Fine Tailings Heap High Levels of Radiation Seepage Drainage Wells Application

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Abstract. Jiangxi Xingan Xinheng mining tailings, the tailings discharge chute fracture accident, backfilling materials caused by leakage. After emergency measures for drainage tunnel mouth sealed, to make the library lost only drainage channels, the backfilling is fine drainage is poor, saturation line rising, pose a safety hazard. In this paper, Xinheng mining tailings as an example, put forward the suitable level of tailings backfilling fine particle size, small permeability coefficient e radiation well engineering measures and construction technology, let the radiation well drainage and horizontal tube drainage measures etc, for drainage effect comparison and analysis, the results show that, using the radiation well drainage measures more outstanding. Short construction time limit for a project, drainage effect is good, can provide the basis for other similar tailings e measures adopted and the reference.

Keywords: Tailings, High heap fines, Radiation Well, For Drainage.

1. Introduction
Tailings dam is intercepted taniguchi or compound, used to storage place of pulp. It is a high potential energy of man-made debris flow hazards, run a variety of natural and man-made unfavorable factors in the process of threat to its security.

2. Project Overview
Xinheng mining tailings on December 17, 2013, tailings discharge chute fracture accidents occurred in the morning, backfilling materials caused by leakage, after emergency measures for drainage tunnel mouth sealed, to make the library lost only drainage channels, the backfilling is fine drainage is poor, saturation line rising, and the mine dam actual accumulation is nearly 65 meters high, the mine is emissions from fluorite ore, tailing, this tailing more fine, account for most of the tail powder sand and silt, poor water permeability, according to the data indicate[1], high mud content in our country is very fine particles of tailings fill dam disease rate is on the high side, static and dynamic stability of dam body structure is in terms of tailings. This is because the saturation line easy to reduce vibration liquefaction, and there may be higher in the soft mud excess pore water pressure, the shear strength is low, the static stability is low. Therefore, control the saturation line is very important. Tailing is qualitative as dangerous.
Xinheng mining tailings according to the original design for fourth library total capacity is 717000 m³, final accumulation level 63 m, upstream dam slope 1:0.37, the downstream dam slope 1:2.6. Late tailings backfilling materials adopt dam, upstream method of ore stacking dam, now actually eventually dam crest elevation of 200.8 m, tailings sedimentary slope for 1:54.8, at present the rolls water level elevation of 191.58 m, tailings dam relative to total tier 64.9 m, reach the standard of the third class library, belong to the heap of the tailings [2], in a narrow sense H > 60 m of tailings dam, considered a heap of tailings dam.

3. The Seepage Characteristics of Fine Grained Backfilling

Is no accepted definition of fine grained tailings. Access to relevant information, tailings fineness can be based on the average particle size or a certain percentage of particle size classification [3], as shown in Tables 1 and 2.

### Table 1. According to the average grade classification of $d_p$.

| Classification | Thick | Middle | Fine |
|----------------|-------|--------|------|
|                | Very thick | Thick | Middle thick | Middle fine | Fine | Very fine |
| $d_p$/mm       | >0.25 | >0.074 | 0.074~0.037 | 0.037~0.03 | 0.03~0.019 | <0.019 |

### Table 2. According to the proportion of a certain grade classification.

| Classification | Thick | Middle | Fine |
|----------------|-------|--------|------|
| grade /mm      | 0.074 | - 0.019 | 0.074 | - 0.019 |
| The proportion /% | >40 | <20 | 20~40 | 20~50 | <20 | >50 |

The tailings by drilling core reveals the engineering geological profile is shown in Figure 2, end of fine sand, silt, silt clay layered situation, in the sample survey and drilling of tailings particle analysis, a total of 57, the sample collected in the same elevation drilling by the different depth of the borehole stagger from each other, sample disturbance in penetration is taken, tailings sample analysis results as shown in Table 3.
Figure 2. Engineering geological profile.

Table 3. Tailings particle analysis results.

| Name              | >0.25 | 0.25-0.075 | 0.075-0.05 | 0.05-0.01 | 0.01-0.005 | 0.005- |
|-------------------|-------|------------|------------|-----------|------------|--------|
| Tail sand         | 43.9  | 28.8       | 19         | 8.3       |            |        |
| The tail silt     | 13.9  | 30.9       | 21.9       | 19.8      | 11.5       |        |
| The tail silty clay| 6.9   | 10.6       | 25.2       | 39        | 18.3       |        |

According to drilling engineering geological profile uncovered, discharge under the action of gravity tailings backfilling is from coarse to fine particle distribution law of particles to the reservoir distribution, the whole tailings as a whole is made up of tail tail sand, silt (or tail silt) and the tail of silty clay, what do we learn from the profile of the rolls tail tail silt and silty clay in the majority, the tail silty clay occupies most. From Table 3 that tailings sample particles less than 0.05 mm percentage of more than 50%, less than 0.01 mm particles accounted for 39%, according to the standard of Tables 1, 2, this paper argues that the tailings can be classified into fine grained tailings, this paper argues that the tailings can be classified into fine grained tailings.

