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研究论文

粘结剂对颗粒活性炭PSA分离CH4/N2性能的影响

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摘要： 以褐煤为原料, 分别采用煤焦油、可溶淀粉和聚丙烯酰胺(PAM)作粘结剂, 制备了用于变压吸附(PSA)分离CH4和N2混合气体(CH4/N2)的三种颗粒活性炭GAC--C、GAC--T和GAC--P, 对样品的表面官能团和孔结构进行表征, 研究了粘结剂对活性炭PSA分离CH4/N2性能的影响。结果表明: 粘结剂的种类和用量对样品分离效果影响较大, GAC--T的PSA分离CH4/N$_{2}$的性能最好。粘结剂用量(粘结剂与煤粉的质量比)为0.15--0.20时, GAC--T可将CH4浓缩28\%左右; GAC--C、GAC--T和GAC--P表面含氧官能团含量的关系排序为GAC--T>GAC--C>GAC--P, 而三者的孔结构范围则为10--30 nm、2--10 nm和0.4--2 nm, 相差较大; 样品碱性表面含氧官能团的含量越高越有利于CH4/N2的PSA分离; CH4/N$_{2}$分离效果受微孔的影响较大, 0.4--0.7 nm的微孔是造成GAC--C、GAC--T和GAC--P分离效果差异的主要因素。

关键词： 无机非金属材料 颗粒活性炭 变压吸附 CH4/N2 孔结构

Effect of Binders on CH4/N2 Performances of Granular Activated Carbons by Pressure Swing Adsorption

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Abstract: Three kinds of granular activated carbons(GACs), GAC－C, GAC－T and GAC－P were prepared with lignite by using coal tar, tragantine and PAM as binders, respectively. The pore structures and surface functional groups of GAC－C, GAC－T and GAC－P were characterized, and the effects of binders on the CH4/N2 separation performances of GACs by PSA were investigated. The results show that the influences of binders on the performance of GAC for enrichment methane from CH4/N2 are very notable. Among the three kinds of GACs, GAC－T has the best PSA separation performance. When the mass ratio of tragantine to lignite is 0.15－0.20, GAC－T can improve the concentration of CH4 about 28%. The relationship of surface oxygen－containing functional groups contents for GAC－C, GAC－T and GAC－P is GAC－T>GAC－C>GAC－P, and there are some differences in the ranges of pore distribution 10－30 nm, 2－10 nm and 0.4－2 nm for the three GACs. The CH4/N2 separation performances of GAC－C, GAC－T and GAC－P are mainly influenced by basic surface oxygen－containing functional groups and micropore. The higher basic surface oxygen－containing functional groups concentrations are suitable for CH4/N2 separation by PSA, and the micropores from 0.4nm to 0.7nm are the important factors resulting in the separation performance differences of GAC－C, GAC－T and GAC－P.

Keywords: inorganic non-metallic materials granular activated carbon pressure swing adsorption CH4/N2 pore structure

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