

论文

定向水力压裂工作面煤体应力监测及其演化规律

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摘要:

为研究水力压裂的机理和评价压裂效果, 采用空心包体应变计, 对水力压裂前后钻孔附近煤层应力的变化, 及水力压裂实施后, 随着工作面推进, 前方煤层应力的变化进行了监测。通过分析监测数据, 得到以下应力演化规律与结论: ① 水力压裂前后, 在压裂钻孔附近煤层中的主应力增量值、倾角和方位角均会出现突变。突变程度与至压裂孔的距离、水压、裂缝扩展方式及煤层力学性质等多种因素有关; 压裂后主应力增量得到恢复, 但比压裂前均有所降低, 水力压裂可改变煤层的应力状态。② 顶板压裂后, 再受到工作面采动影响, 煤层垂直应力增加, 水平应力有降低的趋势, 但采动引起的主应力增量变化幅度远小于压裂引起的变化, 而且采动对主应力增量的倾角和方位角的影响不大; 水力压裂可使顶板来压强度降低, 工作面超前支承压力的影响减弱。③ 晋城王台铺煤矿坚硬顶板综采工作面进行水力压裂后, 顶板的整体性和强度得到弱化, 工作面采动影响减弱, 顶板能够紧随工作面推进及时垮落, 说明水力压裂效果良好。

关键词: 水力压裂; 应力变化监测; 空心包体应变计; 主应力增量; 演化规律; 顶板弱化

Monitoring of stress change in coal seam caused by directional hydraulic fracturing in working face with strong roof and its evolution

Abstract:

In order to study the mechanism and evaluate the effect of hydraulic fracturing, the hollow inclusion cells were adopted for stress monitoring of coal mass nearby the fracturing borehole before and after hydraulic fracturing as well as coal mass ahead of working face after hydraulic fracturing. Through the monitoring data analysis, stress evolution laws and conclusions are as follows: ① The principle stress increment, inclination and azimuth in coal mass nearby the fracturing borehole change suddenly after hydraulic fracturing. The change extent is potentially related to distance between monitoring borehole and fracturing borehole, water pressure, fracture propagation and mechanical property of coal mass; After fracturing, principle stress increments are nearly recovered to the level lower than that before fracturing, therefore, stress state can be changed by hydraulic fracturing. ② Due to the effect of hydraulic fracturing and mining, vertical stress in coal mass increases and horizontal stress decreases, the change extent of principle stress increments caused by mining where inclination and azimuth are almost invariable is much more less than that caused by hydraulic fracturing. Roof weighting intensity can be reduced by hydraulic fracturing; consequently, the effect of abutment pressure on working face is weakened. ③ The directional hydraulic fracturing in the roof of a fully mechanized working face in Wangtaipu Coal Mine is implemented. Afterwards, strength and integrity of roof along with effect of mining are weakened; roof caving is in time with the advance of working face, which demonstrates that the effect of hydraulic fracturing conducted in roof goes well.

Keywords: hydraulic fracturing; stress change monitoring; hollow inclusion cell; principal stress increment; evolution law; roof weakening

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