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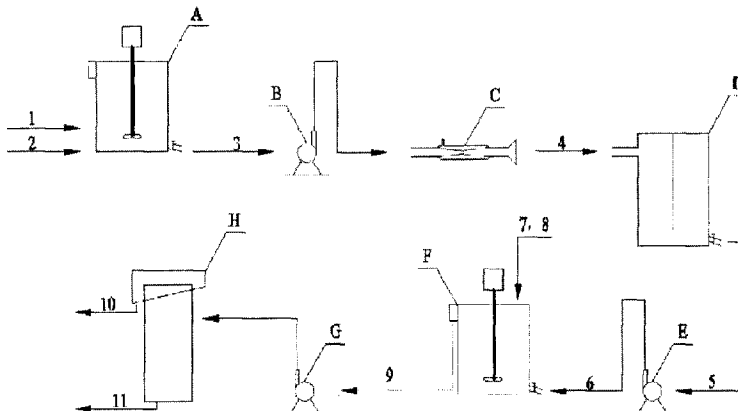
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(54) Titre : PROCEDE DE FLOTTATION POUR CHARBON A FAIBLE FLOTTAISON

(54) Title: FLOTATION METHOD FOR COAL HAVING POOR FLOATATION



(57) **Abrégé/Abstract:**

A flotation method for a coal comprises: supplying, by means of a pump (E), a solution containing nanobubbles (5) to a mineral slurry mixing tank (F), and simultaneously supplying coal (7) and a flotation reagent (8) to the mineral slurry mixing tank (F); and supplying, by means of a material feeding pump (G), a mineral slurry mixture (9) to a countercurrent static micro-bubble flotation column (H) to undergo floatation, thereby obtaining two resulting products, a fine coal (10) and a tailing (11). The method utilizes a property of nanobubbles that the same preferentially gather at a hydrophobic surface, increasing the difference in hydrophobicity between the fine coal and coal gangue. The gathering of the nanobubbles also significantly reduces a fine mud covering a coal particle surface, thereby greatly reducing contamination caused by the fine mud, and increasing a recycling rate of the fine coal.

Abstract

A flotation method for a coal comprises: supplying, by means of a pump (E), a solution containing nanobubbles (5) to a mineral slurry mixing tank (F), and simultaneously supplying coal (7) and a flotation reagent (8) to the mineral slurry mixing tank (F); and supplying, by means of a material feeding pump (G), a mineral slurry mixture (9) to a countercurrent static micro-bubble flotation column (H) to undergo floatation, thereby obtaining two resulting products, a fine coal (10) and a tailing (11). The method utilizes a property of nanobubbles that the same preferentially gather at a hydrophobic surface, increasing the difference in hydrophobicity between the fine coal and coal gangue. The gathering of the nanobubbles also significantly reduces a fine mud covering a coal particle surface, thereby greatly reducing contamination caused by the fine mud, and increasing a recycling rate of the fine coal.

Description

FLOTATION METHOD FOR COAL HAVING POOR FLOTATION

I. Technical field

The present application relates to a coal slime flotation technique, particularly provides a flotation method for coal slime having poor flotation.

II. Background Art

As the degree of mechanization of coal mining is improved, the geologic conditions of the resources are deteriorated, the coal flotation plants are upsized and heavy-medium flotation techniques are widely applied in China, the proportion of high-ash coal slime having poor flotation is increased sharply and exhibits a further worse trend, and the contradictions in coal slime flotation are more prominent. At present, flotation is one of the major measures for treating coal slime. In a conventional flotation process, coal particles with better hydrophobicity collide with the bubbles, adhere to the bubbles and float up with the bubbles to the froth phase, to become flotation fine coal finally; gangue particles with poorer hydrophobicity are returned to the coal pulp, because the gangue particles are more difficult to adhere to the bubbles, or the gangue particles are captured by the bubbles in the pulp but the bubbles in the froth phase are ruptured or permeated. However, it is difficult to achieve efficient flotation for high-ash coal slime having poor flotation in a conventional flotation process, because, on one hand, the high-ash coal slime having poor flotation are difficult to capture by the bubbles in the mineralization process of the bubbles and consequently results in loss of cleaned coal owing to the poor hydrophobicity of the coal slime; on the other hand, the high-ash coal slime having poor flotation may easily cover the surfaces of low-ash coal particles in the pulping process and consequently results in severe contamination to the flotation cleaned coal owing to the high ash content and high fine slime content in the coal slime.

