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Numerical Simulation on Wet Grinding Classification of Fine Particles

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Abstract: Manganese dioxide is an important inorganic chemical material, mainly used in the manufacture of dry batteries, but also used in the production of manganese zinc ferrite magnetic materials in the electronics industry, as oxidant and catalyst in the chemical industry, and as catalyst for the purification of hydrogen sulfide gas, sulfur dioxide and automobile exhaust in environmental protection [1]. Industrial use of manganese dioxide can be divided into natural manganese dioxide (NMD), electrolytic manganese dioxide (EMD) and chemical manganese dioxide (CMD) [2]. Natural manganese dioxide has been used extensively in the battery industry in the past, but it is gradually replaced by synthetic materials, especially electrolytic manganese dioxide, due to the exhaustion of rich ore mining over the years. Electrolytic manganese dioxide has high purity, good crystal shape, and good discharge performance. As a good depolarizing agent of high-performance zn-mn battery, its demand is constantly increasing [3]. The battery industry has high requirements on the particle size range of manganese dioxide, so electrolytic manganese dioxide needs further treatment. At present, guizhou hongxing group is using the dry ball grinding method to treat the ore. Although it has the advantages of mature technology and short process, simple configuration, etc., its disadvantages are also obvious: a large amount of dust will be produced in the production process, which is easy to cause environmental pollution. Compared with the dry ball grinding method, the wet test ball grinding method has obvious advantages: it has strong adaptability to materials, high yield, and is suitable for large powder processing projects, with good equipment stability, short process and no further pulping. The hydrocyclone plays an important role in controlling the size range of manganese dioxide particles.

Keywords: Manganese dioxide; Self-propelled; Efficient.

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1. INTRODUCTION

Hydrocyclone [4] is a kind of equipment that classifies and sorts materials of different sizes or densities according to the principle of centrifugal sedimentation. With the continuous expansion of the application field of cyclone, the problem of low utilization rate of mineral resources becomes more and more serious [5]. The industry has raised the production requirements for grading and sorting operations and hopes to obtain products of fine grain size and narrow grain size. Therefore, it is a very important and urgent task to develop a grading process for fine grade manganese dioxide,

and to explore the law of particle movement in the cyclone and the mechanism of classification and separation. In view of the above problems, it is urgent to develop a new technology for narrow grain grading and separation with cyclone as the core equipment. The manufacturer, this paper put forward two kinds of classification of the requirements of the product, on the basis of traditional craft, using the classification characteristics of two kinds of different specifications of hydrocyclone and the gradation of different particle size range, design a set of multi-stage classification specifications hydrocyclone separation technology, through adjusting the parameters for two kinds of different particle size range of products, so as to achieve a set of process to produce the purpose of the two products, and to reduce waste of resources, reduce pollution and improve the enterprise benefit has obvious effect.

2. RESEARCH PURPOSE

For existing in the traditional EMD grade separation technology covers an area of big, the equipment cost is high, the classification efficiency is low and there is a big pollution problems, combining the theory of cyclone, research and development for the EMD fine grain grading of the new technology, at the same time according to the size difference and density difference for classification and sorting, get two different particle size range of products, at the same time, the remaining material recycling, achieve the goal of recycling, thus improve the resource utilization, reduce the manufacturing cost, decrease the pollution to the environment. [6].

The mathematical model of particle dynamics in the cyclone was built to explore the laws of motion of fine particles, and the influence rules of structure parameters and process parameters on the performance of grading and separation were obtained to improve the efficiency of grading and separation.

At present, guizhou hongxing group USES dry ball mill method for processing mineral materials. After introduction of on-site technicians and reference of relevant materials, it is found that it has the advantages of mature technology, short process and simple configuration. After observing the entire treatment process and communicating with technicians, it is found that it has great disadvantages: a large amount of dust will be produced in the production process, which is easy to cause environmental pollution. At a time of growing public concern about environmental issues, such approaches clearly need to be improved. This paper intends to develop a new technology for narrow grain grading and separation using cyclone as the core equipment, and USES numerical simulation and test methods to explore the influence of the diameter of the bottom orifice, feeding pressure and material concentration on its internal flow field and grading and separation performance. In addition, the new technology does not produce dust in the process of classification and separation, and it plays a great role in protecting the environment. The research results can change the traditional EMD fine particle classification process and have important theoretical significance and engineering application value for the development of new EMD fine particle classification equipment [7].

