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(54)

Method of Operating a Pelletizing Plant.

(57)

Abstract: The invention relates to a method of operating a pelletizing plant for additional treatment of iron making, steelmaking and pellet plant residues. The pelletizing plant comprises an indurating furnace in which green pellets are charged and fired to produce hard pellets. The method includes: preparing iron ore green pellets; and charging and firing said green pellets in an indurating furnace. The method is remarkable in that agglomerates of by-products are charged and fired with the green pellets in the indurating furnace, thereby producing hardened pellets and hardened agglomerates of by-products. A pelletizing plant is also presented, which comprises a pelletizing section (16), an indurating furnace (12), an agglomerating section (40) for producing agglomerates of by-products. A feeding arrangement is configured to charge agglomerates of by-products into said indurating furnace, together with the green pellets. (Fig.1) LU100075

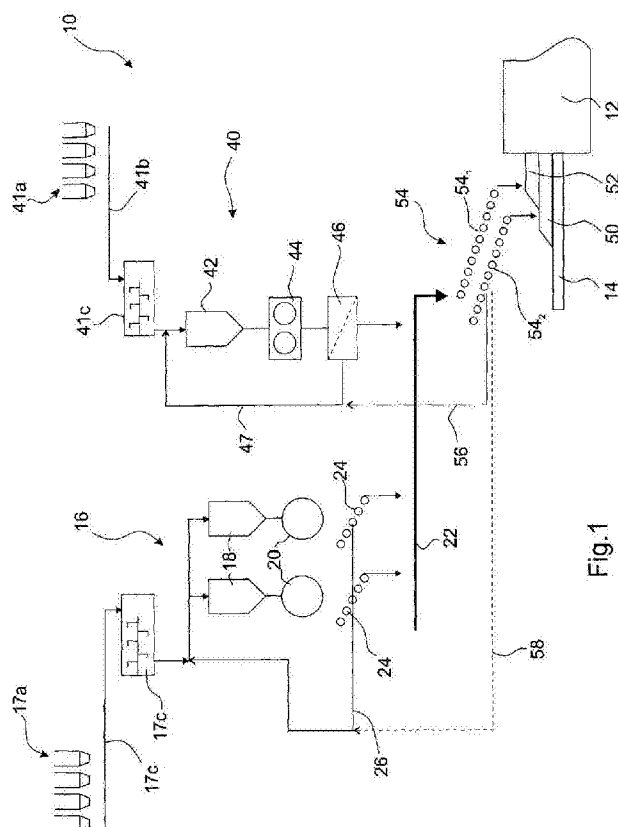


Fig.1

METHOD OF OPERATING A PELLETIZING PLANT

FIELD OF THE INVENTION

The present invention generally relates to the field of iron making. More particularly, it relates to the agglomeration of iron ore by pelletization and specifically to a method of operating a pelletizing plant.

BACKGROUND OF THE INVENTION

As it is well known in the art, the blast furnace is a countercurrent gas-solid reactor in which the solid charge materials move downward while the hot reducing gases flow upward. The best possible contact between the solids and the reducing gas is obtained with a permeable burden, which permits not only a high rate of gas flow but also a uniform gas flow, with a minimum of channeling of the gas.

In this context, agglomeration processes have been developed in order to enable the use of fine material, improve the burden permeability and thereby reduce blast furnace coke rates and increase the rate of reduction. They also permit reducing of the amount of fine material blown out of the blast furnace into the gas recovery system. Furthermore, in ironmaking furnaces, agglomerated materials, when they have the proper chemical composition, can substitute for lump ores used as charge ores.

Sintering and pelletizing processes are today the two major agglomeration processes, especially for the blast furnace. Sintered ore is made by partially melting and sintering coarse iron ore 0.5 to 3 mm in size into products having a size of 5 to 50 mm. The sintering process uses the combustion heat of coke breeze (fuel).

Pellets are made from iron ore that is finer than that used for sintered ore. The fine-grained ore can be relatively easily formed into spheroids, called green balls, typically with a diameter ranging from 9 to 18 mm. The green balls are fired into hard product pellets, so-called indurated pellets or simply pellets.

These pellets have attracted great interest since they are well adapted for use as raw materials for blast furnaces, but also for direct reduction furnaces.

In general, the pelletizing process is desirable for agglomeration of finely divided concentrates because they are normally of such fine size that they will form into a green ball with little difficulty. Concentrates and high grade ores that are not suitable in size for pelletizing are in some cases ground to the required size.

