World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:16, No:09, 2022

Experimental Investigation on the Effect of Prestress on the Dynamic Mechanical Properties of Conglomerate Based on 3D-SHPB System

Authors : Wei Jun, Liao Hualin, Wang Huajian, Chen Jingkai, Liang Hongjun, Liu Chuanfu

Abstract : Kuqa Piedmont is rich in oil and gas resources and has great development potential in Tarim Basin, China. However, there is a huge thick gravel layer developed with high content, wide distribution and variation in size of gravel, leading to the condition of strong heterogeneity. So that, the drill string is in a state of severe vibration and the drill bit is worn seriously while drilling, which greatly reduces the rock-breaking efficiency, and there is a complex load state of impact and three-dimensional in-situ stress acting on the rock in the bottom hole. The dynamic mechanical properties and the influencing factors of conglomerate, the main component of gravel layer, are the basis of engineering design and efficient rock breaking method and theoretical research. Limited by the previously experimental technique, there are few works published yet about conglomerate, especially rare in dynamic load. Based on this, a kind of 3D SHPB system, three-dimensional prestress, can be applied to simulate the in-situ stress characteristics, is adopted for the dynamic test of the conglomerate. The results show that the dynamic strength is higher than its static strength obviously, and while the three-dimensional prestress is 0 and the loading strain rate is 81.25~228.42 s-1, the true triaxial equivalent strength is 167.17~199.87 MPa, and the strong growth factor of dynamic and static is 1.61~1.92. And the higher the impact velocity, the greater the loading strain rate, the higher the dynamic strength and the greater the failure strain, which all increase linearly. There is a critical prestress in the impact direction and its vertical direction. In the impact direction, while the prestress is less than the critical one, the dynamic strength and the loading strain rate increase linearly; otherwise, the strength decreases slightly and the strain rate decreases rapidly. In the vertical direction of impact load, the strength increases and the strain rate decreases linearly before the critical prestress, after that, oppositely. The dynamic strength of the conglomerate can be reduced properly by reducing the amplitude of impact load so that the service life of rock-breaking tools can be prolonged while drilling in the stratum rich in gravel. The research has important reference significance for the speed-increasing technology and theoretical research while drilling in gravel layer.

Keywords : huge thick gravel layer, conglomerate, 3D SHPB, dynamic strength, the deformation characteristics, prestress
Conference Title : ICRMRS 2022 : International Conference on Rock Mechanics and Rock Strength
Conference Location : Singapore, Singapore
Conference Dates : September 08-09, 2022