3. RESEARCH STATUS AT HOME AND ABROAD

As early as 1918, Van Arsdale et al. proposed the preparation of EMD by electrolysis using solution electrolysis. This process takes soft manganese ore or hard manganese ore as raw material and changes into pure divalent manganese salt through chemical transformation. He also pointed out that using EMD as depolarizing agent for dry batteries can increase the discharge capacity of batteries .

Then Nickols in 1932, Story in 1994 and Lee in 1949 all described the process of producing EMD with solution. M Ghaemi et al. studied the influence of electrolytic temperature, and found that high temperature could improve the electrochemical performance of EMD, and the results were all of mechanical type. Japan's takehara so rhodochrosite as raw material, smelting with titanium plate as the anode, carbon plate as cathode, current density of 50 ~ 80 a/cm squared, electrolytic temperature 94 ~ 98 □, electrolytic tail liquid sulfuric acid concentration in 0.4 ~ 0.7 mol/L. However, the leaching residue of this process is large, and 3 tons of residue will be generated per ton of EMD. In recent years, a two-ore one-step process for EMD production has been developed, that is, electrolysis after divalent manganese salt is obtained by using, mining and direct leaching of pyrolusite. At present, this technology is still in the stage of research and preliminary application in China. According to literature reports, the daxin chemical plant in guangxi successfully adopted the two-mine one-step method, with an annual output of electrolytic manganese dioxide of 5000 tons. Compared with the previous general production technology, the technological process avoids the reduction roasting process of pyrolusite, directly leaches the prepared liquid, and expands the utilization and deep processing of ore [13]. In the early 1980s, the theory of liquid-solid fluidization in the vertical system was first applied in the electrolytic manganese dioxide industry in China to successfully develop the liquid-solid separation technology for the non-polar counter-current scrubber column. In 1994, the concentrator was applied to further improve the efficiency of liquid-solid separation. The development and application of these new technologies have effectively realized continuous and stable production of manganese dioxide, improved production efficiency and product quality, and reduced production cost .

4. RESEARCH STATUS AND PROGRESS OF CYCLONE

Separation hydrocyclone is a kind of heterogeneous phase mixture multiphase separation equipment, with its simple structure, easy operation, large production capacity, cover an area of an area small, no moving parts, high separation efficiency and short processing time, since 1914 since hydrocyclone formally applied to industrial production, various types of hydrocyclone has been widely used in mineral processing, coal, oil, environmental protection, and so on industry.

Dong Lianping for separation hydrocyclone were studied, the cyclone characteristics for the cone Angle is larger (80 ° ~ 140 °), on the part of the cone is shorter, and the vortex appliances have bigger overflow pipe diameter, overflow mouth and grit mouth gap is small. Mo China such as using the 120 ° short cone cyclone mineral primary demineralization tests have been carried out, its effect is obvious and stable. Zhu liangyin et al. studied the separation performance of hydrocyclone from the aspects of feed pipe structure, overflow pipe structure and cone section structure, and drew a series of conclusions: the separation efficiency of rectangular feeding pipe is higher than that of circular feeding pipe. Increasing the diameter of overflow pipe, increasing the particle size and decreasing the separation efficiency. Increasing the diameter of cyclone makes the separation efficiency low. The smaller the cone Angle, the lower the separation ability. Pang xueshi et al. found that the higher the feeding pressure, the higher the separation efficiency, but the energy consumption was also increased correspondingly. The optimal value of the feeding pressure should be considered comprehensively. Using PIV (laser particle image velocimetry system), zhang Dan et al. studied the influence of cone Angle change of solid-liquid hydrocyclone on its velocity and separation efficiency. Artamonov et al.

improved separation efficiency of hydrocyclone by changing different geometric structure sizes and feed concentration of hydrocyclone. Kawatra et al. adjusted the viscosity of the feed liquid by changing the temperature and slurry concentration, and studied the influence of viscosity on the graded particle size of the hydrocyclone. Shu-jun li hydrocyclone through experimental study on the separation of potato starch, respectively, using the least squares method, MATLAB software stepwise regression analysis method to establish the single factor and multiple factors separation model, the vortex system optimization design scheme was put forward and using computer simulated, the work to fill the gaps in this field of research, make people begin to focus on the development of special hydrocyclone. The working principle of cyclone.

