(12) INNOVATION PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. **AU 2020101153 A4**

(54) Title
A Method For Grinding To Get Slag Micro-powder In Stages

(51) International Patent Classification(s)
B02C 17/10 (2006.01) ***B02C 17/18*** (2006.01)
B02C 15/00 (2006.01) ***B02C 23/32*** (2006.01)

(21) Application No: **2020101153** (22) Date of Filing: **2020.06.26**

(45) Publication Date: **2020.07.30**
(45) Publication Journal Date: **2020.07.30**
(45) Granted Journal Date: **2020.07.30**

(71) Applicant(s)
Qian'an Weisheng Solid Waste Environmental Protection Industry Co., Ltd;University of Science and Technology Beijing

(72) Inventor(s)
CAI, Shuisheng;NI, Wen;DU, Huihui;WANG, Yufeng;WU, Wei;WANG, Kun;BA, Haojing;LI, Ying;WANG, Xue

(74) Agent / Attorney
WRAYS PTY LTD, L7 863 Hay St, Perth, WA, 6000, AU

2020101153 26 Jun 2020

Abstract of Descriptions

This invention provides a method for grinding to get slag micro-powder in stages , and the specific steps include feeding and iron removal, first-stage grinding and iron removal, and second-stage grinding. Through the series grinding method, the first-stage grinding plays the great role in reduction of energy consumption, and the second-stage grinding helps to change the morphology and gradation of particles. Besides, removal of iron in real-time circularly in the first-stage grinding to separate and recycle the metallic iron mixed in the slag, improves the grinding efficiency, reduces the system energy consumption and mill loss, improves the product performance, and finally helps to get the high fineness slag micro-powder.

