

Experimental study on the influence of water-saturation on rock breakability using conical pick in rock indentation test

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Abstract: In order to investigate the effect of water saturation on the breakability of rocks with different lithologies, this paper measured the physical properties such as density and P-wave velocity on 20 rocks with different lithologies. Uniaxial compression test, Brazilian split test and Vickers hardness test were used to measure the mechanical properties of rocks. Subsequently, rock indentation test was carried out using conical pick. The test results show that density and P-wave velocity of the rocks with different lithology increase in different degrees after water saturation treatment. Uniaxial compressive strength, Brazilian tensile strength, Vickers hardness, peak indentation force and cutting work all decrease in varying degrees. The results further show that water has a weakening effect on rocks of different lithology, and the weakening effect of water on sedimentary rocks is greater than that on magmatic rocks and metamorphic rocks. Meanwhile, according to the test results, two-dimensional and three-dimensional regression models were established to analyze the relationship between rock breakability (peak indentation force and cutting work) and rock physical and mechanical properties. The influence of rock physical and mechanical properties on rock breakability is non-linear. Based on this, Xgboost, neural network, SVM (support vector machine), and Gaussian regression analysis and prediction models were established to measure the effect of rock physical and mechanical properties and water content on rock breakability. The results indicate that the Xgboost model has the highest accuracy in predicting rock breakability. The study also found that rock mechanical properties have a greater influence on rock breakability than rock physical properties and water content. Additionally, the brittleness index has a greater influence on rock mechanical properties than Vickers hardness. These findings suggest that rock breakability in underground geotechnical engineering or mining engineering, can be predicted by measuring rock density, P-wave velocity, Vickers hardness, and other simple tests.

Keywords: Water-saturated rock; Rock breakability; Rock indentation; Prediction model