The interest for pellets has increased in modern countries, where pelletizing plants have been built with the goal of producing material for blast furnace under strong environmental regulations.

This being said, sinter remains an attractive process since it allows the flexibility to process ores as well as by-products of iron making and steel making industries (oxide and metallic dusts), commonly refer to as "revert materials".

OBJECT OF THE INVENTION

The object of the present invention is to provide an improved concept of pelletizing plant, which can more flexibly handle iron ores and by-products produced either by an integrated plant, or a direct reduction unit of a pellet plant.

This object is achieved by a method as claimed in claim 1.

SUMMARY OF THE INVENTION

With this objective in mind, the present invention proposes a method of operating a pelletizing plant with traditional ore feed and some by-products. The pelletizing plant comprises an indurating furnace in which green pellets are charged and fired to produce hard pellets. The method comprises the steps of preparing iron ore based green pellets; and charging and firing the green pellets in the indurating furnace.

According to an important aspect of the invention, by-products previously agglomerated are charged and fired with the green pellets in the indurating furnace, whereby hardened pellets and hardened agglomerates of by-products are produced in the indurating furnace.

A remarkable aspect of the present invention is thus the processing of agglomerates of by-products in the indurating furnace, together with green pellets. In other words, agglomerates of by-products and green pellets undergo concurrently/simultaneously the same thermal treatment for their hardening in the indurating furnace.

The term 'by-products' is herein used to generally designate the ironmaking, the steelmaking, the pelletization and the direct reduction waste materials, and may typically include one or more of: steelmaking slag, mill scale, scrap fines, oxide fines, dust and sludges collected in offgas lines, fines fractions from the screening units, sludges iron- or flux-bearing blast furnace by-products. These by-products, also known as 'reverts', may typically have a size in the range of 0.045 to 5 mm.

The by-products are preferably agglomerated by a compacting process via pressurized rollers, as is known in the art, to form the agglomerates of by-products. The by-products may be processed in an extrusion or roll device, optionally together with an additive (e.g. lime, binder, etc.), to form lumpy products of predetermined shape and size. A so-called briquetting machine can be used for the preparation of briquette-like agglomerates having a non-spherical shape with dimensions greater than pellets. Preferably, the briquettes/agglomerates of by-products have a minimum size of 20 mm (in all dimensions). For example, the briquettes may be 20 x 30 x 30, or 20 x 20 x 40, all expressed in mm, or even larger, e.g. 50 x 40 x 100.

It shall be appreciated that, in the process according to the present invention, the briquetting-type agglomerating process is used to produce agglomerates of by-products that are charged together with the green pellets in the indurating furnace. This is to be put in contrast with conventional plants, where briquettes

are not thermally hardened and directly charged into the blast furnace or the electric furnace.

A great advantage of the present invention is to provide a pelletizing process and plant that is adapted to completely substitute a sinter plant in a coal-based iron making installation. Another great benefit is for gas-based iron making plants, where the present process provides a circular technology. Indeed, as sinter plants are more and more being challenged with higher amounts of finer iron ore, the present invention offers an attractive alternative process route for customers operating blast furnaces. The invention may be of particular interest for gas-based iron making plants operating with iron ore pellets, where the present process makes it possible to produce pellets and treat all by-products with one technology – whereas current gas-based iron making plants transfer such iron waste into other facilities, outside the plant boundaries. The present invention thus constitutes an attractive solution addressing also environmental aspects and namely waste management strategy in a circular technology.

The pellets are conventionally prepared in a balling section of the plant, using balling equipment that produces spheroidal or ball-like aggregates referred to as green pellets or green balls. Any appropriate equipment may be used, in particular a balling drum or a disc pelletizer. Pellets are prepared from a fined grained mixture that includes mainly iron bearing material, in particular iron ore, and some additive(s), in particular a binder (e.g. bentonite). The material ready for balling has a grain size below 0.15 mm with about 80% thereof below 45 μm (i.e. minus 325 mesh).

In the present process, the green pellets typically preferably contain at least 61% iron ore, and have a diameter in the range of 9 to 18 mm, preferably 9-14 mm, typically with a mean diameter of about 12 mm.

The indurating furnace can be based on any appropriate technology, e.g. traveling grate furnace, grate-kiln-cooler, or circular induration furnace.

