Application Status and Prospect of Flotation Column in the Beneficiation of Cu-Mo Sulfide Ore

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Abstract. This paper introduces the development history of column flotation and the unique advantages of the column. Because of its good selectivity, high enrichment ratio, strong recovery ability, and so on, it is more and more used in the beneficiation of various metallic ores in recent years. In this paper, copper molybdenum ore resources, beneficiation of Cu-Mo sulfide ores by applying column flotation are summarized, and the development trend in future is pointed out.

A Brief History and Application of Flotation Column

The flotation column was evolved from the flotation equipment with foam washing water device first developed by Canadian Engineer Bouttin. From research to application is only a short period of several decades, but compared with the traditional flotation machine, flotation column has excellent advantages like small footprint, simple structure, no mixing equipment, high efficiency. So it has been widely used in the beneficiation process, especially in the field of coal preparation. However, due to the plugging of filling medium occurs repeatedly, operation isn't convenient and other reasons, many concentrator plants have abandoned the column selection process. The improved flotation column greatly improves the problem, and the flotation column re-energizes itself. Not only in the coal preparation process, but also broaden its application in the metal mine.

The Working Principle of the Flotation Column

When the flotation column is working, the ore pulp is sprayed into the column from the top of the ore feeder and slowly drops down along the section of the column. At the same time, at the bottom of the column by the inflatable device will have a certain pressure of compressed air into the cylinder inflated, a large number of tiny bubbles along the column section slowly rise, pulp and bubble to form convection, mineral particles are in full contact with the bubbles and mineralized. After the mineralization of the bubble rose to the upper part of the formation of mineralization foam layer, from the overflow or with a blower scraper to the concentrate tank, and gangue minerals fall to the lower part of the column, collected by the tail pipe.

Summary of Copper and Molybdenum Resources in China

Copper-molybdenum ore is mainly produced in porphyry copper and skarn copper deposits. The porphyry copper deposits in the world's first copper reserves are almost always associated with molybdenum deposits. Due to the huge reserves of porphyry copper deposits, copper molybdenum has become an important source of molybdenum production in the world at present. Typical porphyry-type copper-molybdenum ore in the main metal minerals for the chalcopyrite, chalcopyrite, often associated with spot copper, pyrite, galena, sphalerite, chalcopyrite, pyrrhotite, natural gold, chalcocite, limonite and so on. The main minerals of nonmetallic minerals are quartz, feldspar, muscovite, biotite, chlorite and carbonate minerals. The copper molybdenum deposits have fine grain size and low grade of copper and molybdenum ores, and their floatability is similar, which brings great inconvenience to the selection work. Generally speaking, there are three methods for flotation of copper and molybdenum, such as bulk flotation, preferential flotation and equal flotation. Because the grade of copper molybdenum ore is low, and it is dense and symbiotic,
bulk flotation is often used in production. Copper molybdenum concentrates is easy to get by rough selection, but it is complicated to separate the copper and molybdenum concentrates because of similar floatability.

**Application of Flotation Column in Copper-Molybdenum Beneficiation**

As the natural floatability of molybdenum is excellent[4], and the embedded grain size is thin, almost decided to molybdenum ore can only use flotation method. The traditional flotation process has the problem of low recovery of molybdenum and complex process. Molybdenum selection also requires 5 or 6 times concentrations or more.

Compared with the traditional flotation machine, flotation column with foam layer thickness, bubble size, the number of bubbles and other advantages of convenient control. And the general molybdenum selection stage with flotation machine needs 8 -12 times, with the flotation column only about 3 times, flotation column bubble and pellet dynamic collision and bubble particles combined static beneficiation of the environment is conducive to fine particles or fine grained molybdenum ore sorting, in addition, flotation column easy to achieve automatic control[5], so more suitable for the selection of molybdenum ore. The domestic election of molybdenum process more advanced plant has begun to use: "flotation column + flotation machine" flotation process, the process flow compared with the flotation machine is greatly simplified, high degree of automation, good flotation indexes.

**Copper and Molybdenum Beneficiation Practice in Dexing Copper Mine**

The beneficiation process of copper and molybdenum flotation in Dexing copper mine is bulk flotation and suppressing copper floating molybdenum. The reagent system is simple. However, there is a certain degree of difficulty in the beneficiation of copper and molybdenum. Even when the content of molybdenum in the ore is low, the beneficiation of copper and molybdenum cannot be completed. Another scheme of molybdenum removal process is equal flotation, which is the process of separating copper flotation into two stages. The first stage is the flotation of partially soluble copper minerals while fully recovering molybdenum minerals. The second stage selected collector-strong collector to strengthen the recovery of copper minerals. For the first phase of the output of copper and molybdenum bulk concentrate, through the copper-free molybdenum to achieve copper and molybdenum beneficiation. Dexing Copper Mine in 2002 from Canada CPT company to introduce a 2.44m * 10m flotation column, and in the same year to start the research and practice of flotation column transformation process. CPT flotation column has the characteristics of low energy consumption, high sorting efficiency and convenient automation control. It also solves the problem that the aerated structure of the flotation column is easy to be calcined. In the concentration job segment, flotation column efficient sorting ability, one time selection[7] will be able to achieve flotation machine 2-3 times the effect of selection.