In view of the problem of low flotation efficiency of coal slime having poor flotation, many experts and researches in China and foreign countries have made a lot of beneficial researches, which are generally classified into several aspects, including development of new chemical reagents, improvement of existing separation processes and improvement of separation performance of the equipment, etc., for example, dispersers or the like are added to reduce the coverage of fine slime on the surfaces of coal particles, thereby attaining the purpose of reducing the ash content in the flotation cleaned coal; the original chemical reagents are emulsified and then added into the pulp, so as to increase the specific surface area of the collecting agent, thereby improving the flotation effect by means of further dispersion of the oil drops; and flotation is carried out with low-concentration feed material on the basis of the intrinsic characteristics of coal slime, etc. Those efforts have attained some effects in improvement of flotation efficiency of coal slimes having poor flotation, but cannot solve the problem of low flotation efficiency of coal slime having poor flotation from the root. Therefore, there is an urgent need for a novel flotation technique, which can overcome the drawbacks in the existing coal slime flotation techniques in flotation of coal slime having poor flotation and realize efficient separation and recovery of coal slime having poor flotation.

The key to the flotation of coal slime having poor floatation is collision of to bubbles and adherence to the bubbles. Nanobubbles have a characteristic of accumulation on the surfaces of coal particles with better hydrophobic in precedence, which can increase the probability of particle collision with bubbles and adherence to the bubbles and decrease the probability of particle fall-off, thereby remarkably improving the recovery efficiency of coal slime having poor floatation. Besides, owing to the coverage of nanobubbles on the surfaces of coal particles, the coverage effect of fine slime is greatly weakened, and the contamination of fine weakened to the flotation cleaned coal is effectively mitigated. On this basis, the present application provides a method for enhancing the flotation process of coal slime having poor floatation by introducing bubbles in diameter of about tens of nanometers in the flotation process of coal slime having poor floatation, which greatly improves the recovery efficiency of coal slime having poor floatation.

III. Contents of the Invention

The object of the present invention is to provide a flotation method for coal slime having poor floatation, and by introducing nanobubbles into the flotation, radically, the problem of low flotation recovery efficiency of coal slime having poor floatation incurred by the poor hydrophobicity of the coal slime having poor floatation is solved.

The technical solution of the present application is as follows:

A flotation method for coal slime having poor floatation, comprising the following steps: supplying a solution containing nanobubble (5) into a mineral slurry mixing tank(F) by means of a pump (E), and simultaneously supplying an appropriate amount of coal slime (7) and a flotation reagent (8) into the mineral slurry mixing tank (F), so that the nanobubbles are accumulated on the surfaces of the particles and the hydrophobicity of the coal particles is greatly improved; supplying a mineral slurry mixture (9) to a countercurrent static micro-bubble flotation column (H) by means of a material feeding pump (G) to undergo flotation, thereby obtaining two products, a cleaned coal (10) and a tailing (11). The flotation reagent is composed of the following components by weight: kerosene: 20-80pbw, isopropyl ethyl thionocarbamate: 5-13pbw, Tween 40: 1-10pbw, sodium alcohol ether sulphate: 0.01-0.05pbw, p-toluene sulfonic acid: 0.01-0.07pbw, Span 60: 1-3pbw, phthalic anhydride: 1-3pbw, sodium dodecyl benzene sulfonate: 0.03-0.1pbw, and benzene anhydride: 0.01-0.06pbw.

Furthermore, the coal slime is in size of 325-mesh.

Furthermore, the frothing agent is secondary octanol.

