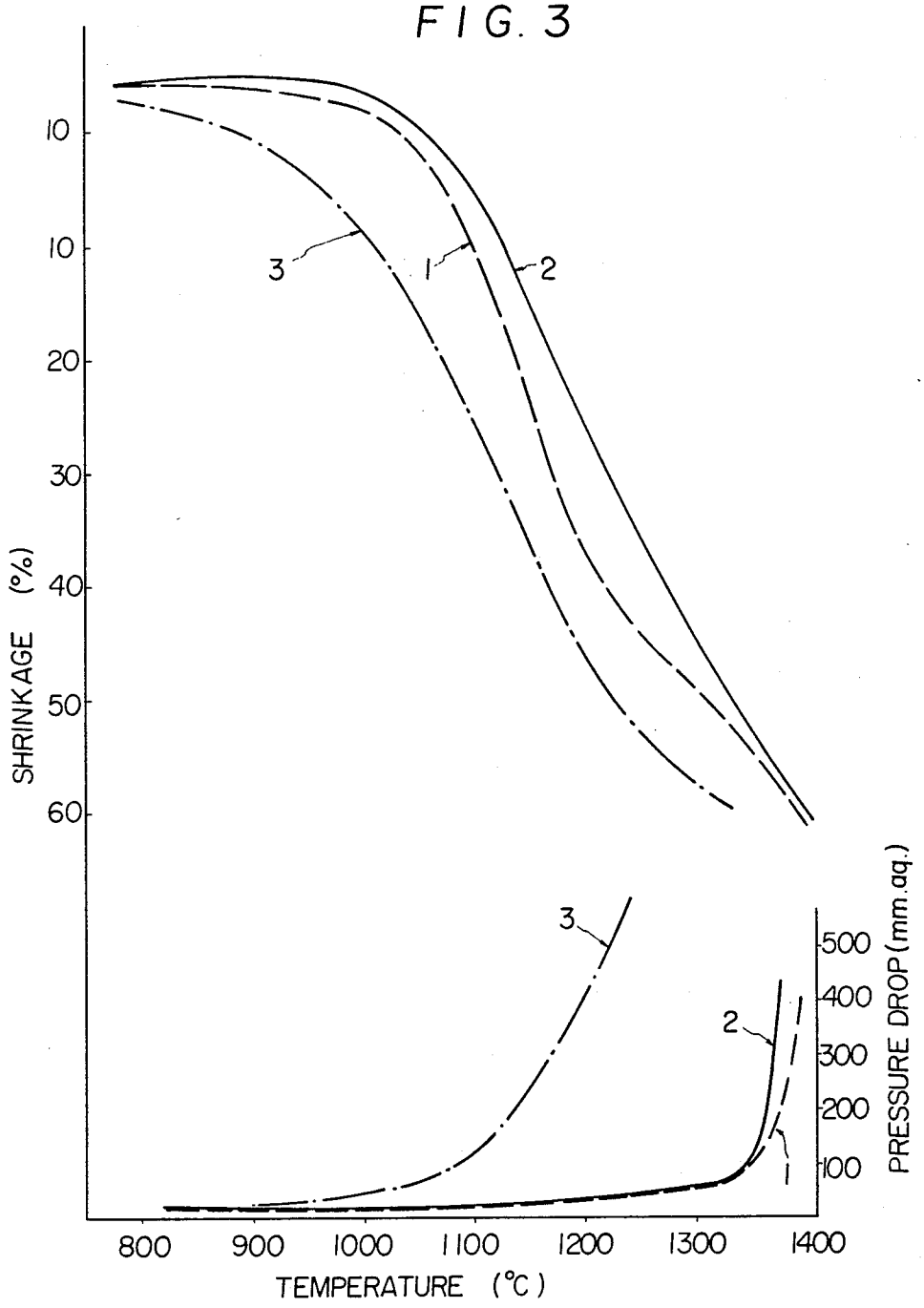


FIG. 1

FIG. 3


10
10
20
30
40
50
60
SHRINKAGE (%)
3
1
2
3
2
1
500
400
300
200
100
PRESSURE DROP (mm.aq.)
800
900
1000
1100
1200
1300
1400
TEMPERATURE (°C)

PROCESS FOR PRODUCING PELLETS WITH CEMENT

The process of the present invention relates to a process for producing pellets.

As well-known, sintered ores are mostly used for the blast furnace materials. However, troubles of public nuisance are brought about by these sintered ores due to the dusts or exhaust gas, generated during the production. Therefore, pellets, and particularly cold pellets are drawing attention. But the conventional cold pellets are inferior in hot properties. That is, the strength is decreased at 700° to 1300°C. During the operation of a blast furnace, they are degradaded in the furnace and repeat the swelling and shrinkage, so that the gas permeability is impaired and the furnace condition is made unstable.