In the transformation process, the copper molybdenum concentrate of molybdenum in low grade, contain more reagent，slime and other characteristics, designed to take the corresponding technical measures. The pretreatment to the seperation of copper and molybdenum firstly use hydrocyclone to remove residual reagent and slime. Flotation beneficiation process structure used one roughing and one scavenging, molybdenum coarse and copper concentrate obtained. Molybdenum rough concentrate after a selection of flotation machine and a flotation column selected concentrate regrinding, concentrate regrinding after selected by molybdenum concentrate final scan two times and the selection of flotation column a flotation machine. Dexing Copper did not sacrifice copper recovery to improve copper concentrate grade. On the contrary, while expanding mine productivity, the recovery rate of copper and molybdenum was also improved. It is a successful example to use the column selection in the concentration section. In the process of upgrading the process flow, reducing operation cost and saving energy, it is a typical case to be used for reference.
Beneficiation of Copper and Molybdenum from Wushan Copper Mine in Inner Mongolia

Wushan copper molybdenum ore composition is more complex, copper grade in about 0.3%, molybdenum grade in about 0.03%. Metal minerals are mainly copper minerals and molybdenum minerals. Copper, molybdenum, sulfur are independent minerals exist. beneficiation of copper and molybdenum usdonetime roughing, two times scavenging, six times concentration process. Firstly, the KYF-24 flotation machine with 3-2-2 configuration is used for 1 roughing and 2 scavenging. The products after second scavenging are selected as copper concentrates. The coarse concentrate is selected by flotation column + flotation machine. The first three selected KYF-4 flotation machines are carried out by flotation of 5-3-2. The foam products 3th concentrated are divided into KYF-1512 flotation column through the overflow of the cyclone classifier, and the 4th concentrate and the 5th concentrate flotation are carried out. The tailings of 4th concentrate and 5th concentrate are merged into 3th concentrate. Foam products into the KYZ-1212 flotation column for 6th concentrate operations, and 6th concentrate of the foam product is the ultimate molybdenum concentrate. The combination of flotation column and flotation machine selection improve the mine production capacity, and ensure that the recovery of copper and molybdenum, enhance the quality of the concentrate.

Copper and Molybdenum Beneficiation Practice in Tibet Huatailong Jiama

Tibet Huatailong Jia Ma copper polymetallic mining area in the copper and molybdenum beneficiation operation is used to suppress the copper floating molybdenum process. Copper and molybdenum bulk concentrate in the thicker machine removal treatment, the bottom flow through the cyclone classification. Cyclone sedimentation back to the ball mill and then grinding, overflow mixing tank after mixing into the copper and molybdenum beneficiation operations. Copper and molybdenum beneficiation process using a roughing two scavenging six concentrating flotation process. The first three concentrate using inflatable flotation machine, fine three of the concentrate by the cyclone classification, sedimentation or into the mill and then grinding, overflow as the fourth concentrating to the mine. The latter three sections are selected by flotation column, and four concentrates are selected to be fed into the mill for scouring, removing, grinding and regrinding. The fineness reaches 90% -0.045mm, followed by five and six. The concentrate selected by refined six is dried and dried to serve as the final molybdenum concentrate. The coarse copper concentrate was separated by rough two times, and the crude concentrate selected by second rough was dehydrated to be copper concentrate. In the combined flotation machine and flotation column selection process, the grade of copper molybdenum concentrate and the recovery rate of copper and molybdenum have been guaranteed.

The Prospect of Flotation Column in Copper - Molybdenum Beneficiation

Of course, the flotation column in the practical application has some problems, since tailings pipe and bubble generator are often clogged. The nature of the original ore and other details should be taken into account when the flotation column is replaced by flotation machine.

In the beneficiation of Cu-Mo sulfide ores, following important factors should be considered like the amount of residue of flotation reagents in the bulk Cu-Mo concentrate, fine fractions in the feed. Hydrocyclones are often used to remove the residue reagent and the fine mud for creating a favorable condition of the beneficiation of copper and molybdenum minerals. With the further deepening of the research on flotation column, the combined use of flotation column and flotation machine is worthy to promote in the beneficiation of copper and molybdenum sulfide ore.

Flotation column with efficient sorting efficiency, shorten the process, improve the advantages of concentrate grade. It is entirely feasible to use the "flotation column + flotation machine" pillar instead of the traditional flotation machine. As the flotation column equipment has low investment, simple structure, low unit energy consumption and low unit consumption, it is worth more copper molybdenum ore concentrator application.
References