Furthermore, the solution containing nanobubble may be prepared easily by the following steps: supplying water (2) and a frothing agent (1) into an agitation barrel (A), after mixing, supplying the mixture (3) via a mixture feeding pump (B) into a Venturi tube (C), so that air is dissolved in the mixture under the action of negative pressure generated by a jet stream and a large quantity of bubbles are generated at the tail end of the Venturi tube (C); supplying a solution containing bubbles (4) to the upper part of a defrothing barrel (D) which is divided into two parts by a baffle plate mounted at the middle of the defrothing barrel, wherein the two parts are only communicated by the lower part; injecting the nanobubbles with the solution into the upper part of the defrothing barrel at one side and then to the other side of the defoaming barrel (D) through a communication channel in the lower part; large-size bubbles in the mixture float up to the upper part of the defrothing barrel under the action of buoyancy and are

ruptured gradually, such that after the bubbles generated in the Venturi tube (C) pass through the defrothing barrel (D), large-size bubbles are removed and nanobubbles are left in the solution.

Furthermore, the defrothing barrel (D) is a conventional cylindrical barrel, which is divided into two parts by a baffle plate mounted at the middle part of the barrel, wherein the two parts are only communicated with each other at the lower part; the nanobubbles are injected along with the solution from the upper part of the defrothing barrel at one side, and flow to the other side of the defrothing barrel through a communication channel in the lower part.

Furthermore, the mixture ratio of the water and the frothing agent is 0.01-0.1g of frothing agent per liter of water; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is 60-90g of dry coal slime and 0.01-0.04g of flotation reagent per liter of solution containing nanobubble.

Furthermore, the flotation reagent is composed of the following components by weight: kerosene: 76pbw, isopropyl ethyl thionocarbamate: 9pbw, Tween 40: 7pbw, sodium alcohol ether sulphate: 0.03pbw, p-toluene sulfonic acid: 0.02pbw, Span 60: 2.1pbw, phthalic anhydride: 1.6pbw, sodium dodecyl benzene sulfonate: 0.07pbw, and benzene anhydride: 0.03pbw.

Furthermore, the flotation reagent is composed of the following components by weight: kerosene: 48pbw, isopropyl ethyl thionocarbamate: 9pbw, Tween 40: 3pbw, sodium alcohol ether sulphate: 0.045pbw, p-toluene sulfonic acid: 0.046pbw, Span 60: 2.6pbw, phthalic acid anhydride: 1.7pbw, sodium dodecyl benzene sulfonate: 0.067pbw, and phthalic anhydride: 0.022pbw.

Furthermore, the mixture ratio of the water and the frothing agent is 0.016g of frothing agent per liter of water; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is 80g of dry coal slime and 0.024g of flotation reagent per liter of solution containing nanobubble.

The present application overcomes the drawbacks in the conventional flotation techniques for coal slime having poor floatation, and provides a flotation method for coal slimes having poor floatation on the basis of nanobubbles, which utilizes the characteristic of nanobubbles (i.e., accumulation on hydrophobic surfaces in precedence) to increase the difference in hydrophobicity between low-ash particles and high-ash gangue, and solves the problems of poor selectivity, high chemical reagent consumption, low recovery efficiency, and out-of-specification of ash content in cleaned coal in the flotation process of coal slime having poor floatation. Besides, the method provided in the present application has the following advantages:

The flotation method provided in the present invention employs an innovative and unique idea for improving the selectivity in flotation of coal slime having poor floatation, solves the problem of low efficiency in the conventional froth flotation process, and is of great significance to the realization of an efficient flotation process of coal slime having poor floatation.

The flotation reagents are optimized in the present application; especially, the design and mixture ratio of flotation reagent ease the flotation of coal slime having poor floatation, improve flotation efficiency, and attain an obviously better effect over conventional flotation reagents.

The present application employs a specially designed defrothing barrel, in which a large quantity of nanobubbles can be generated. Though the defrothing barrel appears to be simple, it can attain high efficiency for removing large-size bubble, and improve production efficiency.

