

K⁺、Na⁺、Ca²⁺、Mg²⁺对胜利褐煤平衡复吸水的影响

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Effect of K⁺, Na⁺, Ca²⁺ and Mg²⁺ on equilibrium adsorption of water content of Shengli lignite

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摘要 以胜利褐煤为研究对象, 利用FT-IR等手段, 用灰分、不同湿度下的平衡复吸水含量等, 系统研究了不同相对湿度下K⁺、Na⁺、Ca²⁺、Mg²⁺的水合作用对胜利褐煤平衡复吸水含量的影响。结果表明, 相同浓度不同类型的金属离子与煤样的交换能力的趋势为Ca²⁺>Na⁺>K⁺>Mg²⁺。金属离子对胜利褐煤平衡复吸水含量影响力的顺序为Mg²⁺>Ca²⁺>Na⁺≈K⁺。相对湿度高时, 平衡复吸水含量的主要控制因素为游离水分子之间的分子作用力; 相对湿度中等时, 平衡复吸水含量的主要控制因素为金属水簇与毛细管之间的毛细管作用力; 相对湿度低时, 平衡复吸水含量的主要控制因素为金属离子的水合作用。

关键词: 褐煤 离子交换 FT-IR 平衡复吸水含量 离子水合作用

Abstract: To investigate the effects of cations on equilibrium re-adsorption water content of lignite, the acid-washed Shengli lignite was exchanged with different concentrations of K₂SO₄, Na₂SO₄, MgSO₄, Ca(CH₂COOH)₂ solution, respectively. Ion-exchange process was characterized by the changes in wavenumber of carboxyl group and the ash contents. The equilibrium adsorption water contents of all samples were determined in a range of relative humidities. It is shown that the extent of ion-exchanged exchange in Shengli coal is in order of Ca²⁺>Na⁺>K⁺>Mg²⁺. The relative effectiveness of cations in increasing the equilibrium adsorption water content is in order of Mg²⁺>Ca²⁺>Na⁺≈K⁺. At high relative humidity, the factor that control equilibrium adsorption water content is free water molecules interactions. However, at middle relative humidity capillary force between metal cation-carboxyl group complex and capillary is more important. At low relative humidity water interactions with sorption sites which are cation-carboxyl group complex become more important.

Key words: lignite ion-exchange FT-IR equilibrium adsorption water content ionic hydration

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