According to the data reveals [4], partial fine grained tailings poor permeability, consolidation is slow, partial fine grained tailings fill dam saturation line generally on the high side, coarse particles less, Upstream tailings dam type in its downstream slope have a coarser particles “dam shell”, partial fine tailings damming the thinner “dam shell”, more fine tailings and made of soft soil layer is relatively thick, it is not easy to drainage consolidation, difficult to dissipate excess pore water pressure, adverse to the tailings dam stability. To determine the coefficient of permeability of indoor core sample, the results as shown in Table 4.

Table 4. Statistics of the tailings soil permeability coefficient.

| Tailings soil       | Vertical: The permeability coefficient $K_v$ ($\times 10^{-5}$ cm/s) | The number of statistical | Range | The average | Classification of permeability |
|---------------------|-----------------------------------------------------------------------|--------------------------|-------|-------------|-------------------------------|
| Tail sand           | Vertical: The permeability coefficient $K_v$ ($\times 10^{-5}$ cm/s) | 4                         | 50-190| 105         | weak                          |
| The tail silt       | 4                                                                    | 2.3-8.6                  | 4.88  | tiny        |
| The tail silty clay | 4                                                                    | 1.2-0.8                  | 1     | tiny        |

The tailings soil geotechnical test report from the graph, with the decrease of tailings particles, the permeability coefficient is reduced, micro bedding in a small fine mud, according to engineering
experience tail sand soil horizontal permeability coefficient is greater than the vertical permeability coefficient 3-4 times, conform to the general law of sedimentary. The permeability coefficient is too small, lead to the rolls saturation line is high, and as rain and mountain surface water intake, saturation line will continue to rise, tailings of saturation line is the lifeline of tailings dam [5], the discretion of the saturation line, the stability of tailings dam is very important. Therefore, to improve the seepage condition of the rolls, the reservoir internal seepage dam was derived in time, to prevent the seepage line increasing, guarantee the stability of fine grained tailings is the important content of safety engineering technical measures.

4. The Dam Drainage Measures

Drainage many commonly used method, such as well type drainage, pipe trench type drainage, mattress drainage and wall type drainage, and new development of tailings dam is special drainage horizontal well and vertical well and horizontal well combined drainage, radial well drainage and so on[6], these special precipitation technology development and application, on the stability of tailings dam upstream method reinforcing has achieved positive results [7].

By the above-mentioned can be found, Should from the siphon drainage, the level of drainage and radiation well these three drainage measures from excellent choice.

In siphon drainage, the data showed [6], due to the general tailings dams can be formed thick sand dam shell, the permeability coefficient is generally not less than 10^{-4} cm/s, so drainage facilities easy to obtain apparent effect. And fine grained tailings dam won’t form a thick sand dam shell, the dam average permeability coefficient is low, its value in 10^{-6}-10^{-5} cm/s, estimated using the drainage precipitation facilities, effect is not obvious.

The level of drainage using horizontal drilling technology, first level into the hole after embedding e blind pipe, drainage pipe generally adopts the UPVC pipe, length is 50 ~ 80 m, pipe diameter φ 76-89 mm, the plum blossom shaped distribution, drainage tube decks using φ 16 mm round hole, a circumference 4 hole, network from 35 x 100 mm, opening rate of no less than 6.5%, Outsourcing geotextile 400 g/m², with the lead wire binding, this method is simple in process time is shorter, can control the dam slope seepage, as shown in Figure 3 the level of drainage effect diagram.

![Figure 3. The level of drainage effect diagram.](image)

Open caisson method of radial well drainage technology, through the open caisson construction methods to casting a good set of water, set above the dam slope ooze water area, can be up to 15 to 25 m depth, after the collection of water well casing in the use of radial horizontal drilling technology laid the horizontal tube, diameter of 63-89 mm, horizontal length the radiation radius of 50-80 m, radiation Wells
of tailings seepage control range up to hundreds of meters, widely used at present. As shown in Figure 4 radiation well arrangement.

![Figure 4. Radial well arrangement.](image)

By the above analysis, contrast Radial well drainage and level of drainage two methods, Radiation wells drainage can be fully set e tube in the house of the rolls. This 3D drainage effect is good, more than level of drainage.

5. Radiation Well Drainage Effect
The engineering practice of stewarding two radial well, profile location is located in the saturation line hole ZK07 and ZK09 place, as shown in Figure 5 months saturation line measured values, look from the monitoring data of seepage line, saturation line under control, drainage effect is good, especially ZK07 and ZK09 two-hole saturation line down significantly.

![Figure 5. Months saturation line measured values.](image)

Located in radiation on ZK07 hole Wells at the end of May completion, located in radiation on ZK09 hole Wells at the end of August completion, learn from Figure 6 data we can know ZK07 May June and ZK09 July August stable after saturation line down significantly, ZK10 since May in a downtrend tends to be stable, The three holes down rules consistent with radial well construction sequence.
6. Conclusion
In this paper, Xinheng mining tailings as an example, based on the radiation well drainage, let the radiation well drainage and horizontal tube drainage measures etc, found that radiation well more advantages, construction period is short, the drainage result is good, especially in the high pile of fine grained tailings, the characteristics of the radial well 3d drainage backfilling materials more adapt to the fine particle size, the characteristic of the coefficient of permeability smaller tailings drainage.

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