

活性炭低温低压吸附等温线试验研究*

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摘 要:介绍了低温低压下活性炭吸附等温线的试验原理、装置、样品制备、试验步骤及数据处理。对 DX-30 煤质颗粒状、ZX-15 无烟煤粉圆柱状及 CH-1 椰子壳粒状活性炭做了液氮温区低压下 CO₂、空气、N₂、Ar、H₂、He 的吸附等温线试验。试验表明: 活性炭对 CO₂、空气、N₂、Ar 的吸附等温线表现为朗缪尔 (Langmuir) I 型等温线; H₂ 表现为弗伦德利希 (Freundlich) 线性等温线; He 表现为下凹的 III 型等温线。吸附能力比较: 吸附平衡压力 10⁻²Pa 时, 活性炭对 CO₂ 的吸附量最大为 10cm³/g~120cm³/g; 对 N₂、空气、Ar 次之为 0.2cm³/g~1.5cm³/g; 对 H₂ 较弱, 为 1.5 × 10⁻³cm³/g~2.3 × 10⁻³cm³/g; 对 He 极弱, 吸附平衡压力 10⁻⁴Pa 时小于 3 × 10⁻⁵cm³/g。液氮温度下三种活性炭的综合吸附能力: DX-30 型稍强、ZX-15 型其次、CH-1 型稍弱。文中的吸附等温线可供低温吸附泵及低温容器设计参考。

关 键 词:低温容器; 低温吸附泵; 低温吸附剂; 活性炭; 吸附等温线。

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Experimental Study on Adsorption Isotherms of Activated Carbon at Low Temperature and Pressure

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Abstract: The test principle, equipment, sample preparation, test method and data processing of activated carbon adsorption isotherm at low temperature and low pressure were introduced. The adsorption isotherms of CO₂, air, N₂, Ar, H₂ and He by DX-30 briquette, ZX-15 columnar anthracite and CH-1 coconut shell particles were tested at low pressure of liquid nitrogen temperature. The results show that the adsorption isotherms of activated carbon for CO₂, air, N₂ and Ar are Langmuir I isotherms, Freundlich isotherms for H₂ and concave type III isotherms for He. Comparison of adsorption capacity: when the adsorption equilibrium pressure is 10⁻²Pa, the maximum adsorption capacity of activated carbon for CO₂ is (10~120)cm³/g; for N₂, air and Ar, the next is (0.2~1.5)cm³/g; for H₂, it is only (1.5×10⁻³~2.3×10⁻³)cm³/g; for He, it is very weak, and the adsorption equilibrium pressure is less than 3 × 10⁻⁵cm³/g at 10⁻⁴Pa. The comprehensive adsorption capacity of the three activated carbons at liquid nitrogen temperature is: DX-30 type is slightly stronger, ZX-15 type is next, CH-1 type is slightly weaker. The adsorption isotherm in this paper can be used as a reference for the design of low temperature adsorption pump and cryogenic vessel.

Key words: cryogenic vessels; cryogenic adsorption pumps; cryogenic adsorbent; activated carbon; adsorption isotherms

活性炭是一种用途非常广泛的吸附材料,其丰富的孔隙结构形成了内部巨大的比表面积。孔隙结构之丰富使得其微孔直径从 2nm 延伸至 50nm 以上,比表面积一般可高达 1500m²/g 左右^[1],甚至超过 2000m²/g 以上^[2,3]。活性炭具有数倍于分

子筛的比表面积,有更大的吸附潜力。活性炭具有比分子筛更复杂、更发达的孔隙结构,这就决定了活性炭对气体的吸附是广谱的。活性炭的活化温度也较分子筛低,200℃即可激活。这些优点有利于活性炭在真空绝热容器,特别是用低温吸

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