2020101153 26 Jun 2020

Drawings of Descriptions

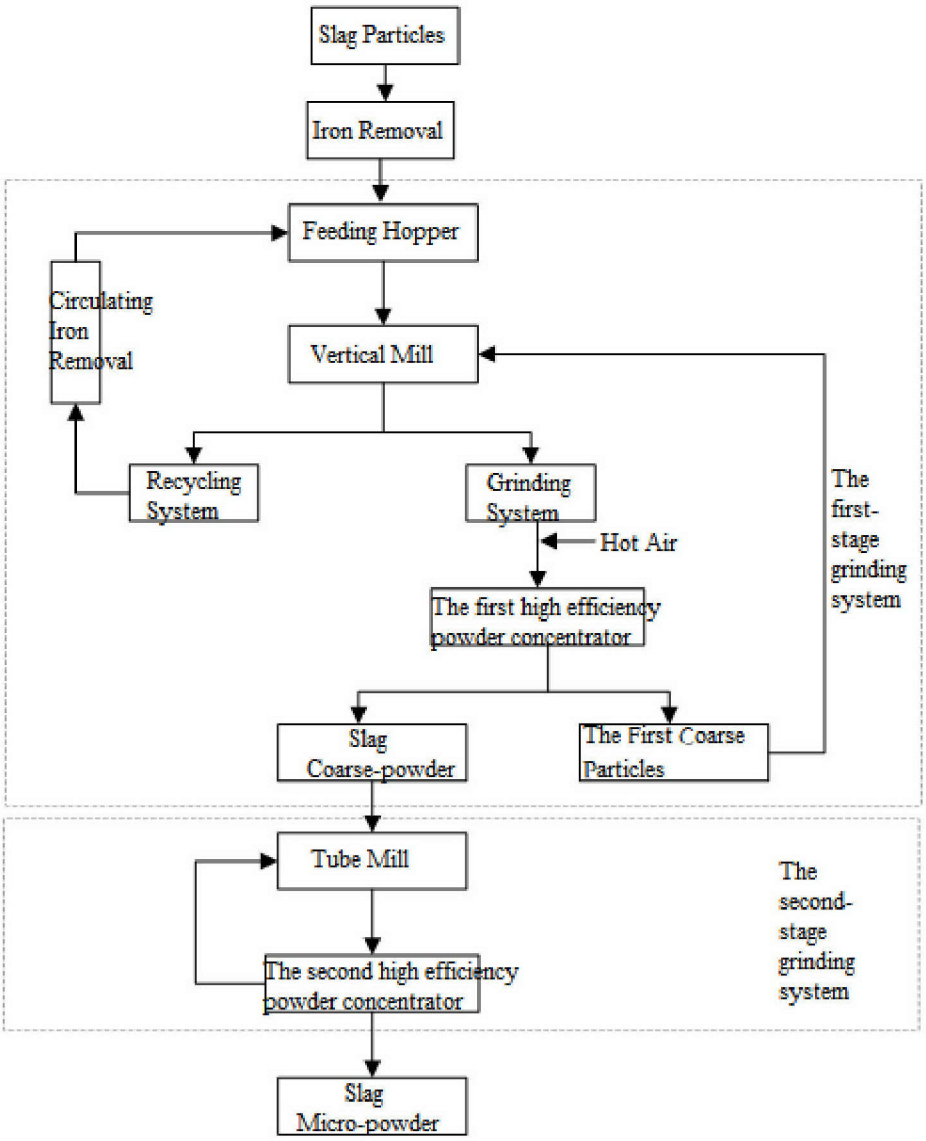

FIG. 1

2020101153 26 Jun 2020

Descriptions

A Method for Grinding to Get Slag Micro-powder in Stages

Technical Field

This invention relates to the technical field of comprehensive utilization of industrial solid waste, in particular to a method for grinding to get slag micro-powder in stages.

Background Technology

Slag is the large amount of glassy structure containing silicon-oxygen tetrahedron, which is formed when the waste residue discharged in the process of iron-making in blast furnace is quenched by water after high-temperature smelting without crystallization due to time constraints. Its main components are C2S, C3S, C3A, C2AS and other active minerals, so it has some potential hydraulic activity. Traditional applications of slag are relatively extensive, by which slag and cement clinker are usually ground together to be used as cement admixture. However, due to the big difference of grindability between slag and cement clinker, the slag particles are coarse and the specific surface area is about 300m^2/kg after they are mixed and ground, so the activity cannot be fully excited in the process of cement hydration, so it can only fill as a micro-aggregate. In building materials industry, slag particle with specific surface area greater than 400m^2/kg and high activity is called slag micro-powder. A large number of studies show that the improvement of the fineness of slag through grinding can improve its potential activity, especially fully excite its potential activity in alkaline conditions, so that the mechanical strength and working performance of cement and concrete are greatly improved. Some studies have shown that the slag micro-powder with specific surface area greater than 400m^2/kg can replace 50% - 70% of cement clinker, which greatly improves the later strength of concrete, and at the same time, reduces the hydration heat of concrete, and improves the working performance such as fluidity, workability and pumpability, especially suitable for large volume concrete, marine concrete engineering, etc. The 28-day activity index of slag micro-powder with specific surface area of 600m^2/kg and 800$m^{2/}$kg reaches 114% and 127% respectively, which is higher than that of cement clinker with ordinary fineness. Therefore, improving the fineness of slag can greatly improve its activity index. The improvement of grinding process of slag is very important to improve the activity and application performance of slag.

The traditional ball mill is generally used to grind slag in the application of construction work in China. It has low input cost of equipment foundation, large amount of feeding in one time, high fineness of grinding, round shape of particles, which is beneficial to the hydration and hardening of slag and has good particle gradation. However, the ball mill has low grinding efficiency and high energy consumption. It has strong vibration and noise when running. In

2020101153 26 Jun 2020

addition, if the grinding time is too long, there will be a dynamic balance of "grinding-agglomeration". With the increase of specific surface area, the specific surface energy is also increased, and the fine particles agglomerate with each other, so it is difficult to grind them finer when the grinding time is increased. In recent years, the vertical mill grinding system, which integrates drying, grinding and separating, is relatively mature. It has small floor area, small operation noise, no dust in the fully closed system, high grinding efficiency due to the extrusion principle of material bed, the features of energy saving, environmental protection and low consumption. In particular, the mill has large space inside, high air speed at the air ring, fast heat transfer, heat exchange of materials in suspension, strong drying capacity, and suitable for materials with high moisture content and poor grindability. However, the vertical mill products have relatively concentrated fineness range of particles, poor particle gradation, and the particles of finished products are mostly flakes, which is not conducive to reducing the voidage of hardened cement and concrete, and is not good for the strength. Therefore, it is very important to improve the fineness of slag, particle morphology and particle gradation for improving the activity index of slag.