Preferably, the agglomerates of by-products and green pellets are loaded on the charge conveyor of the indurating furnace in two superposed layers, the

upper layer mainly comprising the agglomerates of by-products and the lower layer mainly comprising the green pellets.

The charging is advantageously made by means of a segregating unit receiving the green pellets and agglomerates of by-products and distributing the latter into the upper and lower layers, based on particle size.

These and other features of the present process are also recited in the appended dependent claims.

According to another aspect, the invention concerns a pelletizing plant comprising:

a pelletizing section for producing green pellets comprising fine iron ore;

an indurating furnace for firing said green pellets into hardened pellets;

a feeding arrangement configured to charge said green pellets onto a charge conveyor of said indurating furnace; and

characterized in that it further comprises an agglomerating section for producing agglomerates of by-products, and in that said feeding arrangement is further configured to charge said agglomerates of by-products into said indurating furnace, together with said green pellets.

The above and other features of the present pelletizing plant are also recited in the appended dependent claims.

BRIEF DESCRIPTION OF THE DRAWING

The present invention will now be described, by way of example, with reference to the accompanying drawing, in which:

Figure 1: is a process flow diagram of a pelletizing plant according to an embodiment of the invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

As it is well known, pelletizing plants for the iron making industry involve generally the following processes:

- material pre-processing, in particular grinding;
- balling;
- indurating.

The pelletizing plant according to the present invention, an embodiment of which is shown in the figure, also relies on these three processes, which are briefly described below.

In the material pre-processing stage, the iron ore is ground into fines having qualities required for the subsequent balling process. The pretreatment may typically include concentrating, dewatering, grinding, drying and prewetting. In general, low-grade iron ore is ground into fines to upgrade the quality of the iron ore, remove gangues containing sulfur and phosphorus, and control the size of the grains.

Conventional grinding methods are roughly categorized as to the following three aspects:

- 1) wet grinding - dry grinding;
- 2) open-circuit grinding - closed circuit grinding;
- 3) single stage grinding - multiple stage grinding.

These methods are used in combination depending on the types and characteristics of the ore and the mixing ratio, taking into account the economic feasibility.

Next, the goal of the balling process is to produce spheroid-type green pellets (also referred to as green balls) from the pre-wetted material prepared in the previous process. The balling equipment may comprise a balling drum or a disc pelletizer, which are the most widely used for forming green balls.

In the indurating process, the green pellets are charged into a furnace, in which they are fired, to increase their hardness. The following furnace systems may be used for indurating pellets: a traveling grate (straight grate) system and a grate-kiln-cooler system. The traveling grate system consists of a single unit which moves a static layer of pellets. The system has a simple structure for drying, preheating, firing and cooling pellets. Due to its relative ease of

operation, along with ease of scaling-up, makes the system one used by many plants. The grate-kiln-cooler system consists mainly of a grate, a kiln and a cooler, respectively designed for drying/preheating, firing, and cooling the pellets. This system allows controlling individually the residence time in each zone of the furnace.

Figure 1 shows a diagram according to one embodiment of the present pelletizing plant 10. The material pre-processing section may use the above-described conventional material for grinding and handling bulk materials, or any other appropriate equipment.

Reference sign 12 designates an indurating furnace, which comprises conveyor means 14 for transferring the material throughout the furnace 10. The indurating furnace 12 is preferably of the traveling grate type. Conventionally the furnace 12 comprises zones for drying, preheating, firing and cooling (not shown). The four zones are arranged one after another. Each zone is held at a predetermined temperature, and heat exchange occurs via hot air and/or combustion gas to fire the pellets. In the travel grate furnace 12, the charge conveyor comprises an endless grate car consisting of grate bars with side walls, in which pellets are charged (typically over a layer of already fired material). The green pellets on the grate travel through the zones for drying, preheating, firing and cooling.

At the furnace's outlet, the hardened pellets and hardened agglomerates of by-products are discharged together, and may be screened to separate them by particle size.

It shall be appreciated that in the present pelletizing plant 10, two types of materials are fed into the indurating furnace: green pellets and briquette-like agglomerates of by-products.

