Experimental study of flocculant dosage on improving paste permeability

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ABSTRACT: Based on the permeability characteristics of tailings paste storage and industrial application scenarios, this paper takes a nickel tailings as the experimental object and uses variable water head penetration experiment to measure the permeability rate of tailings paste with concentrations of 66%, 68% and 70% respectively, and the dosage of flocculant is 15g/t, 20g/t, 25g/t, 30g/t, 35g/t and 40g/t. The research results show that the order of permeability rate of tailings paste with different concentrations is 15g/t < 25g/t < 20g/t < 30g/t < 35g/t < 40g/t, which indicates that the amount of flocculant can improve the permeability characteristics of tailings paste, and provides a theoretical basis for the development of paste storage technology in rainy areas.

1.Introduction

The development of metal mineral resources leads to the generation of a large number of solid waste from mines. According to statistics, the surface heap stock of tailings in China has reached 14.6 billion tons [1], and the total volume of underground goaf has reached 1.28 billion cubic meters [2]. At present, research hotspots of tailings paste mainly focus on flocculation, settlement and thickening [3,4], so as to meet the needs of paste filling in stope and goaf, and provide a safe, green and efficient solution for the treatment of underground stope and goaf [5,6]. The research on the seepage and stability of the tailing paste stacking technology is not enough to support the large-scale application of the technology. At present, tailings paste stacking [7] is more suitable for projects in arid areas, high cost of tailings water treatment and long-distance and high concentration transportation of tailings. If the application scenarios of paste storage can be broadened, "one waste and two treatments" can be realized on a large scale, the problem of solid waste treatment can be solved, and the green and safe mining of metal mineral resources can be realized [8].

Domestic and foreign scholars have modified the chemical composition and molecular structure of flocculant in the fields of coal slurry dehydration and sewage treatment to form a variety of flocculant products to meet different needs [9~15]. Laskowski J S[16] theoretically explained the adsorption and filtration aid functions of flocculants in coal washing. McCormick C L[17] studied the composition of hydrophilic chain and hydrophobic group in the flocculant, and adjusted the hydrophilic chain and hydrophobic group to meet the needs of different uses. Chinese scholar Hu Xiaomin et al. [18] put forward the process of using hydrophobic flocculant to strengthen the concentration and filtration
process. When treating Donganshan flotation iron concentrate, adding non-ionic polyacrylamide (PAM) can reduce the moisture content of iron concentrate filter cake by 1%-2% and increase the treatment capacity by more than 5 times. Shichang [19] et al used four different types of flocculants to conduct pulp dehydration experiments. The results showed that the adsorption-bridging effect of polyacrylamide formed flocs that were conducive to dehydration by changing the particle size composition of pulp, thus improving the permeability effect. Ren Xiao fin [20] used SEM to compare blank tests and concluded that the filter cake with the addition of flocculant had loose structure and was conducive to improving the penetration rate. The research results of the above experimental research on coal filtration aid provide a research idea for the influence law of flocculant on the seepage characteristics of paste slurry storage field. Therefore, this paper carried out an experimental study of paste permeability under different concentrations and different dosage of flocculant. It provides a theoretical basis for the effect of flocculant on the accumulation and seepage characteristics of paste.

The research results of the above experimental research on coal filtration aid provide a research idea for the influence law of flocculant on the seepage characteristics of paste slurry storage field. Therefore, this paper carried out an experimental study of paste permeability under different concentrations and different dosage of flocculant. It provides a theoretical basis for the effect of flocculant on the accumulation and seepage characteristics of paste.

2. Materials and Method

2.1. Milltailings
Taking the straight-row total tailings of a nickel mine as the experimental material, the particle size composition of the total tailings was analyzed by using laser particle size analyzer and artificial wet screen (Fig.1). 18 kinds of samples were prepared with slurry concentrations of 66%, 68% and 70%, and flocculant solution dosage of 15g/t, 20g/t, 25g/t, 30g/t, 35g/t and 40g/t.

![Fig.1 Concentration of sample size and content of test sample](image)

2.2. Selection of flocculant
The experimental materials are: RH-1030 flocculant, flocculant agitator, electronic balance (precision 0.01g), syringe (to measure flocculant), beaker (500ml), millisecond meter. In the experiment, an electronic balance (accuracy 0.01g) was used to weigh 0.5g of anionic flocculant and add it into a 500ml beaker. The flocculant agitator (100 ~ 300r/min, preparation of 0.1% flocculant solution) was used to stir it for 1-2h. Then the flocculant solution was passed through the syringe to carry out the penetration test according to the standards of 15g/t, 20g/t, 25g/t, 30g/t, 35g/t and 40g/t.

2.3. Experimental device
The experimental device consists of a TST-55 penetrator and a self-made osmotic pressure vessel (Fig.2). TST-55 type penetrator is composed of cylinder 1 (with outlet pipe), permeable stone 2, ring cutter 3 (inner diameter Φ6.18cm, height 4cm, volume 119.92cm³), rubber washer 4 and other
components. The osmotic pressure device is made of welded "L" type permeable pipe and plastic cylinder. In addition, electronic balance (precision 0.1g), scale paper (measuring liquid level height, mm), leather hose, pipe clamp valve and so on are also needed.

Fig.2 Variable head infiltration device: 1—Water beaker; 2—Drain hole; 3—Porous stone; 4—Sealing gland; 5—Exhaust vent; 6—Flatjaw pinchcock; 7—Graduation paper; 8—External water; 9—Plastic bucket

2.4. Experimental method
Firstly, slurry with mass concentration of 66%, 68% and 70% (300g) was proportioning, and flocculants (15g/t, 20g/t, 25g/t, 30g/t, 35g/t, 40g/t) were successively added to slurry with different concentrations to stir evenly. Next, put the permeable stone in the bottom of the TST-55 accessory sleeve, and put the ring knife into the sleeve of the penetrator, and add the sample in the sleeve in times. After adding a certain amount of sample, tap the shock sleeve, repeat the above operation, add the sample to 212.5g, press the gasket, cover the top cover and tighten it with screws; The permeameter device connected to the water supply device, add a certain amount of water in the water supply device, open the tongs, let the water through the TST-55 permeameter flows through the sample, and in the open vent clips, side permeameter, emptying permeameter inside until the air exhaust no bubble, in the process of drainage outlet pipe mouth with water, shut a exhaust clip; Finally, add water to the water supply device to the required height, open the water supply pipe stop clip again, measure the initial water head height H1 and the stopping water head height H2, record the time interval ΔT and water temperature θ between the water level water head height H1 and the stopping water head height H2. Each sample needs to repeat the measurement of experimental data for three times, and take the average value of the three times as the measurement result.

3. Results & Discussion
As can be seen from Fig3, the permeability rates of samples with different concentrations and different dosage of flocculant all show a changing trend of increasing first, decreasing and finally increasing to different degrees. On the whole, with the increase of the amount of flocculant, the hydrophobic group of the molecular branch chain of the flocculant increases, and the permeability of the sample is better.
The experiment also found that with different concentrations of tailings slurry, the permeability rate of samples fluctuated greatly when the dosage of flocculant reached 20g/ t. It is believed that the change of flocculant size and permeability channel, the phenomenon of fluctuation is presented.

4. Conclusion
The experimental results show that the increase of the amount of flocculant can improve the penetration rate of tailings paste, which provides theoretical support for the application of paste stacking technology.

Acknowledgments
Thanks to the National Science Foundation of China for Excellent Young Scholars, (No.51722401) and National Key Research and Development Program (No.2017YFC0804609) for supporting

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