The patent application with the publication number of CN1559690A discloses a grinding process for blast furnace slag powder. After drying the blast furnace slag powder, it combines the large ball mill with the high efficiency combined separator to form a closed-circulation system. The specific surface area of the produced slag powder is greater than 450m^2/kg. This process can improve grinding efficiency and reduce unit energy consumption. However, since steel ball is used as the grinding medium in the ball mill, when the grinding time is too long, "grinding-agglomeration" will occur, which is not conducive to the improvement of slag fineness.

The patent application with the publication number of CN109455960A discloses a preparation technology of slag micro-powder, which is a slag micro-powder production equipment composed of a hot blast furnace, a vertical mill, a dust collector, etc. This process has high grinding efficiency for slag, but the additional hot blast furnace needs to burn coal powder to generate hot air flow, which will produce harmful gases such as CO, CO_2, etc. that cause greenhouse effect.

The patent with the publication number of ZL204194036U discloses a new slag grinding system, which consists of belt, air lock feeding valve, feeding hopper, reducer, vertical mill and belt conveyor. The advantages of this system include that the stable material bed can prevent vibration and slow down the wear of grinding roller and millstone, and four iron removal measures are set in the grinding process to fully recover metallic iron resources and protect grinding equipment.

Invention Summary

2020101153 26 Jun 2020

This invention aims to, at least to some extent, solve one of the above-mentioned technical problems in the prior art.

Therefore, one purpose of this invention is to provide a method for grinding to get slag micro-powder in stages, which grinds slag particles in stages by using a closed-circulation series grinding system composed of a vertical mill and a tube mill, so as to solve the problems of large energy consumption, low grinding efficiency and single particle gradation in the process of slag particle grinding. In the staged grinding process, the circulating iron removal process is set to protect the equipment and fully recover the iron resources. The realization of large-scale production can not only reduce the unit energy consumption, but also obtain high active slag powder and realize high added value utilization. For large-scale production, it can not only reduce unit energy consumption, but also obtain highly active slag micro-powder and realize the utilization of high added value.

In order to achieve the above purpose, this invention adopts the following technical proposal: a method for grinding to get slag micro-powder in stages, including the following steps:

(1) Feeding and iron removal: weigh the slag particles, remove the large metallic iron mixed in the slag with a suspended iron separator, and convey them to the feeding hopper;

(2) The first-stage grinding and iron removal: the slag particles enter the first-stage grinding system after iron removal, some of them are ground and separated to obtain the first fine particles and the first coarse particles, some of the slag particles leave the grinding system, enter the recycling system for iron removal, and return to the feeding hopper for circulating grinding and separation after iron removal. The separated described first coarse particles are mixed with the newly fed iron removed slag particles, and then enter into the first-stage grinding system again, thus forming the first-stage closed-circulation grinding; the described first fine particles form slag coarse-powder;

(3) The second-stage grinding: the slag coarse-powder obtained in Step (2) enters the second-stage grinding system for grinding and separation to obtain the second fine particles and the second coarse particles. The described second fine particles form the slag micro-powder, and the described second coarse particles return to the second-stage grinding system, thus forming the second-stage closed-circulation grinding.

It can be seen from the above technical proposal that, compared with the prior art, by the method provided by this invention for grinding to get slag micro-powder in stages to the public, the slag particles enter the first-stage grinding system after the mixed large metallic iron is removed by the suspended iron separator, which reduces the iron content in the slag, improves the efficiency of the first-stage grinding system and reduces the circulating load of the grinder;

2020101153 26 Jun 2020

it grinds the slag particles in stages by the way of series grinding composed of the first-stage grinding and the second-stage, which gives full play to the advantages of grinding in different stages. In addition, it removes iron circularly in real time in two stages of grinding, separates the metallic iron mixed in the slag for recycling and utilization, improves grinding efficiency, reduces system energy consumption and mill loss, and improves product performance.

