

Experimental study on failure mechanical properties and acoustic emission characteristics of soft rock–coal combination under dynamic disturbance

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Abstract: This study aims to investigate the failure mechanical properties of deep soft rock-coal combinations when subjected to dynamic disturbance. Hence, uniaxial compression and dynamic disturbance experiments were conducted on samples of muddy sandstone, coal, and soft rock-coal combinations using a creep disturbance dynamic impact loading experimental system. This study analyzed the damage properties of soft rock-coal combinations under dynamic disturbance by combining sample failure characteristics, energy evolution, and waveform signals of samples using the acoustic emission system. Results indicate that the peak strength and modulus of elasticity of the soft rock-coal combinations under uniaxial compression and dynamic disturbance are intermediate between those of coal and rock. The strength deterioration effect of the rock-coal combinations under dynamic disturbance is obvious, and the peak strength of the roof-coal and coal-floor combinations are reduced by 6.17% and 10.30%, respectively. Dynamic disturbances increase the degree of damage to the rock-coal combinations, which is accompanied by large amounts of coal fragments and large fragments of the rock-coal combinations. The failure to the sample is primarily caused by the extension of tensile damage, with the development of shear cracks playing a secondary role. The AE absolute energy of the soft rock–coal combination sample has evident time-effect characteristics, which can be divided into four stages: fluctuation, silence, active, and dramatic increase. At the beginning of specimen loading, a small amount of energy is released, indicating the development of tiny cracks within the specimen because of dynamic disturbance. Following the dynamic disturbance, energy fluctuations of varying sizes were observed. The rock–coal combination is known to release significant amounts of energy during failure instability, resulting in severe internal damage. The soft rock-coal combinations undergo small-scale damage at the initial disturbance (N_1), with large main frequency eigenvalues. Large-scale damage occurs at the time of failure (N_2), with smaller main frequency eigenvalues, sharp fluctuations in the acoustic emission signal, and peaks in the absolute AE energy and counts.

Keywords: Dynamic disturbance; Soft rock–coal combination; Failure mechanical properties; Acoustic emission