In Fig.1, one will recognize the conventional balling section 16. It comprises storage bins 18 containing fine grained material ready for balling into associated balling equipment 20. The storage bins are located downstream of a set of raw materials storage bins 17a and mixer equipment 17b of the pre-processing

section. A desired recipe of raw materials is prepared on a conveyor belt 17c and conveyed to the mixer equipment 17b. The mixture is then forwarded to the respective bins 18. The balling equipment 20 may be a balling drum or a disc pelletizer. Green balls formed in the balling equipment 20 are discharged on a main collecting conveyor 22, typically a belt conveyor, to carry the on-size green pellets towards the furnace 12. The transfer of the green pellets onto the conveyor 22 is done by a roller screen 24. The rolls of the roller screen 24 are configured such that green pellets with desired size proceed to the main collecting conveyor 22, whereas undersized and oversized pellets as well as fines are separated and collected to be recycled back to the bins 18. The recycling route is indicated 26. Typically, the collected material is recycled back to the bins 18 or can also be conveyed to a mixing system to properly homogenize all raw materials as appropriate for balling.

The storage bins 18 contain a mixture of ready to mix materials, which depends on the desired composition for the green pellets. Typically the mixture comprises at least one type of fine grained iron ore, typically with a mesh minus 320, and at least one additive, e.g. bentonite or limestone. Annexed Tables 1 and 2 list possible materials for the preparation of green pellets and their properties.

It shall be appreciated that the present pelletizing plant 10 further comprises an agglomerating section 40, for forming agglomerates of reverts-products. As can be seen, the agglomerates formed in this section are also transferred towards the indurating furnace 12. In the shown embodiment, the agglomerates of by-products are discharged on the main collecting conveyor belt 22, with the green pellets.

The agglomerating section 40 comprises a storage bin 42 with the by-products to be agglomerated. The by-products may be stored in bins 41a upstream of the storage bin 42. One or more types of by-products are discharged on a conveyor belt and forwarded to the storage bin 42, optionally via a mixing/grinding equipment 41c. These materials are then compacted, typically via a pressurized

rollers device 44, to form lumpy products of predetermined size. The formed aggregates are discharged from device 44 in a screen 46, where undersized material is recycled to the storage bin 42, as indicated by return line 47, while the qualified agglomerates are transferred onto the main collecting conveyor 22. Table 3, in annex, gives an exemplary list of by-products that can be used for preparing agglomerates in the context of the present process, together with typical grain sizes.

As can be seen in the Figure, the green pellets and agglomerates of by-products are preferably charged into the furnace 12 in two superposed layers. The lower layer 50 on the traveling grate 14 comprises mainly the green pellets. The top layer 52 is mainly formed by the agglomerates of by-products.

In the embodiment, the furnace feeding unit 54 comprises a double deck roller screen device comprising superposed set of rolls configured to carry the agglomerates toward the furnace. The top roll arrangement 54₁ is configured to transfer the agglomerates of by-products to the furnace, whereas the lower roll arrangement 54₂ is configured to carry the green pellets to the furnace. As it will be understood, the spacing between the top rolls 54₁ is defined so that green pellets fall through the rolls onto the lower rolls 54₂. Likewise, the roll spacing of the lower screen 54₂ is such that green pellets with a given minimum size are carried to the furnace, while undersized green pellets, particles and fines fall through the lower screen 54₂ and are collected.

The ends of the respective screens 54₁ and 54₂ are positioned so that the green pellets are deposited first on the furnace conveyor 14, forming the first layer 50, and the agglomerates are deposited by the second screen over the first layer 50, to form the second layer 52.

The ratio between green pellets and agglomerates of by-products, in particular the thickness of each layer 50, 52, can be varied by adjusting the amounts of pellets and briquettes delivered onto the main collecting conveyor 22.

The undersized green pellets, particles and fines collected at the lower screen 54₂ are returned to storage bin 42 via a return route 56, to be recycled into briquettes. It should be noticed that when the agglomerating section 40 is in operation, all undersized material from the furnace feeding system 54, is preferably conveyed to the storage bin 42.

Alternatively, the pellets, particles and fines collected at the lower screen 54₂ may be recycled towards the pelletizing section 16, as indicated by return route 58 (dashed line). This is return route is namely used when the agglomerating section 40 is not in operation.

