(51) International Patent Classification:
B03D 1/16 (2006.01) B01F 15/00 (2006.01)
(21) International Application Number:
PCT/K2014/050912
(22) International Filing Date:
26 November 2014 (26.1.2014)
(25) Filing Language:
English
(26) Publication Language:
English
(30) Priority Data:
20136197 29 November 2013 (29.11.2013) FI
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(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, TR), WO.

Title: GAS FEED SYSTEM FOR A FLOTATION MACHINE AND METHOD FOR PREVENTING ITS GAS OUTLET BLOCKING

Abstract: A gas feed system for a flotation machine comprises a rotary shaft (1) including a gas feed duct (2) inside it, a gas inlet pipe (3) connected to the upper end of the rotary shaft (1), a rotor (4) connected to the lower end of the rotary shaft (1), and a plurality of gas distribution apertures (5) provided in the rotor (4) for introducing flotation gas into the flotation cell. A liquid inlet pipe (6) is provided in connection with the gas feed duct (2) to permit flushing of the gas feed duct (2) and gas distribution apertures (5) in order to prevent their blocking during the operation of the flotation machine. The method comprises the steps of connecting a liquid inlet pipe (6) in flow communication with the gas feed duct (2) and feeding liquid into the gas feed duct (2) to prevent blocking of the gas feed duct (2) and gas distribution apertures (5) during the operation of the flotation cell.

Published:

Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(H))

— with international search report (Art. 21(3))
GAS FEED SYSTEM FOR A FLOTATION MACHINE AND METHOD FOR PREVENTING ITS GAS OUTLET BLOCKING

FIELD OF THE INVENTION

The invention relates to a gas feed system for a flotation machine, which comprises a rotary shaft including a gas feed duct inside it, a gas inlet pipe connected to the upper end of the gas feed duct, a rotor fixed to the lower end of the rotary shaft, and a plurality of gas distribution apertures provided in the rotor for introducing flotation gas into the flotation cell of the flotation machine.

The invention also relates to a method for preventing blocking of the gas feed system in a flotation cell.

BACKGROUND OF THE INVENTION

A flotation machine that can be used in mineral processing for recovery of valuable minerals from ore slurry consists of a flotation cell and a flotation mechanism. The flotation mechanism comprises a vertical shaft, which is operationally connected to a driver, for example an electric motor, at the upper end and to a rotor at the lower end. The vertical shaft is often provided with an internal gas feed duct for supplying gas into the slurry contained in the flotation cell. The rotor is provided with a plurality of gas distribution apertures through which gas is introduced into the slurry while the rotor is rotated.

During the operation of the flotation machine, the rotor is rotated to keep the slurry in motion and flotation gas is fed into the slurry through the gas feed duct to create gas bubbles in the slurry. As a consequence of mixing and gas feeding, a part of the slurry that contains desired minerals is flotated.
The flotated part of the slurry is removed from the flotation cell as an overflow, whereas the non-flotated part of the slurry is removed through an outlet in the lower part of the flotation cell.

During the operation of the flotation machine, the gas distribution apertures of the rotor and the lower part of the gas feed duct, which are in contact with the mineral slurry, can be contaminated and, in the worst case, blocked by solids from the slurry. The risk of blocking increases when the consistency (solids content) of the slurry is very high, or when the feed is enriched with lime and sulfuric acid, which leads to gypsum precipitation in the flotation cell, or when the gas pressure in the gas feed duct is lower than the slurry pressure. Also prolonged dirt accumulation, or dirt pushing from the top down into the hollow shaft can lead to blocking of modern rotor shaft structures. In general, if there is a stable and undisturbed interface between the slurry and gas in the gas feed duct, the slurry surface tends to dry and solids can be deposited on the surfaces of the gas feed duct, thus blocking the gas supply to the flotation cell.

Currently, the most common way to solve the blocking of the rotor shaft in large flotation cells is to dismantle the flotation mechanism and to clean the hollow rotor shaft while in a horizontal position in a workshop. This kind of cleaning procedure increases the downtime of the flotation cell. Removal of the flotation mechanism from the flotation cell takes a lot of time and resources, and an overhead crane is required for lifting the flotation mechanism.

Consequently, there is an obvious need to solve and prevent the blocking of the rotor shaft online without the need to remove the flotation mechanism from the flotation cell.
OBJECTIVE OF THE INVENTION

Briefly, it is an objective of the present invention to eliminate the problems of the prior art. More precisely, it is an object of the present invention to reduce the number of maintenance breaks and to increase the operation time of a flotation machine.

A further object of the present invention is to prevent blocking of a gas feed system of a flotation cell without the need to remove the flotation mechanism from the flotation cell.