Until now, there has been proposed for example a pelletizing process, such as Grangcold pelletizing process, which is disclosed in U.S. Pat. No. 3,490,895. According to this process, iron ores are mixed with cement and pelletized. The thus obtained pellets are covered with fine ores and hardened for about a week. After the fine ores are separated by screening, the pellets are hardened, with a long time taken. The feature is to cover the pellets with fine ores after pelletization so that the pellets may be prevented from mutual attachment and deformation.

Though this process enables the production on an industrial scale, the stages of work are complicated and necessitates a large amount of construction cost and running expenses since the stage of covering with fine ores, the stage of hardening pellets, the stage of separating fine ores and others are required. And yet, the hot properties of the product during the reduction are not considerably improved as compared with the conventional. Accordingly, there is a limitation for use in the present operation of a blast furnace.

The present invention is to provide a process for producing a cold pellet in a simple stage of work and besides, with excellence in cold strength and of course, hot strength.

The gist is that cement, ferruginous powders (containing metallic iron) and iron ores are mixed and pelletized in an ordinary pelletizing process. Because of blending ferruginous powders into cement, the hardening of cement, and accordingly, of pellets can be achieved in a short time by the oxidizing exothermic reaction of Fe, contained in the ferruginous powders. And moreover, the expansion and contraction can be restrained by ferruginous powders. Thus, the process can be simplified by such like and besides, the hot properties may be remarkably improved.

For the cement to be used according to the present invention, there may be used ordinary commercial cement, for example, Portland cement, pozzolan cement, slag cement, aluminate cement. A favourable effect can be obtained with use of aluminate cement.

The ferruginous powder to be used in the present invention will do if it is a pulverized material, having metallic Fe contained, such as cutting scrap of iron, atomized iron powder, reduced iron powder, ferruginous scale or the like.

Any iron ore used for producing an ordinary pellet may be used in the present invention.

When cement, ferruginous containing metallic iron powders and iron ores are mixed and this mixture is added with water to be pelletized according to the present invention, the oxidizing exothermic reaction of Fe, contained in the ferruginous powders, is employed to accelerate the hardening of cement and to restrain the expansion and contraction during the time of hardening, whereby the process can be simplified and the hot properties of the produced pellet during the reduction may be improved. In order to achieve this object, the mixing ratio of the above mentioned three components is limited in the present invention as follows:

1. Mixing ratio of ferruginous powder to cement ferruginous powder 5 to 85% preferably 20 to 60% by weight
2. Mixing ratio of cement and ferruginous powder to iron ore cement and ferruginous powder 2 to 40%, preferably 10 to 30% by weight

If the ratio of ferruginous powder to cement is below 5% by weight, the oxidizing exothermic reaction of Fe becomes insufficient, and it becomes difficult to restrain the swelling and shrinkage of the pellet during the reduction at the time of hardening, so that the hot properties of the pellet cannot be improved. While, if the ratio is above 85% by weight, the quantity of cement becomes short and the bonding power is insufficient, so that the satisfactory pellet cannot be obtained.

Further, the finer the ferruginous powder is, the better it is to improve the pelletizing property and the reactivity of Fe. It is necessary to use the particles under 100 meshes (by Tailor). It is preferable that the particles are under 300 meshes. If the particles are over 100 meshes, the pelletization becomes difficult by the difference of specific gravity from the iron ore.

The reason for that the mixing ratio of cement and ferruginous powders to iron ores is limited to 2 to 40% by weight in the present invention as above mentioned, is that the bonding powder is insufficient in case of less than 2%, while the slag component becomes more in case of above 40%, so that the grade is too low to be used in practice as the iron source for a blast furnace material.

The grain size of iron ore may be the grain size of an ordinary pellet material in consideration of the pelletizing property. But in order to prevent agglomeration during the hardening of pellets, it is preferable that there exist 2 to 10% by weight of ores, having the grain size of 0.25 to 1 mm.

An appropriate quantity (9 to 20% by weight) of water is added in order to pelletize the mixture of the three components, mixed as above mentioned.

The present invention shall be explained referring to the drawings, wherein;

FIG. 1 shows a process according to the conventional method;

FIG. 2 shows an example of the process according to the present invention; and

FIG. 3 is a graph, showing the comparison of the hot properties of a pellet during the reduction between the conventional method and the process of the present invention.

In FIG. 1, 11 is a hopper for fine iron ores; 12, a hopper for cement; 13, a mixer; 14, a pelletizer; 15, a hopper for fine iron ores; 16, a hopper for preliminary hardening; and 17, a screen for fine iron ores.

FIG. 2 shows an example of the process according to the present invention and 1 shows a hopper for cement; 2, a hopper for ferruginous powders; 3, a mixer; 4, a hopper for iron ores; 5, a mixer; 6, a pelletizer; 7, a yard for pellets; 7', an indoor yard; and 8, a blast furnace.

