Physical Simulation Experiments: Impact of Coal Maceral and Coal Structure Difference on Coal Fines Generation Characteristics

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Abstract

Coal fines generation in coalbed methane production is a coefficient result of static geologic factors and dynamic engineering factors. Static geologic factors are the base of coal fines generation and mainly include coal maceral, coal structure, surrounding rocks types, hydrological conditions, etc. While the dynamic engineering factors include drilling, perforation, fracturing and dewatering which are the trigger for coal fines. Based on physical simulation experiments, the impact of coal maceral and coal structure difference on characteristics of coal fines generation was analysed. The experiment aimed to reveal the relationship between coal seam property and coal fines generation trend, prejudge the spatial distribution state of coal fines generation in coal reservoir and provide basic data for reasonable prevention of coal fines in well placement and effective control of coal fines in coal bed methane production.

Acid-etched fracture conductivity instrument was chosen for the experimental apparatus. The instrument can simulate formation pressure and temperature condition in standard experimental simulation, and can realize gas-liquid two phase flow. The instrument includes computer monitoring system, sample preparation system, pump flooding system, physical simulation system, coal fines collection system and coal fines analysis system.

The experimental coal samples were collected from Hancheng area in the eastern margin of Ordos Basin, China. The experimental coal fines were produced from 3#, 5#, 11# coal samples with different component characteristics and primary structure coal and granulated coal with different coal structure were contrast analysed. With the application of laser particle analyzer, scanning electron microscopy (SEM) and oil immersed reflective polarizing microscope, under the same experimental conditions, coal fines characteristics at output, size, maceral component and morphology were compared and analysed. Under the influence of coal maceral difference, the higher the content of clay minerals in coal samples is, the stronger the water sensitivity will be. In addition, the higher the content of vitrinite is, the stronger the pressure sensitivity will be. Both of high content of clay minerals and coal vitrinite can lead to increases of coal fines generation. There was a good sorting in maceral components during coal fines generation, vitrinite and clay minerals contents increased by 3.89% to 4.16% and 0.17% to 1.70% respectively but decreased for inertinite by 3.49% to 5.87% which showed obvious deinertinite.

Compared with primary structure coal, granulated coal was more prone to generating coal fines. Output percentage of coal fines for primary structure coal was 0.06% to 0.28% while was 0.19% to 2.0% for granulated coal. Coal fines generated from primary structure coal had a wide particle size distribution range and large average particle size but for granulated coal had a relatively concentrated particle size distribution range with obvious fluctuation and much smaller average particle size. For primary structure coal, morphology of coal fines was angular which shape was mainly blocky and columnar with smooth surface feature. For granulated coal, morphology of coal fines was grainy which shape

was mainly rounded and sub-rounded with relatively rough surface feature. Based on the experimental results, adopting novel chemical reagents, engineering and equipment optimization measures to change the surface property and migration pattern of coal fines can effectively mitigate their generation and resulting production damage.