

CBM Extraction System Simulation Research

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Abstract

Coal mines in many countries which rely heavily on fossil energy have huge CBM, coal bed methane, reserves. Meanwhile, methane extraction efficiency of low permeability coal seam is very low. It causes seriously waste of low-carbon energy source. For the sake of enhancing the efficiency of CBM extraction system and decreasing energy consumption of electrical equipment of CBM extraction system, a physical model of CBM extraction system is established in this paper. The simulation model of CBM extraction system is constructed with COMSOL Multiphysics®. And this model is based on a coupled model, which consist of two simulation model, which are CBM extraction pipeline system and gas drainage borehole simulation model. The volume flow rate can be obtained through gas drainage borehole simulation model, and this physical quantity will be passed to CBM extraction pipeline system simulation model as a boundary condition.

The CBM extraction pipeline system simulation model is based on Dingji coal mine in Huainan Mining group. The paper used pipe flow module in COMSOL Multiphysics. The extraction borehole mouth is set as inlet boundary, and extraction pump station is set as outlet boundary. Inlet boundary condition is volume flow rate which offered by gas drainage borehole simulation model. Outlet boundary condition is the working condition of pump station, and it's usually a function of pump absolutely pressure and pump flux. Then we used Livelink for MATLAB to write MATLAB script, and the script can optimize the extraction system efficiency through setting valve resistance coefficient and pump working condition. Therefore, the system efficiency is enhanced and energy consumption is decreased.

The gas drainage borehole simulation model is based on 11-2 coal bed gas drainage. The simulation condition of mines is in deep coal seam, and borehole is in the pre-extraction coal seam. The assumptions of simulation model include ideal gas assumption, Isotropic permeability assumption, isotropic body assumption and there is no leakage in borehole. The Darcy's law module is used in the simulation model. The boundary conditions of the simulation model include mass source and boundary pressure of wall of borehole. The boundary pressure is a const, while mass source boundary condition is an empirical function of pressure of porous medium gas. The model solves gas extraction flow rate which is set as inlet boundary condition of pipeline system simulation model.

Reference

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Figures used in the abstract

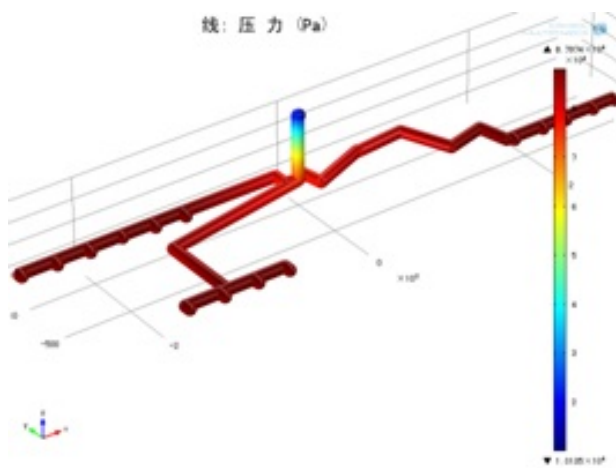


Figure 1: pressure profile of extraction pipeline system

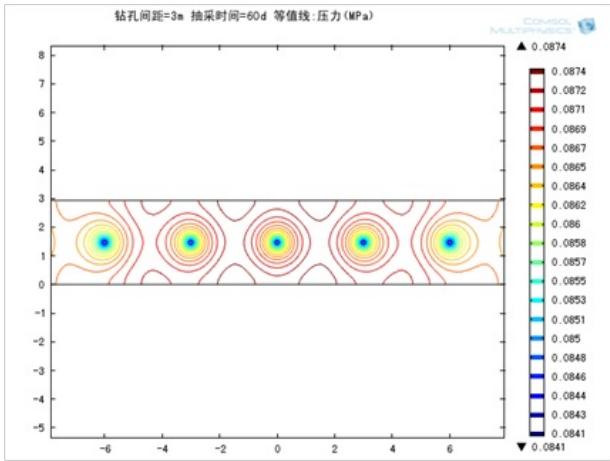


Figure 2: pressure intersecting surface of coal seam near the borehole

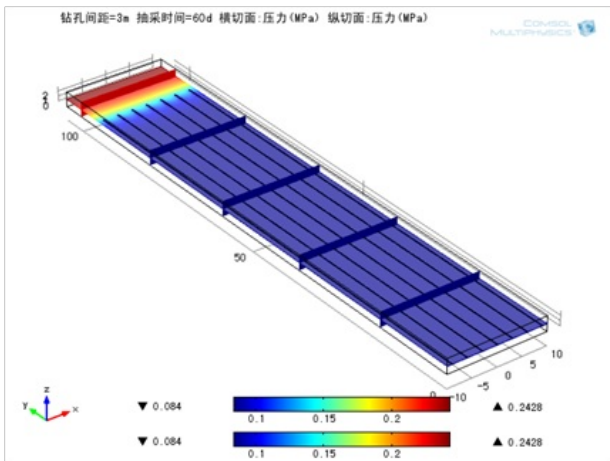


Figure 3: pressure profile of coal seam near the borehole

Figure 4