		Iron Ore Concentrate	Bentonite	Limestone
Fe _{tot}	%wt	68	n.d.	n.d.
FeO	%wt	16	n.d.	n.d.
CaO	%wt	0.5	1.4	50
MgO	%wt	1.5	2.4	0.8
SiO ₂	%wt	1	60	12.3
Al ₂ O ₃	%wt	1	12	1.3

Table 1

	Bulk density loose	Bulk density compacted	Moisture	Grain size distribution	Specific surface
	t/m ³	t/m ³	%wt		cm ² /g
Iron ore concentrate	1.8	2.3	9.5	100% < 150 µm 80% < 45 µm	1800 - 2000
Limestone coarse	1.4	1.6	5	100% < 25mm	
Limestone ground	1.2	1.4	<1	100% < 150 µm 80% < 45 µm	2000 - 3000
Bentonite	0.7	1.0	5	98% < 147 µm 95% < 74 µm 80% < 45 µm	2000 - 3000
Mixed Material	1.8	2.2	9	100% < 150 µm 80% < 45 µm	

Table 2

		+ 1mm	+0,500 mm	+ 0,250 mm	+ 0,100 mm	+ 0,050 mm	+ 0,025 mm	- 0,025 mm	Total
Dust- Steelmaking EC	[wt%]	5,00	17,00	33,00	25,00	20,00	> 1	0,00	100,00
Dust- BOF B/F	[wt%]	1,00	6,00	22,00	25,00	45,00	> 1	0,00	99,00
Dust- Steelmaking E/P	[wt%]	30,00	30,00	20,00	15,00	4,00	> 1	0,00	99,00
Sludge- Steelmaking OG	[wt%]	52,00	18,00	8,00	6,00	15,00	> 1	0,00	99,00
Sludge - BF	[wt%]	> 1	> 1	5,00	25,00	25,00	20,00	25,00	100,00
DRI fines	[wt%]	0,00	0,00	0,00	> 1	> 1	70,00	30,00	100,00
DRI Oxide Fines	[wt%]	30,00	5,00	5,00	10,00	20,00	15,00	10,00	95,00
DRI - Sludges	[wt%]	> 1	2,50	2,50	10,00	15,00	40,00	30,00	100,00

Table 3

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REVENDICATIONS

- 5 1. Procédé de fonctionnement d'une usine de pelletisation pour des fours
de fabrication de fonte, ladite usine de pelletisation comprenant un four
de durcissement dans lequel des pellets crus sont chargés et cuits pour
produire des pellets durs, ledit procédé comprenant :
- 10 la préparation de pellets crus de minerai de fer ;
le chargement et la cuisson desdits pellets crus dans un four de
durcissement ;
caractérisé en ce que des agglomérats de sous-produits sont chargés
et cuits avec lesdits pellets crus dans ledit four de durcissement,
produisant ainsi des pellets durcis et des agglomérats durcis de sous-
15 produits.
2. Procédé selon la revendication 1, dans lequel lesdits agglomérats de
sous-produits et lesdits pellets crus sont chargés sur un transporteur de
charge dudit four de durcissement en deux couches superposées, la
20 couche supérieure comprenant principalement les agglomérats de sous-
produits et la couche inférieure comprenant principalement lesdits pellets
crus.
3. Procédé selon la revendication 2, dans lequel le chargement dudit
25 transporteur de charge est effectué au moyen d'une unité de ségrégation
recevant lesdits pellets crus et lesdits agglomérats de sous-produits et
distribuant ces derniers dans lesdites couches supérieure et inférieure.
4. Procédé selon la revendication 1, 2 ou 3, dans lequel ledit procédé
30 comprend une étape de préparation d'agglomérats de sous-produits, qui
inclut le traitement de sous-produits, en particulier à grains grossiers,
avec des additifs et facultativement des fines ou autre matériau portant

du fer, dans un appareil de compactage pour former des agglomérats de sous-produits.

5. Procédé selon la revendication 4 dépendant de la revendication 3, dans lequel lesdits agglomérats de sous-produits sont préparés à partir d'un mélange comprenant :
- des sous-produits incluant du fer et/ou des déchets de fabrication d'acier ; et
- des fines recueillies de ladite unité de ségrégation.
6. Procédé selon l'une quelconque des revendications précédentes, dans lequel lesdits agglomérats de sous-produits sont formés comme des blocs ou des briquettes avec une taille supérieure à 16 mm, préférablement supérieure à 20 ou 24 mm.
7. Procédé selon l'une quelconque des revendications précédentes, dans lequel ladite étape de préparation de pellets crus comprend la préparation d'un mélange de matières brutes incluant : du minerai de fer à grains fins et d'éventuels additifs, en particulier un liant, et le traitement dudit mélange pour former des pellets sensiblement en forme de billes.
8. Procédé selon la revendication 7, dans lequel lesdits éventuels additifs incluent des sous-produits fins avec 70% en poids des particules ayant un tamis de moins 352 mesh.
9. Procédé selon l'une quelconque des revendications précédentes, dans lequel lesdits pellets consistent en plus de 61% en poids de particules portant du fer à grains fins, en particulier de particules de minerai de fer ; et préférablement lesdits pellets consistent en au moins 80% en poids de particules ayant un tamis de moins 325 mesh.