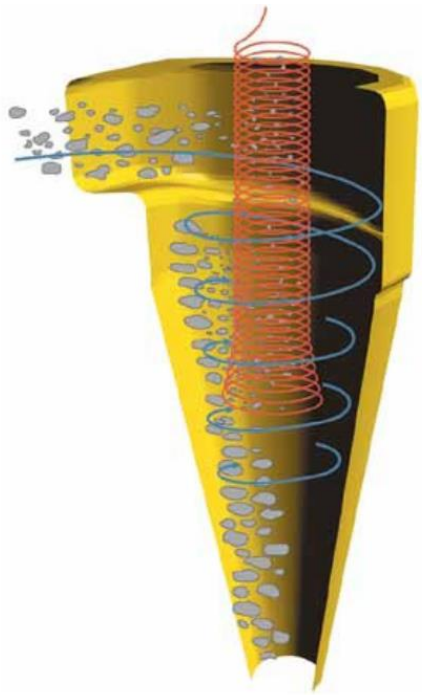

Fig. 1 The working principle of cyclone

In EMD, the micro-particle classifier is the core equipment, which requires the participation of a variety of different specifications and two products. Therefore, it is necessary to study the multi-stage multi-product cyclone. Julius Kruttschnitt Mineral Research Centre (JKMRC) studied a JK type three product cyclone, which can obtain three products including internal overflow, external overflow and underflow simultaneously in the primary classification process. Experimental studies have shown that the particle size of internal overflow is smaller than that of external overflow. Mahmoud et al. developed a mother-child cyclone, which has an additional outlet at the cone section compared with the ordinary cyclone, so that the coarse particles entering the external cyclone can discharge the cyclone ahead of time, effectively reducing the overflow coarse phenomenon of the cyclone. Du zhenbao et al. optimized the three-product heavy medium cyclone and preliminarily explored the classification and separation mechanism of the three-product cyclone. As researchers at home and abroad have carried out in-depth studies on hydrocyclones, the structure and composition of hydrocyclones have also undergone great changes. At the same time, in order to improve the separation performance of the cyclone, the column and cone segments of the cyclone were improved, and some practical problems were solved in industrial application. However, the cyclone cannot completely separate the material. In order to improve the separation efficiency in industrial production,

it is often necessary to separate the slurry by multiple stages or use multiple cyclones to work simultaneously. In the early 1980s, Italian scholars developed a cylindrical series cyclone. In essence, two cyclones are used to connect the bottom flow in series. The bottom flow generated after the separation of the mother cyclone is separated and separated again as the feed of the sub cyclone. The separation of cleaned coal, middle coal and gangue is completed by the primary separation. Jiangxi copper mine group has carried out a series test of two cyclones, and the overflow series method is applied to the grinding process. The primary overflow is used as the secondary feed, and the secondary overflow is used as the final product into the subsequent flotation and after subsequent debugging, the scheme has been successfully tested in the industrial field. Liu peikun et al. used hydrocyclone to separate gold tailings, explored the influence of cone Angle on their separation performance, and proved that series hydrocyclone has a broad application prospect in tailing treatment. , relative to the tandem hydrocyclone can be split apart in the actual production, namely a cyclone to work alone at work, and then its overflow or underflow again through the pump into the next level in the cyclone points and processing, in the process to the next level of cyclone adjusted working pressure and feed concentration, and so on, according to the requirements of the product indicators, formation, including various specifications cyclone, multi-stage cyclone working group. It has many adjustable parameters and can produce a variety of products with different particle size range. It greatly improves production efficiency and reduces waste of resources.

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