SUMMARY OF THE INVENTION

The gas feed system for a flotation machine is characterized by what is presented in claim 1.

The method for preventing blocking of the gas feed system is characterized by what is presented in claim 3.

A gas feed system for a flotation machine comprises a rotary shaft including a gas feed duct inside it, a gas inlet pipe connected to the upper end of the gas feed duct, a rotor fixed to the lower end of the rotary shaft, and a plurality of gas distribution apertures provided in the rotor for introducing flotation gas into the flotation cell of the flotation machine. In the present invention, a liquid inlet pipe is provided in connection with the gas feed duct to permit flushing of the gas feed duct and gas distribution apertures in order to prevent their blocking during the operation of the flotation machine.

The method for preventing blocking of the gas feed system in a flotation cell comprises the steps of connecting a liquid inlet pipe in flow communication with the gas feed duct and feeding liquid into the gas feed duct to prevent blocking of the gas feed duct and
gas distribution apertures during the operation of the flotation cell.

Preferably, the liquid inlet pipe is connected to the gas inlet pipe. Alternatively, it can also be possible to connect the liquid inlet pipe directly to the gas feed duct.

According to one embodiment of the present invention, gas and liquid are fed at the same time into the gas feed duct.

According to one embodiment of the present invention, liquid is continuously fed into the gas feed duct as a precautionary measure.

According to another embodiment of the present invention, liquid is periodically fed into the gas feed duct, either as a precautionary measure or when need arises.

Periodical or continuous flushing of the rotor shaft can be carried out as a preventive measure, for instance daily or hourly together with gas feed to prevent blockages in the lower parts of the gas feed system.

In assisting mode, flushing of the gas feed duct should be practiced, for instance, when gas feed to the flotation cell is stopped and slurry is drained, or when the rotor is stopped and slurry is drained. Flushing of the rotor shaft should also be practiced over periods of prolonged stoppages of gas feed or rotor or both.

The pressure in the liquid inlet pipe should be the same or slightly higher than the pressure of the process gas in the gas inlet pipe. Liquid flushing through the process gas feed pipe can be activated either manually or automatically. Automatic control can be a part of the PID loop measuring the gas feed flow and the pressure of the process gas (gas flow and pressure meter installed as preset). If the gas feed flow drops below a certain threshold value, liquid
feed can be activated, and the response in the flow measurement is monitored. Information about the gas feed pressure is used for adjusting the flushing liquid feed pressure. In case liquid flushing does not solve the issue, the operator receives an invitation to check the process gas in the gas feed line.

Benefits of the proposed method are plural. Online cleaning of the gas supply shaft can be carried out without removal of the flotation mechanism, which leads to savings in downtime. The method allows preventive cleaning of the gas supply shaft so that the maintenance of operation performance can be ensured through better gas supply. The need for flushing liquid in the entire cell can be reduced. Last but not least, the new method reduces downtime of the flotation cells caused by maintenance tasks.

The new method is especially valuable for flotation operations in which the feed density of the slurry is too high, the solids content of the slurry is excessively high, the slurry feed is enriched with lime and sulfuric acid, leading to gypsum precipitation in the flotation cell, housekeeping is not at a good level on the site, or the experience of the site operator and maintenance personnel is on a low level.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Figure 1 shows a flotation mechanism with a gearbox drive, provided with means for preventing the blocking of a gas feed system.
Figure 2 shows a flotation mechanism with a belt drive, provided with means for preventing the blocking of a gas feed system.

5 DETAILED DESCRIPTION OF THE INVENTION

Figure 1 shows a flotation mechanism which is intended to be placed in the flotation cell of a flotation machine. The flotation mechanism comprises a hollow rotor shaft 1, a rotor 4 mounted at the lower end of the rotor shaft 1, and a gas inlet pipe 3 connected to the upper end of the rotor shaft 1. The flotation mechanism also comprises an electric motor 7 connected through a gearbox to the upper end of the rotor shaft 1 for bringing the rotor shaft 1 into rotation. When mounted in the flotation cell (not shown) of a flotation machine, the rotor 4 is surrounded by a stator 8, which is fixed to the bottom of the flotation cell.

Inside the hollow rotor shaft 1 there is a gas feed duct 2 for conveying process gas from the gas inlet pipe 3 into a plurality of gas distribution apertures 5 provided in the rotor 4 for introducing flotation gas into the flotation cell. The gas inlet pipe 3, the gas feed duct 2 and the gas distribution apertures 5 together form the gas feed system of the flotation machine.