10. Procédé selon l'une quelconque des revendications précédentes, dans lequel lesdits pellets ont un diamètre dans la plage de 9 à 18 mm, préférablement 9 à 14 mm.
- 5 11. Usine de pelletisation comprenant :
- une section (16) de pelletisation pour produire des pellets crus comprenant du minerai de fer fin ;
- un four (12) de durcissement pour cuire lesdits pellets crus en pellets durcis ;
- 10 un agencement (54) d'alimentation configuré pour charger lesdits pellets crus sur un transporteur de charge dudit four de durcissement ;
- caractérisée en ce qu'elle** comprend en outre une section (40) d'agglomération pour produire des agglomérats de sous-produits, et en ce que ledit agencement d'alimentation est en outre configuré pour
- 15 charger lesdits agglomérats de sous-produits dans ledit four de durcissement, en même temps que lesdits pellets crus.
12. Usine de pelletisation selon la revendication 11, dans laquelle des pellets crus formés dans ladite section de pelletisation et des agglomérats de
- 20 sous-produits formés dans ladite section d'agglomération sont déchargés sur un transporteur (22) commun, transférant les pellets crus et les agglomérats de sous-produits jusqu'audit agencement (54) d'alimentation.
- 25 13. Usine de pelletisation selon la revendication 12, comprenant un premier chemin de retour (26) pour des pellets sous-dimensionnés ou surdimensionnés, recueillis lors du transfert de ceux-ci sur ledit transporteur commun.
- 30 14. Usine de pelletisation selon la revendication 11, 12 ou 13, dans laquelle ledit agencement (54) d'alimentation est configuré pour charger les

pellets crus et les agglomérats de sous-produits en deux couches (50, 52), avec lesdits agglomérats de sous-produits au-dessus.

- 5 15. Usine de pelletisation selon l'une quelconque des revendications 11 à 14, dans laquelle ledit agencement d'alimentation comprend un ensemble de cribles à rouleaux (54₁, 54₂) superposés.
- 10 16. Usine de pelletisation selon l'une quelconque des revendications 11 à 14, comprenant un deuxième chemin de retour (58) pour recueillir des matières sous-dimensionnées et des fines dudit agencement (54) d'alimentation et transférer ces dernières jusqu'à ladite section d'agglomération.