In summary, the flotation method and apparatus provided in the present application are simple, involve less investment and less operation cost, and can achieve remarkable economic benefits.

IV. Description of Drawings

Fig. 1 is a schematic diagram of the method according to the present application.

In the figures: 1 - frothing agent; 2 - water; 3 - mixture of frothing agent and water; 4 - bubble mixture; 5, 6 - solution containing nanobubble; 7 - coal slime; 8 - flotation reagent; 9 - mineral slurry mixture after pulping; 10 - flotation cleaned coal; 11 - flotation tailing; A - agitation barrel; B - mixture feeding pump; C - Venturi tube; D - self-made defrothing barrel for large bubble; E - nanobubble-containing solution feeding pump; F - mineral slurry agitating tank; G - mineral slurry feeding pump; H - flotation column

V. Embodiments

Hereunder the preferred embodiments of the present application are described in detail with reference to the accompanying drawings, wherein the drawings constitute a part of the present application and are used in conjunction with the embodiments of the present application to illustrate the principle of the present application.

Embodiment 1

As shown in Fig. 1, water (2) and secondary octanol frothing agent (1) are supplied into an agitation barrel (A) and mixed at a mixture ratio of 0.07g of frothing agent per liter of water; after mixing, the mixture (3) is supplied via a mixture feeding pump (B) into a Venturi tube (C), so that air is dissolved in the mixture under the action of negative pressure generated by a jet stream and a large quantity of bubbles are generated at the tail end of the Venturi tube (C); the solution containing bubble (4) is supplied to the upper part of a defrothing barrel (D), which is divided into two parts by a baffle plate mounted at the middle part of the defrothing barrel, wherein the two parts are only communicated at the lower part; the nanobubbles flow along with the solution to the right side of the defrothing barrel (D) via a communication channel in the lower part, thus large-size bubbles in the mixture float up to the upper part of the defrothing barrel under the action of buoyancy and are ruptured gradually, such that after the bubbles generated in the Venturi tube (C) pass through the defrothing barrel (D), large-size bubbles are removed and nanobubbles are left in the solution; the solution containing nanobubble (5) is supplied into a mineral slurry agitating tank (F) by means of a pump (E), and an appropriate amount of 325-mesh coal slime (7) and a flotation reagent (8) are supplied into the mineral slurry agitating tank (F) simultaneously; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is determined as 77g of dry coal slime and 0.018g of flotation reagent per liter of solution containing nanobubble; since the nanobubbles are accumulated on the surfaces of the particles, the hydrophobicity of the coal particles is greatly improved; the mineral slurry mixture after pulping (9) is supplied into a countercurrent static micro-bubble flotation column (H) by means of a material feeding pump (G) to undergo flotation, and finally

two products (cleaned coal (10) and tailing (11)) are produced;

The flotation reagent is composed of the following components by weight: kerosene: 55pbw, isopropyl ethyl thionocarbamate: 8.6pbw, Tween 40: 5.6pbw, sodium alcohol ether sulphate: 0.027pbw, p-toluene sulfonic acid: 0.033pbw, Span 60: 2.68pbw, phthalic anhydride: 2.6pbw, sodium dodecyl benzene sulfonate: 0.055pbw, and benzene anhydride: 0.04pbw.