The cement and the ferruginous powders, charged out respectively from the hopper **1** for cement and the hopper **2** for ferruginous powders, are mixed in a mixer **3** and then configurated with the fine iron ores, charged out from a hopper **4** for iron ores. They are mixed in a mixer **5** and fed into a pelletizer **6** to be pelletized.

The mixer **3** is used for mixing before the cement and the ferruginous powders are blended with the iron ores. But it may be omitted according to circumstances. If it is omitted, the three components, namely cement, ferruginous powders and iron ores, are mixed in the mixer **5.** However, in order to improve the effect of the present invention, it is better to use the mixer **3.** The pellets, pelletized in the pelletizer **6,** are hardened as they are, ordinarily in the yard **7,** but may be hardened in the indoor yard **7'** in order to prevent the influence from such as rains. Then, the pellets are fed in a reducing furnace.

The process, shown in FIG. **1,** is characterized by the omission of a preliminary hardening stage, necessary for the Grangcold pelletizing process, and also the operation of covering with fine iron ores. That is to say, according to the conventional method cement has a low velocity of hardening and remains in a plastic condition for a long time without increase of the strength. And besides, the swelling and shrinkage during the hardening are great, so that a pressing power is produced and together with gravity, makes the pelletized pellets agglomerated or deformed. Therefore, it is necessary to perform a preliminary hardening with fine iron ores inserted among the pellets. On the contrary, according to the present invention the hardening velocity of cement is increased by the oxidizing exothermic reaction of ferruginous powders and the strength is relatively increased early. When the pellets are left in a stacking, they will not be crushed. The swelling and shrinkage of cement are restrained by the ferruginous powders during the stacking, so that the external factors of agglomeration or deformation can be reduced. According to the present invention the agglomeration or deformation of the pellets can be effectively prevented by making coarse particles above 0.25 mm present in the fine iron ores at the rate of 2 to 10% by weight.

The hot properties of the pellets according to the conventional methods and the present invention are compared in FIG. **3.** (A) shows a standard Wayara pellet (oxidized and baked pellet); (B), a pellet according to Example **1** of the present invention; and (C), a pellet according to the Grangcold pelletizing process.

The conventional cold pellet (C) is inferior in its hot properties, and particularly in the loaded softening property to the standard pellet (A) as shown in FIG. **3.** On the contrary, the pellet (B) of the present invention is remarkably improved in its hot properties as compared with the pellet (C) of the Grangcold pelletizing process, so that it can be used in a large amount for the operation of a blast furnace.

Further, for the hot properties, swelling becomes a problem when the pellet is used in a blast furnace. There may be at least about 10% of swelling in the conventional method. However, the swelling can be restrained to about 1% according to the present invention.

Thus, it is the effect of the ferruginous powders that the hot properties, namely the loaded softening property and swelling can be restrained. That is to say, the hot strength of the conventional pellet becomes lowest at the Wustite stage and changes to recover when metallic Fe begins to be generated, while according to the present invention ferruginous powders are previously blended, so that the generation of the nucleus of metallic Fe can be helped and the strength (loaded softening property) of the pellet can be improved. The swelling of the pellet in the blast furnace is due to the fibrous metallic iron, generated during the reducing process. According to the present invention ferruginous powders are previously blended for the existence of the Fe nucleus. The fibrous metallic iron, which begins to be generated, is adhered with each other and coagulated. Thus, the swelling may be prevented.

The embodiment examples of the present invention shall be explained in the following.

Example 1:

Blending of raw materials;

Cutting scrap	5% size −200 mesh
Alumina cement(commercial)	10%
Iron sand	50% +0.25mm : 6% average size 0.19 mm
Sinter dust, collected by electric collector	35% −200 mesh
Water	12% of the above mixture
Hardening time:	one month
Crushing strength:	143.2 Kg/pellet
Swelling :	1%

Note: Measuring method of swelling : Volumetric change at 900°C for 3 hours in a reducing atmosphere, having 30% of CO and 70% of N.

Example 2:

Blending of raw materials:

Reducing iron powders	10% size −200 mesh
Portland cement (commercial)	15%
Kamaishi concentrates	50% +0.25 mm : 7%
Lamco fine ores	25% −200 mesh
Water :	14% of the above mixture
Hardening time :	one month
Crushing strength :	205 Kg/pellet
Swelling :	1.1%

What is claimed is:

1. A process for producing pellets, which comprises blending **98** to **60%** by weight of iron ores and **2** to **40%** by weight of a mixture comprising **95** to **15%** by weight of cement and **5** to **85%** by weight of iron containing powders smaller than **100** meshes with addition of **9** to **20%** by weight of water on the basis of the mixture.

2. A process according to claim **1,** in which the iron containing powder is one or more selected from the group consisting of cutting scrap of iron, atomized iron powder, reduced iron powder and ferruginous scale.

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