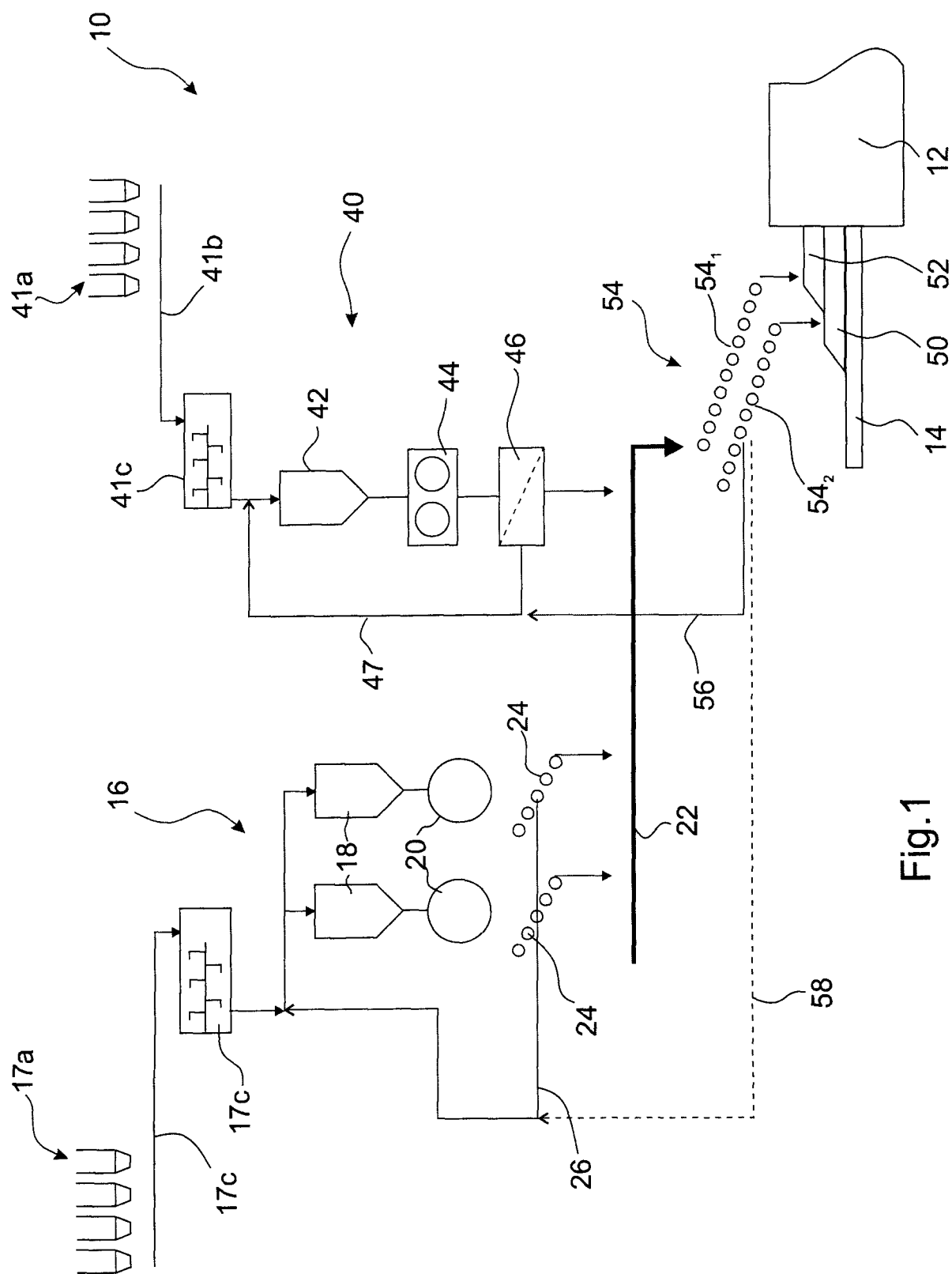


Fig.1

Abstract

The invention relates to a method of operating a pelletizing plant for additional treatment of iron making, steelmaking and pellet plant residues. The pelletizing plant comprises an indurating furnace in which green pellets are charged and fired to produce hard pellets. The method includes: preparing iron ore green pellets; and charging and firing said green pellets in an indurating furnace. The method is remarkable in that agglomerates of by-products are charged and fired with the green pellets in the indurating furnace, thereby producing hardened pellets and hardened agglomerates of by-products.

A pelletizing plant is also presented, which comprises a pelletizing section (16), an indurating furnace (12), an agglomerating section (40) for producing agglomerates of by-products. A feeding arrangement is configured to charge agglomerates of by-products into said indurating furnace, together with the green pellets.

(Fig.1)



SEARCH REPORT
in accordance with Article 35.1 a)
of the Luxembourg law on patents
dated 20 July 1992

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
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24 October 2017		Juhart, Matjaz	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE SEARCH REPORT
ON LUXEMBOURG PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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		WO 9718338 A1 22-05-1997	



WRITTEN OPINION

File No. LO1578	Filing date (day/month/year) 10.02.2017	Priority date (day/month/year)	Application No. LU100075
International Patent Classification (IPC) INV. C22B1/24			
Applicant PAUL WURTH S.A.			

This report contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

Form LU237A (Cover Sheet) (January 2007)	Examiner Juhart, Matjaz
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WRITTEN OPINION

Application No.

