Experimental Study on Dynamic Properties of Reservoir Red Mud Tailings (Post-print)

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Abstract

This study investigates red mud tailings material using a GCTS cyclic triaxial apparatus to conduct cyclic triaxial tests, examining the dynamic deformation and dynamic strength characteristics of red mud under varying consolidation confining pressures and consolidation ratios. The results indicate that with increasing dynamic strain, the growth of dynamic stress exhibits a trend of initially rapid then gradual increase; the reciprocal of dynamic modulus is negatively correlated with consolidation confining pressure and consolidation ratio; with increasing dynamic shear strain, the damping ratio gradually increases, and as dynamic shear strain continues to increase, the damping ratio rises sharply and finally reaches a stable state. Dynamic deformation results show that the dynamic stress-strain backbone curve and dynamic elastic modulus are positively correlated with consolidation confining pressure and consolidation ratio; the damping ratio is negatively correlated with consolidation confining pressure and consolidation ratio. Dynamic strength results demonstrate that the higher the consolidation confining pressure and consolidation ratio, the greater the number of cyclic loading cycles required for specimen failure; failure dynamic stress exhibits a linear relationship with the number of cycles to failure. The test results can provide a scientific basis for subsequent treatment and comprehensive utilization of red mud and hold practical significance for improving the design and management of tailings storage facilities.

Full Text

Experimental Study on the Dynamic Characteristics of Red Mud Tailings

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Abstract

This study investigates the dynamic characteristics of red mud tailings material through cyclic triaxial testing using a GCTS apparatus. Experiments were conducted to examine the dynamic deformation and strength properties under various consolidation confining pressures and consolidation ratios. The results indicate that dynamic stress increases rapidly at first and then more gradually with increasing dynamic strain. The inverse of dynamic elastic modulus shows a negative correlation with both consolidation confining pressure and consolidation ratio. The damping ratio initially increases gradually with dynamic shear strain, then rises sharply before stabilizing. Dynamic deformation analysis reveals that both the dynamic stress-strain backbone curve and dynamic elastic modulus correlate positively with consolidation parameters, whereas the damping ratio correlates negatively. Dynamic strength results demonstrate that higher consolidation confining pressure and consolidation ratio require more cyclic loading cycles to reach failure, with a linear relationship between failure dynamic stress and the number of cycles to failure. These experimental findings provide a scientific basis for the subsequent treatment and comprehensive utilization of red mud, and hold practical significance for improving tailings pond design and management.

Keywords: red mud; tailings material; dynamic triaxial test; dynamic characteristic parameters

Note: Figure translations are in progress. See original paper for figures.