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论文

空化水射流声震效应促进瓦斯解吸渗流测试装置的改进

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摘要：

为确保完善空化水射流声震促进含瓦斯煤层解吸试验效果，针对原研制的模拟试验台存在的不足，对实验空化腔及其配套的型煤试件成型装置进行改进和重新研制。利用环向和密封圈等全方位密封技术可使三轴压力室、空化腔在高围压下及5 MPa瓦斯压力下达到较长时间的良好密封效果；依靠空化腔内布置的文丘喷嘴及高压射流装置激发腔体产生空化效应促进含瓦斯煤层解吸；依托于空化腔水进出口压力传感器实时监测空化腔空化效应；凭借布置的温度和瓦斯压力传感器、引伸计及配套的试验控制软件连接，模拟空化声震效应含瓦斯煤样瓦斯解吸渗透特性及声震过程中的煤样全应力-应变过程演化规律，实时监测空化声震过程中空化腔内温度及其瓦斯渗渗流的变化规律。此外，在循环系统设计了气-液-固体分离器，解决三相排出问题，使三相分离成为可能，提高了试验可操作性。利用改进后的实验装置系统开展模拟实验表明，空化水射流声震效应促进煤层瓦斯解吸渗流，瓦斯解吸量及解吸速度都有不同程度的提高；声震下空化腔内温度变化及含瓦斯煤试样变形规律验证了空化声震效应的热效应、机械震动效应与致裂损伤效应这一物理现象。

关键词： 瓦斯压力；空化声震；空化射流；解吸渗流；引伸计

Improvement of sonic vibration simulation device for gas desorption and seepage under cavitation water jets

Abstract:

In order to improve the desorption of coal methane by the sonic vibration of cavitation water jets，aiming at overcoming the weakness of originally developed simulation test platform，an experimental cavitation chamber and its coal shaping device have been improved and redesigned.Using the technologies of omnidirectional sealing，such as ring direction and surface sealing，etc.，a good sealing result of triaxial pressure chamber and cavitation chamber for a long time under confining pressure and 5 MPa gas pressure is obtained.Using Venturi nozzle and high-pressure jet device in the cavitation chamber，the cavitation bubble cloud formed in the cavitation chamber enhances the desorption of coal methane.With the installation of pressure sensor at water inlet and outlet，the cavitation effect is monitored in real time.Depending on the temperature and methane pressure sensor，extensometer and the supporting test control software，the permeability characteristics of methane desorption of coal sample under gas pressure and the evolution laws of stress-strain process of coal sample during sonic vibration process can be simulated.The temperature in the cavitation chamber and the variation of gas seepage during sonic vibration process can be monitored in real time.In addition，three-phase separator is designed in the recycle system，and the test maneuverability is improved.The feasibility of separating gas-liquid-solid matters via this separator is realistically proved.The simulation experiments using the improved experimental device show that the sonic vibration of cavitation water jets improves the desorption of coal methane，gas desorption quantity and desorption speed.The variation of temperature in the cavitation chamber and the deformation laws of coal sample verify the thermal effects of sonic vibration，the effects of mechanical vibration and crack damage.

Keywords: gas pressure；sonic vibrating；cavitating jet；desorption and seepage；extensometer

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