LU100075

Box No. I Basis of the opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.
2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:
 - a. type of material:
 - ☐ a sequence listing
 - ☐ table(s) related to the sequence listing
 - b. format of material:
 - ☐ on paper
 - ☐ in electronic form
 - c. time of filing/furnishing:
 - ☐ contained in the application as filed.
 - ☐ filed together with the application in electronic form.
 - ☐ furnished subsequently.
3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes: Claims	3, 5, 6, 8-10, 15, 16
	No: Claims	1, 2, 4, 7, 11-14
Inventive step	Yes: Claims	
	No: Claims	1-16
Industrial applicability	Yes: Claims	1-16
	No: Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Application No.
LU100075

Box No. VII Certain defects in the application

The following defects in the form or contents of the application have been noted:

see separate sheet

Re Item V

1. Preliminary observation

1.1 The apparatus of claim 11 is partially defined by process features, e.g. "... fine iron ore ..." or "... by-products ...". Process features are not necessarily limiting for an apparatus which has to be distinguished over the prior art by an apparatus feature. Thus, the apparatus of claim 11 is limited by the following features:

a pelletization line, an induration furnace, a feeding arrangement, feeding conveyer and an additional agglomeration line.

2. Reference is made to the following documents:

D1 US 3 864 119 A (WHITAKER ORION C ET AL) 4 February 1975
(1975-02-04)

D2 US 3 333 951 A (BAN THOMAS E) 1 August 1967 (1967-08-01)

D3 US 2015/128766 A1 (REIS JOSÉ ANTONINO ALVES E SILVA [BR] ET AL) 14 May 2015 (2015-05-14)

3. D1 discloses a method and an apparatus for producing heat hardened agglomerates of mineral ore such as iron oxide ore (cf. col.1, l.8-14). Referring to the drawing and the description col.2, l.52 to col.4, l.16, green pellets are produced from iron ore in the balling drum. The pellets are then heat treated in the rotary kiln, i.e. indurated, and screened on decks 41 and 42. The pellets fines not passing deck 42 are returned (i.e. by-products) to bin 50 and pelletized by means of balling pan 52. The pellet are then charged on the green pellets (4) layer on the travelling grate 10 (i.e. conveyer) and charged into the rotary kiln for induration. Accordingly, the subject-matter of claims 1 and 11 is not novel over D1.

3.1 Moreover D2 discloses a process for producing metallized layered iron ore pellets including the steps of blending with the iron ore a solid carbonaceous material and moisture, forming pellets of the moist blend, indurating the pellets, coating the indurated pellets with moistened ore blend, and re-indurating the pellets (cf. col.1, l. 10-20). Referring to fig.1, the undersized indurated pellets (i.e. by-product) are returned into agglomeration process and charged on the conveyer together with the green pellets, the latter including iron ore, bentonite, limestone and coke. Hence, the subject-matter of claims 1 and 11 is not novel over D2.

3.2 Furthermore, D3 discloses (cf. fig.1) an apparatus comprising two separate pelletization lines. The pellets can be indurated (compare par.[0049] and claim 19), thus the presence of an induration furnace, a feeding arrangement and a feeding conveyer is implicitly disclosed. Accordingly, the subject-matter of claim 11 is anticipated by D3, either (see also point 1.1 above).

4. The preferred embodiments claimed in the dependent claims 2-10 and 12-16 are either known from the cited prior or considered as a result of optimisation work conducted by a skilled person without need of any inventive activity. Thus, the subject-matter of those claims lacks novelty and/or inventive step either. In particular:

4.1 The lower layer comprising green pellets (claim 2) is known from D1 (cf. col.4, l. 13-15). Each of the process from D1-D3 has to include "a segregating unit" (claim 3) for distribution of the pellets on the conveyer. The utilisation of additives (claim 4) is known from D2 (cf. fig.1) and also well known in the field. The recycling of fines from segregating unit (claim 5) and corresponding return route from feeding arrangement (claim 16) are considered as obvious measurement to improve the material yield. The adaption of agglomerates size (claims 6, 8, 9 and 10) is result of routine tests. Ball shaped pellets (claim 7) are known from D1 and D2, see passages indicated at point 3 and 3.1 above. The system known from any of documents D1-D3 includes a common convey where the green agglomerates and by-products agglomerates can be charged (claim 12). These documents further include a feeding system (claim 14) being able to charge green pellets on the bottom layer of the conveyer and by-products agglomerates on the top. The addition return route for the undersized pellets collected during the transfer of the pellets to a conveyer (claim 13) is known from D1 (cf. drawing). The use of roller screens in a feeding arrangement (claim 15) is a design feature and a well known alternative for a skilled person working in the field of ore processing.

Re Item VII

1. The relevant background art disclosed in D1-D3 is not mentioned in the description, nor are these documents identified therein.