When submerged in the flotation cell, the lower part of the gas feed duct 2 and the gas distribution apertures 5 get into contact with the slurry that is being processed. In order to enable cleaning of the downstream end of the gas feed system, the flotation mechanism is provided with a liquid inlet pipe 6, which in this particular case is connected to the gas inlet pipe 3 by means of an adapter.

During the operation of the flotation machine, pressurized flushing liquid can be supplied into the gas feed duct 2 together with pressurized pro-
cess gas, either continuously or periodically. Feeding pressurized liquid, either together with pressurized gas or alone, is an efficient means for preventing contamination and/or blocking of the lower section of the gas feed duct 2 and gas distribution apertures 5.

Pressurized liquid can be supplied to the gas feed duct 2 either continuously or periodically. Liquid can be supplied together with pressurized gas, or it can be supplied alone without pressurized gas. Preferably, the pressure in the liquid inlet pipe 6 is maintained on the same or slightly higher level than the pressure in the gas inlet pipe 3.

Figure 2 shows an example of a flotation mechanism with a belt drive, which is also provided with a liquid inlet pipe 6 for feeding flushing liquid into a gas feed duct 2 in order to prevent blocking of the gas feed duct 2 and the gas distribution apertures 5.

Liquid feed can be continuous or periodical. It can be started when the rotation of the rotor shaft 1 is stopped and/or when the gas feed is stopped. In this way it is possible to prevent the formation of precipitates on the interfaces between the slurry and gas during stoppages of the process.

Alternatively, liquid feed can be started when the monitoring system of the flotation machine observes reduced gas feed flow, indicating partial clogging of the gas feed duct and/or gas distribution apertures.

It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above; instead they may vary within the scope of the claims.
CLAIMS

1. A gas feed system for a flotation machine, comprising a rotary shaft (1) including a gas feed duct (2) inside it, a gas inlet pipe (3) connected to the upper end of the gas feed duct (2), a rotor (4) fixed to the lower end of the rotary shaft (1), and a plurality of gas distribution apertures (5) provided in the rotor (4) for introducing flotation gas into the flotation cell of the flotation machine, characterized in that a liquid inlet pipe (6) is provided in connection with the gas feed duct (2) to permit flushing of the gas feed duct (2) and gas distribution apertures (5) with liquid in order to prevent their blocking during the operation of the flotation machine.

2. A gas feed system according to claim 1, characterized in that the liquid inlet pipe (6) is connected to the gas inlet pipe (3).

3. A method for preventing blocking of a gas feed system in a flotation cell, which gas feed system comprises a rotary shaft (1) including a gas feed duct (2) inside it, a gas inlet pipe (3) connected to the upper end of the gas feed duct (2), a rotor (4) fixed to the lower end of the rotary shaft (1), and a plurality of gas distribution apertures (5) provided in the rotor (2) for introducing flotation gas into the flotation cell, characterized by the steps of connecting a liquid inlet pipe (6) in flow communication with the gas feed duct (2) and feeding liquid into the gas feed duct (2) to prevent blocking of the gas feed duct (2) and gas distribution apertures (5) during the operation of the flotation cell.

4. A method according to claim 3, characterized by feeding gas and liquid at the same time into the gas feed duct (2).


5. A method according to claim 3 or 4, characterized by continuously feeding liquid into the gas feed duct (2) as a precautionary measure.

6. A method according to claim 3 or 4, characterized by periodically feeding liquid into the gas feed duct (2) as a precautionary measure.

7. A method according to claim 3 or 4, characterized by feeding liquid into the gas feed duct (2) when there is high risk of blocking.

8. A method according to claim 7, characterized by monitoring the gas flow and starting the liquid feed when the gas flow decreases below a predetermined value.

9. A method according to claim 7, characterized by feeding liquid into the gas feed duct (2) when the gas feed into the flotation cell is stopped.

10. A method according to claim 7, characterized by feeding liquid into the gas feed duct (2) when the rotation of the rotary shaft (1) is stopped.

11. A method according to any one of claims 4 to 10, characterized in that the pressure in the liquid inlet pipe (6) is maintained at the same or higher level than the pressure in the gas inlet pipe (3).

12. A method according to any one of claims 4 to 11, characterized by connecting the liquid inlet pipe (6) to the gas inlet pipe (3).
A. CLASSIFICATION OF SUBJECT MATTER
INV. B03D/16  B03D/14  BO1F15/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
B03D  B01F

Documentation searched other than minimum documentation to the extent that such documents are included = the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal  , WPI  Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

Date of the actual completion of the international search
30 January 2015

Date of mailing of the international search report
12/02/2015

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Roi der, Josef
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