Embodiment 2

As shown in Fig. 1, water (2) and secondary octanol (1) are supplied into an agitation barrel (A) and mixed at a mixture ratio of 0.033g of frothing agent per liter of water; after mixing, the mixture (3) is supplied via a mixture feeding pump (B) into a Venturi tube (C), so that air is dissolved in the mixture under the action of negative pressure generated by a jet stream and a large quantity of bubbles are generated at the tail end of the Venturi tube (C); the solution containing bubble (4) is supplied to the upper part of a defrothing barrel (D), which is divided into two parts by a baffle plate mounted at the middle part of the defrothing barrel, wherein the two parts are only communicated at the lower part; the nanobubbles flow along with the solution to the right side of the defrothing barrel (D) via a communication channel in the lower part, thus large-size bubbles in the mixture float up to the upper part of the defrothing barrel under the action of buoyancy and are ruptured gradually, such that after the bubbles generated in the Venturi tube (C) pass through the defrothing barrel (D), large-size bubbles are removed and nanobubbles are left in the solution; the solution containing nanobubble (5) is supplied into a mineral slurry agitating tank (F) by means of a pump (E), and an appropriate amount of 325-mesh coal slime (7) and a flotation reagent (8) are supplied into the mineral slurry agitating tank (F) simultaneously; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is determined as 80g of dry coal slime and 0.027g of flotation reagent per liter of solution containing nanobubble; since the nanobubbles are accumulated on the surfaces of the particles, the hydrophobicity of the coal particles is greatly improved; the mineral slurry mixture after pulping(9) is supplied into a countercurrent static micro-bubble flotation column (H) by means of a material feeding pump (G) to undergo flotation, and finally two products (cleaned coal (10) and tailing (11)) are produced;

The flotation reagent is composed of the following components by weight: kerosene: 65pbw, isopropyl ethyl thionocarbamate: 5.65pbw, Tween 40: 2.2pbw, sodium alcohol ether sulphate: 0.026pbw, p-toluene sulfonic acid: 0.044pbw, Span 60: 1.26pbw, phthalic anhydride: 2.1pbw, sodium dodecyl benzene sulfonate: 0.034pbw, and benzene anhydride: 0.026pbw.

While the present application has been illustrated and described with reference to some preferred embodiments above, the scope of protection of the present application is not limited thereto. The person skilled in the art should recognize that various modifications and replacements that can be made within the technical scope disclosed by the present application should be deemed as included by the scope of protection of the present application.

Claims

1. A flotation method for coal slime, comprising the following steps: supplying a solution containing nanobubble (5) into a mineral slurry agitating tank (F) by means of a pump (E), and supplying coal slime (7) and a flotation reagent (8) into the mineral slurry agitating tank (F), so that the nanobubbles are accumulated on particle surfaces and the hydrophobicity of coal particles is improved; supplying mineral slurry mixture after pulping (9) to a counter-current static micro-bubble flotation column (H) via a feeding pump (G) by means of a material feeding pump (G) to undergo flotation, thereby obtaining two products, a cleaned coal (10) and a tailing (11), wherein, the flotation reagent is composed of the following components by weight: kerosene: 20-80pbw, isopropyl ethyl thionocarbamate: 5-13pbw, Tween 40: 1-10pbw, sodium alcohol ether sulphate: 0.01-0.05pbw, p-toluene sulfonic acid: 0.01-0.07pbw, Span 60: 1-3pbw, phthalic anhydride: 1-3pbw, sodium dodecyl benzene sulfonate: 0.03-0.1pbw, and benzene anhydride: 0.01-0.06pbw; wherein, the solution containing nanobubble is prepared by the following steps: supplying water (2) and a frothing agent (1) into an agitation barrel (A), after mixing, supplying the mixture (3) via a mixture feeding pump (B) into a Venturi tube (C), so that air is dissolved in the mixture under the action of negative pressure generated by a jet stream and a large quantity of bubbles are generated at a tail end of a Venturi tube (C); supplying a bubble-containing solution (4) to an upper part of a defrothing barrel (D) which is divided into two parts by a baffle plate mounted at the middle part of the defrothing barrel, wherein the two parts are only communicated at a lower part; injecting the nanobubbles along with the solution into the upper part of the defrothing barrel at one side and then to the other side of a defoaming barrel (D) through a communication channel in the lower part; large-size bubbles in the mixture float up to the upper part of the defrothing barrel under the action of buoyancy and are ruptured gradually, such that after the bubbles generated in the Venturi tube (C) pass through the defrothing barrel (D), large-size bubbles are removed and nanobubbles are left in the solution.
2. The method according to claim 1, wherein, the coal slime is in size of 325-mesh.
3. The method according to any one of claims 1 or 2, wherein, the frothing agent is secondary octanol.