Preferably, the first-stage grinding system described in Step (2) comprises a vertical mill, a drum iron separator, a recycling system and the first high efficiency powder concentrator. The specific first-stage grinding includes the following steps:

(1) The iron removed slag particles enter into the described vertical mill through the described feeding hopper and fall onto the millstone of the described vertical mill. The large slag particles falling onto the millstone are discharged by the overflow device around the described millstone part and enter the recycling system, in which the iron is removed by the drum iron separator. After iron removal, the large slag particles return to the feeding hopper, and then enter the vertical mill again through the feeding hopper to form the recycling circulation;

(2) The small slag particles falling onto the millstone are ground. After grinding, the slag particles are fed into the first high efficiency powder concentrator above the described vertical mill by hot air for separation. The separated described first fine particles are collected by a cyclone dust collector to form the slag coarse-powder. The separated described first coarse particles fall onto the horizontal millstone of the described vertical mill and are mixed with the newly fed iron removed slag particles, and the large slag particles in the mixture continue the recycling circulation in Step (1). The small slag particles in the mixture are ground and separated to finally obtain the slag coarse-powder formed by the described first fine particles.

In the first-stage grinding system, the closed-circulation iron removal and grinding are conducted on the iron-removed slag by the vertical mill, the recycling system, the drum iron separator and the first high efficiency powder concentrator. The advantages are that the “open material bed extrusion” principle of vertical mill makes grinding efficiency high, energy consumption low and more environmentally friendly; closed-circulation iron removal and grinding can reduce the circulating materials of the grinder and save energy consumption.

Preferably, the specific surface area of the described slag coarse-powder is 380m^2/kg-430m^2/kg, and the specific surface area of the described first coarse particles is less than 380m^2/kg.

Preferably, the described second-stage grinding system in Step (3) includes a tube mill and the second high efficiency powder concentrator. The slag coarse-powder obtained in Step (2) is ground by the described tube mill, the ground slag powder is separated by the described

2020101153 26 Jun 2020

second high efficiency powder concentrator, the separated described second fine particles are collected by the dust collector to form the slag micro-powder, and the described second coarse-particles return to the described tube mill for further grinding.

The beneficial effects of the second-stage grinding are as follows: the tube mill changes the particle shape of the first fine particles discharged from the vertical mill into sphere with good particle gradation; the two-stage tube mill extends the residence time of materials, which is helpful for ultrafine grinding; steel forging has a larger specific surface area, which increases the probability of contact with materials and grinding. Meanwhile, the grinding medium with more than 110% - 140% of the standard allocation is more conducive to improving the grinding efficiency of materials.

Preferably, the tube mill is a two-bin or three-bin tube mill. It has a length of 7-14.5m, a diameter of 2-4.6m, and a grinding medium of steel forging with a diameter of 1cm-3cm and a length of 2cm-6cm. The loading amount of the steel forging is 110% - 140% of the standard allocation.

Preferably, the slag micro-powder obtained in Step (3) has a specific surface area of 480m^2/kg-550m^2/kg, a water content of less than 1.0%, an iron content of less than 0.3%, a fluidity ratio of 102%, a 7d activity index of 95-%100%, a 28d activity index of 105-%120%, and a fluidity ratio≥100%.

The advantages of this invention include that the slag particles are ground in stages by the way of series grinding including the vertical mill in the first-stage grinding system and the tube mill in the second-stage grinding system. The vertical mill makes use of the principle of “material layer crushing”, which has the advantages in the first-stage grinding phase of millimeter level (to crush the material from 3mm-5mm to 0-0.5mm) that the principle of “impact grinding” of ball mill does not have; in the second-stage grinding stage of micron scale (from 80-100μm grinding to 0-40μm), compared with the small and medium-sized ball mill, tube mill has a smaller proportion of the retention area of ineffective grinding and a higher grinding efficiency, which gives the slag micro-powder the characteristics of spherical shape and good particle gradation, and it is beneficial to reduce the voidage and improve the strength in the hardened cement or concrete. Stage grinding gives full play to the advantages of vertical mill and tube mill. Staged grinding gives full play to the advantages of vertical mill and tube mill. In combination with the real-time circulating iron removal in the grinding process, it separates the metallic iron mixed in the slag for recycling and utilization, improves the grinding efficiency, reduces the system energy consumption and mill loss, and improves the product performance. By grinding slag with the series grinding system composed of a vertical mill and a tube mill, compared with the single vertical mill system, the energy consumption is reduced by 30% - 40%, the output is increased by 90% - 100%; compared with the single closed-circulation tube mill system, the energy consumption is reduced by 40% - 50%, and the output is increased by

2020101153 26 Jun 2020

20-30%.

