A new technique of combining accretion by cyclone separator and scattertube for tailings dams

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Abstract: A new technique of combining accretion by cyclone separator and scattertube for tailings dams was developed according to laboratory experiment, model experiment and spot experiment technology. Three tailings dams were successfully constructed by the new technique. The results of engineering geological exploration, static and dynamic test and stability analysis on Baizhishan tailings dams prove that the new technique improves structure and stability of the dams and working conditions compared with the traditional technique. The thin layers of fine-grained soils are greatly reduced, fine tailings sand is solid to make the dam stable and seepage conditions are well improved; the immersing line of the dam descends. In addition, the stability and liquefaction resistance of tailings dams are strengthened remarkably. The interior stress is compressive stress, stress level of every element is less than 1.0 and safety coefficient of every element is greater than 1.0. The safety coefficient against liquefaction of every element of tailings dams is greater than 1.5 according to the analysis of seismic response by finite element method.

Key words: tailings dams; combining accretion; cyclone separator; scattertube; upstream raising method

CLC number: TU435; TV414; P642.13

Document code: A

1 INTRODUCTION

In terms of the upstream raising technology in metallurgy and nonferrous metals mine tailings depository in the world, the techniques of filling a pool, setting scattertubes and accreting sub-dams by bulldozer with human labour are usually used\(^{[1-4]}\). With the advance of science and technology, engineers attempt to apply a new technology to improve the structure of dams and their working conditions, enhance the stability of dams and reduce labor intensity. LIU et al\(^{[5-8]}\) proposed a new technique of combining accretion by cyclone separator and scattertube, which was first successfully applied in Baizhishan tailings depository of Daye Iron Mine of Wuhan Iron and Steel Company, and then was disseminated and applied in Houjing tailings depository of Xishimen Iron Mine in Hebei Province, with the settlement of the depository of flood prevention. But how are the structure and stability of the dams formed by this new technique is always an important problem which numerous engineers and technicians pay attention to. In this paper, a new technique of combining accretion by cyclone separator and scattertube for tailing dams was proposed and applied in Baizhishan tailings dams.

2 COMBINING ACCRETION TECHNIQUE

2.1 Working principle

When tailings reach the peak elevation of starter dike by means of tailings discharge lines, two hydraulic cyclone separators are respectively put in a certain place on both sides of the first sub-dam. Thick liquid tailings with mass fraction less than 40% in the tailings transport pipeline flow into the cyclone separator and rotate by surplus kinetic energy. Acted on centrifugal force and vacuum, water and thick or fine granule of the thick liquid tailings are separated, and then get into the grit mouth at the bottom of the cyclone separator and flowing-pipes, respectively. When the mass fraction of the coarse fraction flowing out from the grit mouth exceeds 70%, the coarse fraction can be used to pile up sub-dams. But the mixture of fine granule and water is transported to spigotted tailings beach 40 m away from sub-dams. Once the piling-up reaches the design elevation, the cyclone separators are moved towards the opposite direc-
tion then close in the middle part of dam. And then its embryonic form is formed.

2.2 Process of new technique

The process of the new combining accretion technique is as follows.

Hydraulic fill using tailings discharge lines→ Altimetric and base measurement→ Setting up cyclone separators and tailings discharge lines→ Accreting sub-dam by cyclone separator→ Leveling and solidifying→ Raising up main tubes→ Erecting secondary tubes→ Hydraulic fill using tailings discharge lines.

2.3 Important procedures and features of new technique

The important procedures of the new technique are accreting sub-dam with coarse fraction disposal from the grit mouth of cyclone separator (Fig. 1) and hydraulic fill using tailings discharge lines evenly (Fig. 2). The new technique has the following features.

![Fig. 1 Schematic diagram of accreting sub-dam with coarse fraction disposal from grit mouth of cyclone separator](image1)

(a)—Plane; (b)—Cross section

![Fig. 2 Plane of hydraulic fill using tailings discharge lines evenly](image2)