4. The method according to claim 1 wherein, the defrothing barrel (D) is a conventional cylindrical barrel, which is divided into two parts by a baffle plate mounted at the middle part of a barrel, wherein the two parts are only communicated at the lower part; the nanobubbles are injected along with the solution from the upper part of the defrothing barrel at one side, and flow to the other side of the defrothing barrel (D) through the communication channel in the lower part.

5. The method according to claim 1, wherein, a mixture ratio of the water and the frothing agent is 0.01g-0.1g of frothing agent per liter of water; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is 60g-90g of dry coal slime and 0.01g-0.04g of flotation reagent per liter of solution containing nanobubble.

6. The method according to claim 1, wherein, the flotation reagent is composed of the following components by weight: kerosene: 76pbw, isopropyl ethyl thionocarbamate: 9pbw, Tween 40: 7pbw, sodium alcohol ether sulphate: 0.03pbw, p-toluene sulfonic acid: 0.02pbw, Span 60: 2.1pbw, phthalic anhydride: 1.6pbw, sodium dodecyl benzene sulfonate: 0.07pbw, and benzene anhydride: 0.03pbw.

7. The method according to claim 1, wherein, the flotation reagent is composed of the following components by weight: kerosene: 48pbw, isopropyl ethyl thionocarbamate: 9pbw, Tween 40: 3pbw, sodium alcohol ether sulphate: 0.045pbw, p-toluene sulfonic acid: 0.046pbw, Span 60: 2.6pbw, phthalic anhydride: 1.7pbw, sodium dodecyl benzene sulfonate: 0.067pbw, and benzene anhydride: 0.022pbw.

8. The method according to claim 5, wherein, the mixture ratio of the water and the frothing agent is 0.016g of frothing agent per liter of water; the mixture ratio of the solution containing nanobubble, the coal slime and the flotation reagent is 80g of dry coal slime and 0.024g of flotation reagent per liter of solution containing nanobubble.

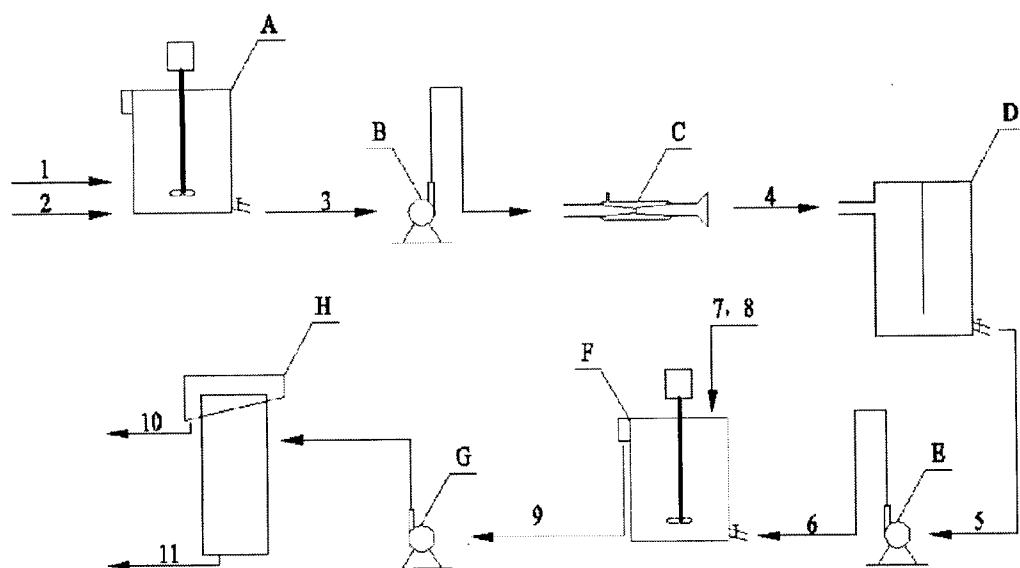


Fig. 1