Description of Drawings

In order to more clearly explain the technical proposals in the embodiments of this invention or in the prior art, the figures needed in the description of the embodiments or the prior art will be briefly introduced below. Obviously, the figures described below are only some of the embodiments of this invention. For the ordinary technicians in this field, other figures can be obtained according to these figures without any creative work.

Figure 1 The attached figure is a flow diagram of a method for grinding to get slag micro-powder in stages provided by this invention.

Detailed Description of the Presently Preferred Embodiments

The technical proposal in the embodiments of this invention will be described clearly and completely below. Obviously, the described embodiments are only part of the embodiments of this invention, not all of them. Based on the embodiments in this invention, all other embodiments obtained by the ordinary technicians in this field without creative work will fall into the scope of protection of this invention.

Embodiment 1

One of the traditional methods for grinding slag is the closed-circulation grinding of the vertical mill system, by which closed-circulation grinding is conducted on wet slag through the vertical mill system. The process is simple. All the technological processes of drying, grinding and separating are completed in the vertical mill. The specific process is as follows: The slag stacked in the raw material plant is taken and fed by the forklift, conveyed to the suspended iron separator by the conveyor belt. After large particle size iron is removed, slag enters the vertical mill through the weighing bin and the elevator for grinding. With the help of the hot air provided by the hot blast furnace, the ground slag is separated and dried by the high efficiency powder concentrator. The slag micro-powder with specific surface area ≥ 350m^2/kg is collected by the dust collector and is conveyed to the finished product warehouse by the air slide and elevator for storage. The slag products obtained through the vertical mill have relatively concentrated fineness range of particles, low specific surface area, poor particle gradation, and the particles of finished products are mostly flakes, which is not conducive to reducing the voidage of hardened cement and concrete, and is not conducive to the strength. Therefore, it is very important to improve the fineness of slag, particle morphology and particle gradation for improving the activity index of slag.

To solve the above problems, this invention provides a method for grinding to get slag micro-powder in stages, by which slag particles are ground in stages by using the closed-circulation series grinding system composed of a vertical mill and a tube mill. This

2020101153 26 Jun 2020

invention solves the problem of single particle gradation in the process of slag particle grinding, realizes the reduction of unit energy consumption, and obtains highly active slag micro-powder. The specific embodiment is as follows:

The slag is metered by belt scale and then conveyed to the drum iron separator for the first iron removal. The particle size of slag particles after the first iron removal is ≤5mm, and the water content is 8% - 12%. It is conveyed to the feeding hopper by the belt, enters the vertical mill and is sent to the millstone of the vertical mill for the first-stage grinding. The diameter of the vertical mill is 4.6m and the installed power is 3200kw. For the slag particles sent to the millstone of the vertical mill, when the millstone rotates, the large slag particles are discharged by the overflow device around the millstone part and enter the recycling system, in which the iron is removed by the drum iron separator. After iron removal, the large slag particles return to the feeding hopper, and then enter the vertical mill again through the feeding hopper to form the recycling circulation; the small slag particles falling onto the millstone are ground. After grinding, the slag particles are fed into the first high efficiency powder concentrator above the vertical mill by hot air for separation. The separated first fine particles are collected by a cyclone dust collector to form the slag coarse-powder. The separated first coarse particles fall onto the horizontal millstone of the vertical mill and are mixed with the newly fed iron removed slag particles, and the large slag particles in the mixture continue the above-mentioned recycling circulation. The small slag particles in the mixture are ground and separated to finally obtain the slag coarse-powder formed by the first fine particles. The specific surface area of slag coarse-powder is 380m^2/kg-430m^2/kg.

