Strength Increasing Of Ultrafine Unsized Tailing Back-filling Materials

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Keywords: ultrafine unsized tailing, back-filling, strength increasing

Abstract. This paper adopts physical experiment method to design uniform experiment on the basis of ultrafine unsized tailing in allusion to the problem of ultrafine unsized tailing back-filling. In this paper, the relationship between the strength of filling material and the ingredients-concentration-ratio of ultrafine unsized tailing backfilling materials is analyzed. The principle of mechanical property & it's change of ultrafine unsized tailing back-filling materials is reveal.

Introduction

The crystallization grain size of iron ore in the eastern area of Hebei is relatively small. The excessive smashing of iron ore is necessary to improve resource recovery, which increases greatly ultrafine particles in the tailings. The increasing greatly of ultrafine unsized particles is adverse effect to the unsized back-filling mining method and lead to excessive consumption of cementing material, reduction in unsized tailing back-filling materials strength and unsteadiness pipeline transport parameter. And then, the applying of ultrafine unsized tailing back-filling mining method is getting harder because cost increase, unsteadiness quality and depravation of back-filling process reliability.

Experimental program

The Diamond No. 325 Portland cement and whole tailings were used as the cementing material and aggregates. A total of three factors, such as cement-sand ratio, mass concentration and curing age, were selected as the experimental data. A total of 36 groups of experiments were conducted, and 6 test blocks were made in each group. The specific parameters were shown in Table 1.

Strength test

Measurement of uniaxial compressive strength of test block was conducted by WAW-2000 press in the form of axial compression. There were three test blocks in each group, the average value of that was the uniaxial compressive strength, and the results were shown in Table 1.

Strength analysis of superfine whole tailings-cemented filling

Effect of mass concentration on strength of superfine whole tailings-cemented filling

Effect of mass concentration on filling strength at the same curing age

Based on the analysis of the test results, the higher concentration of the slurry meant the greater of the uniaxial compressive strength of the whole tailings-cemented filling when the cement-sand ratio of the cemented slurry remained the same standard. The relationship was shown in Fig.1.

a.Curing age of three days b.Curing age of seven days c.Curing age of twenty-eight days

Fig.1 The curve of compressive strength with mass concentration at different curing ages

Table1 The results of strength test of whole tailings-cemented filling

ID	mass concentration	cement-sand ratio	curing age	strength (MPa)
A11	65%	1:6	3d	0.413
A12	65%	1:6	7d	1.08
A13	65%	1:6	28d	1.5
A21	65%	1:8	3d	0.232
A22	65%	1:8	7d	0.36
A23	65%	1:8	28d	1.288
A31	65%	1:12	3d	0.158
A32	65%	1:12	7d	0.276
A33	65%	1:12	28d	1.19
A41	65%	1:20	3d	0.114
A42	65%	1:20	7d	0.241
A43	65%	1:20	28d	0.53
B11	70%	1:6	3d	0.538
B12	70%	1:6	7d	1.382
B13	70%	1:6	28d	2.453
B21	70%	1:8	3d	0.246
B22	70%	1:8	7d	0.732
B23	70%	1:8	28d	2.799
B31	70%	1:12	3d	0.251
B32	70%	1:12	7d	0.293
B33	70%	1:12	28d	1.968
B41	70%	1:20	3d	0.139
B42	70%	1:20	7d	0.319
B43	70%	1:20	28d	1.155
C11	75%	1:6	3d	0.745
C12	75%	1:6	7d	2.753
C13	75%	1:6	28d	3.646
C21	75%	1:8	3d	0.397
C22	75%	1:8	7d	1.482
C23	75%	1:8	28d	3.274
C31	75%	1:12	3d	0.303
C32	75%	1:12	7d	0.346
C33	75%	1:12	28d	2.888
C41	75%	1:20	3d	0.271
C42	75%	1:20	7d	0.359
C43	75%	1:20	28d	2.573

Effect of mass concentration on filling strength at the same cement-sand ratio

Based on the influence of mass concentration on the strength of the whole tailings-cemented filling, a suitable cement-sand ratio could be chosen when the cement-sand ratio remained the same standard. The relationship was shown in Fig.2.

Fig.2 The curve of compressive strength with mass concentration at different curing ages and same cement-sand ratio

Effect of cement-sand ratio on strength of superfine whole tailings-cemented filling

Effect of cement-sand ratio on filling strength at the same curing age

The higher cement-sand ratio meant the greater the compressive strength of the filling, when other conditions remained unchanged,. The impact of cement-sand ratio on the strength of the filling was shown in Fig.3.

Fig. 3 The curve of compressive strength with cement-sand ratio at different mass concentrations and same curing age

Effect of cement-sand ratio on filling strength at the same mass concentration

The cement-sand ratio was an important factor in determining the strength of the filling. The study on the variation law of the filling strength changed with the cement-sand ratio could provide the basis for choosing the reasonable cement-sand ratio and avoid the high cost of filling caused by the high cement-sand ratio. The relationship of cement-sand ratio and strength were shown in Fig.4.

Fig.4 The curve of compressive strength with cement-sand ratio at different curing ages and same mass concentration

Effect of curing age on filling bodies strength

The effect of the curing age on the strength is shown in Figure5, which can be seen from the graphs in Figure5, when the mass concentration is constant, the intensity of each mortar increases with the growth of curing age. The strength increases slowly with the duration of curing age is 3 days and 7 days, and the strength increases rapidly when the curing age is 28 days, and the intensity of the increase was higher than that of 3 days and 7 days.

Fig.5 Intensity versus age of conservation

Conclusions

Using SPSS software, multivariate regression analysis was performed on the strength growth law of super-fine total tailings filling body, the results are as follows:

$$y = -7.516 + 8.635x_1 + 0.069x_2 + 9.721x_3 \quad (1)$$

where x_1 is the gray sand ratio, x_2 is the curing age (/d) and x_3 is the concentration (/%).

$Sig = 0.000 < 0.05$, R^2 is 0.824 and the correlation is good. Through the multivariate regression analysis of the experimental data, it can be seen that the most important factor affected the strength of the filling bodies is the concentration of the slurry, the partial correlation coefficient is the largest. When design of cemented filling with the back-filling, we should first consider how to improve the slurry concentration; Secondly, the sand body of the filling body also has a greater impact on the strength, but it will be greatly increase the filling costs by increasing the amount of cement to improve the strength of the whole tail filling.

Acknowledgements

This work was financially supported by the Hebei Province Department of Education(ZD2015020),and supported by the Graduate Student Innovation Fund of Hebei province(CXZZBS2017125).

References

- [1] Huang Zhiwei, Zhang Bingxu. Research on new technology of whole tailings-classified backfilling[J]. Metal Mine, 2004(06):65–67.
- [2] Xie Ying. Filling process and application prospect of full tailings[J]. Mining Technology, 2001(2):46–47,52.
- [3] Li Dongqing. Research and application of metal mining technology in China[J]. Mining Technology, 2001(2):16–19,52.
- [4] Gao Qian, Nan Shiqing, Sun Aizhi. Experimental study on the development of new filling material for superfine full tailings[C]. China nonferrous metals society mining committee. Proceedings of the 5th China filling mining technology and equipment conference. Hefei city, 2011:54–57.