The formed slag coarse-powder enters into the second-stage grinding system and is ground by the tube mill. The tube mill is a two-bin closed-circulation tube mill with a diameter of 3.8m and a length of 13m, in which the grinding medium is steel forging with a diameter of 1cm-3cm and a length of 2cm-6cm. The loading amount of the steel forging is 110% - 140% of the standard allocation. After grinding, the slag is separated by the second high efficiency powder concentrator to separate the second fine particles and the second coarse-particles. The specific surface area of the second coarse-particles is less than 450m^2/kg. They return to the feeding port of the tube mill for further grinding to form the second closed-circulation. The specific surface area of the second fine particles is 500-550m^2/kg. They are collected by the dust collector to form the slag micro-powder. The highly active finished slag micro-powder with an average specific surface area of 530m^2/kg has a metallic iron content of 0.2%, a water content of 0.4%, a fluidity ratio of 102%, a 7-day activity index of 99% and a 28-day activity index of 113%. The comprehensive energy consumption of slag micro-powder produced according to this method is 45kW·h/t. Compared with the closed-circulation vertical grinding system, the overall energy consumption of slag grinding is reduced by 30% - 40%, and the output increased by 90% - 100%.

Embodiment 2

2020101153 26 Jun 2020

The second traditional method for grinding slag is the closed-circulation grinding of the ball mill system, by which the dried slag is conveyed to the large ball mill for grinding. After being dried by a ϕ3×20m dryer, the wet slag enters a ϕ 3×11m large ball mill for grinding, in which steel balls are used as all grinding medium in the large ball mill. The slag powder after grinding is separated by high efficiency powder concentrator. The coarse-powder returns to the ball mill through the conveyor belt for further grinding, which forms a closed-circulation grinding system. The separated fine powder is the slag micro-powder product with a specific surface area ≥450m^2/kg. Although the whole process is simple in operation and not costly in maintenance, the single ball mill grinding system has high unit energy consumption and low grinding efficiency. In addition, the grinding medium is all steel balls, which leads to "grinding-agglomeration" of slag powder when the grinding time is too long.

In view of the above problems, this invention provides a method for grinding to get slag micro-powder in stages, by which slag particles are ground in stages by using the closed-circulation series grinding system composed of a vertical mill and a tube mill, which solves the problem of large energy consumption and low grinding efficiency in the process of slag particle grinding, realizes the reduction of unit energy consumption, and obtains highly active slag micro-powder. The specific embodiment is as follows:

The slag is metered by belt scale and then conveyed to the drum iron separator for the first iron removal. The particle size of slag particles after the first iron removal is ≤5mm, and the water content is 8% - 15%. It is conveyed to the feeding hopper by the belt, enters the vertical mill and is sent to the millstone of the vertical mill for the first-stage grinding. The diameter of the vertical mill is 4.6m and the installed power is 3200kw. For the slag particles sent to the millstone of the vertical mill, when the millstone rotates, the large slag particles are discharged by the overflow device around the millstone part and enter the recycling system, in which the iron is removed by the drum iron separator. After iron removal, the large slag particles return to the feeding hopper, and then enter the vertical mill again through the feeding hopper to form the recycling circulation; the small slag particles falling onto the millstone are ground. After grinding, the slag particles are fed into the first high efficiency powder concentrator above the vertical mill by hot air for separation. The separated first fine particles are collected by a cyclone dust collector to form the slag coarse-powder. The separated first coarse particles fall onto the horizontal millstone of the vertical mill and are mixed with the newly fed iron removed slag particles, and the large slag particles in the mixture continue the above-mentioned recycling circulation. The small slag particles in the mixture are ground and separated to finally obtain the slag coarse-powder formed by the first fine particles. The specific surface area of slag coarse-powder is 380m^2/kg-430m^2/kg.

The formed slag coarse-powder enters into the second-stage grinding system and is ground by the tube mill. The tube mill is a two-bin closed-circulation tube mill with a diameter of 3.8m and a length of 13m, in which the grinding medium is steel forging with a diameter of 1cm-3cm

2020101153 26 Jun 2020

and a length of 2cm-6cm. The loading amount of the steel forging is 110% - 140% of the standard allocation. After grinding, the slag is separated by the second high efficiency powder concentrator to separate the second fine particles and the second coarse-particles. The specific surface area of the second coarse-particles is less than 450m^2/kg. They return to the feeding port of the tube mill for further grinding to form the second closed-circulation. The specific surface area of the second fine particles is 500-550m^2/kg. They are collected by the dust collector to form the slag micro-powder. The highly active finished slag micro-powder with an average specific surface area of 530m^2/kg has a metallic iron content of 0.2% , a water content of 0.4%, a fluidity ratio of 102%, a 7-day activity index of 99% and a 28-day activity index of 113%. The comprehensive energy consumption of slag micro-powder produced according to this method is 45kW·h/t. Compared with the single closed-circulation tube mill system, the energy consumption is reduced by 40%-50%, and the output is increased by 20-30%.

Each embodiment in these instructions is described in a progressive manner. Each embodiment focuses on the differences from other embodiments. The same and similar parts of each embodiment can be referred to each other. As for the devices disclosed in the embodiments, since they correspond to the method disclosed in the embodiments, the descriptions are somewhat simple, and for the relevant points, please refer to the description of the method.

The above description of the disclosed embodiments enables the professional and technical personnel in this field to embody or use this invention. All kinds of modifications to these embodiments will be apparent to the professional and technical personnel in this field. The general principles defined herein may be embodied in other embodiments without deviating from the spirit or scope of this invention. Therefore, this invention will not be limited to the embodiments shown herein, but shall conform to the widest scope consistent with the principles and novel features disclosed herein.

2020101153 26 Jun 2020

Claims

1. A method for grinding to get slag micro-powder in stages, characterized in that it includes the follows steps:

(1) Feeding and iron removal: weigh the slag particles, remove the large metallic iron mixed in the slag with a suspended iron separator, and convey them to the feeding hopper;

(2) The first-stage grinding and iron removal: the slag particles enter the first-stage grinding system after iron removal, some of them are ground and separated to obtain the first fine particles and the first coarse particles, some of the slag particles enter the recycling system for circulating iron removal, and return to the feeding hopper for circulating grinding and separation l. The separated described first coarse particles are mixed with the newly fed iron removed slag particles, and then enter into the first-stage grinding system again, thus forming the first-stage closed-circulation grinding; In this way, slag coarse-powder is formed in the first-stage grinding and iron removal process.

(3) The second-stage grinding: the slag coarse-powder obtained in Step (2) enters the second-stage grinding system for grinding and separation to obtain the second fine particles and the second coarse particles. The described second fine particles form the slag micro-powder, and the described second coarse particles return to the second-stage grinding system, thus forming the second-stage closed-circulation grinding.

2. The method for grinding to get slag micro-powder in stages according to Claim 1 is characterized in that the first-stage grinding system described in Step (2) comprises a vertical mill, a drum iron separator, a recycling system and the first high efficiency powder concentrator. The specific first-stage grinding includes the following steps:

(1) The iron removed slag particles enter into the described vertical mill through the described feeding hopper and fall onto the millstone of the described vertical mill. The large slag particles falling onto the millstone are discharged by the overflow device around the described millstone part and enter the recycling system, in which the iron is removed by the drum iron separator. After iron removal, the large slag particles return to the feeding hopper, and then enter the vertical mill again through the feeding hopper to form the recycling circulation;

(2) The small slag particles falling onto the millstone are ground. After grinding, the slag particles are fed into the first high efficiency powder concentrator above the described vertical mill by hot air for separation. The separated described first fine particles are collected by a cyclone dust collector to form the slag coarse-powder. The separated described first coarse particles fall onto the horizontal millstone of the described vertical mill and are mixed with the newly fed iron removed slag particles, and the large slag particles in the mixture continue the

2020101153 26 Jun 2020

recycling circulation in Step (1). The small slag particles in the mixture are ground and separated to finally obtain the slag coarse-powder formed by the described first fine particles.

3. The method for grinding to get slag micro-powder in stages according to Claim 2 is characterized in that the specific surface area of the described slag coarse-powder is 380m^2/kg-430m^2/kg, and the specific surface area of the described first coarse particles is less than 380m^2/kg.

4. The method for grinding to get slag micro-powder in stages according to Claim 1 is characterized in that the described second-stage grinding system in Step (3) includes a tube mill and the second high efficiency powder concentrator. The slag coarse-powder obtained in Step (2) is ground by the described tube mill, the ground slag powder is separated by the described second high efficiency powder concentrator, the separated described second fine particles are collected by the dust collector to form the slag micro-powder, and the described second coarse-particles return to the described tube mill for further grinding.

5. The method for grinding to get slag micro-powder in stages according to Claim 4 is characterized in that the described tube mill is a two-bin or three-bin tube mill. It has a length of 7m-14.5m, a diameter of 2m-4.6m, and a grinding medium of steel forging with a diameter of 1cm-3cm and a length of 2cm-6cm. The loading amount of the described steel forging is 110% - 140% of the standard allocation.

6. The method for grinding to get slag micro-powder in stages according to Claim 4 is characterized in that the slag micro-powder obtained in Step (3) has a specific surface area of 480m^2/kg-550m^2/kg, a water content of less than 1.0%, an iron content of less than 0.3%, and a fluidity ratio of 102%.

2020101153 26 Jun 2020

Drawings of Descriptions

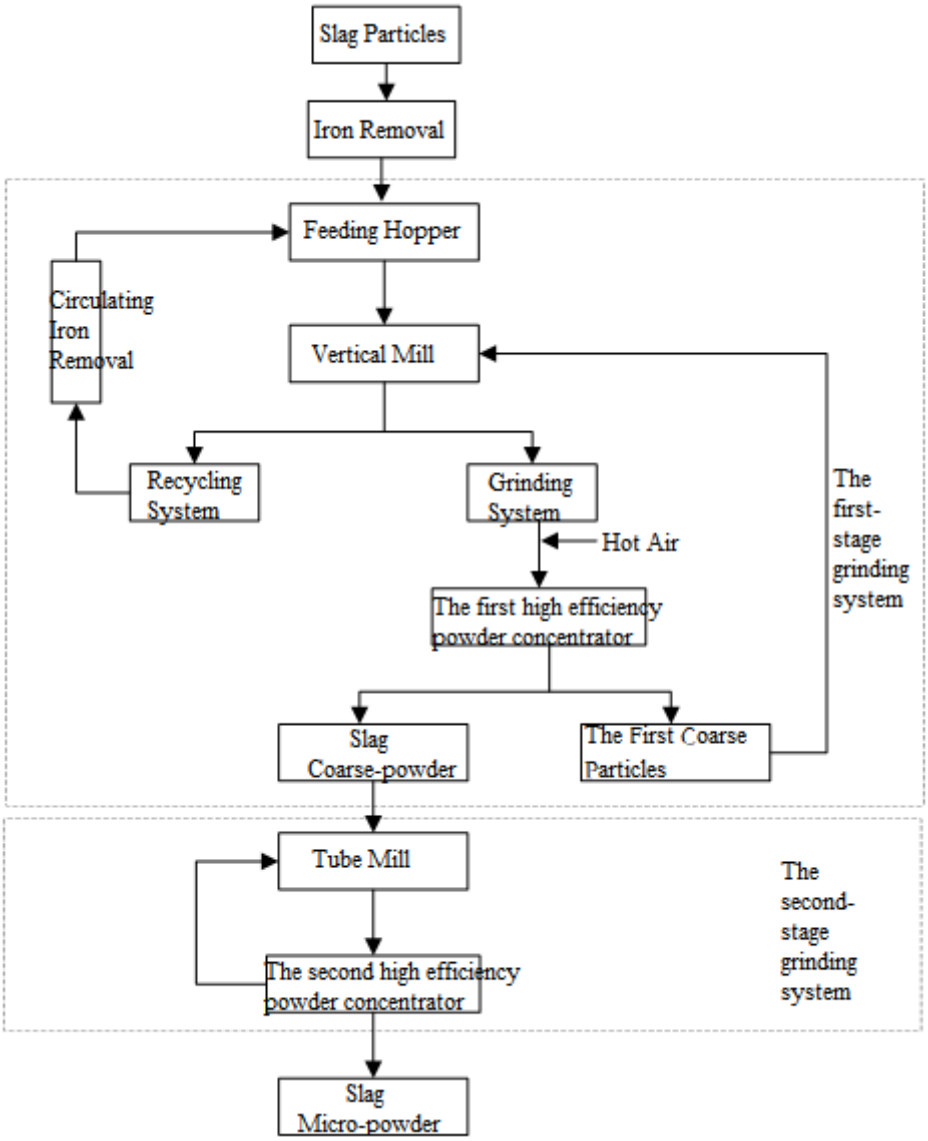

FIG. 1