KRYPTON ADSORPTION ON MICROPOROUS CARBONS AND 5A ZEOLITE*

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Adsorption of krypton on three varieties of carbon molecular sieves (CMS) exhibiting 4A, 5A and 6A molecular sieve properties, respectively; two activated carbons (Barneby Cheney Co. low-activated and medium-activated coconut shell charcoals); and 5A Linde zeolite sieve has been studied at 273 and 298°K at pressures from about 15 millitorr to 500 torr. This study was performed with the view to find the most suitable adsorbent for krypton released as a gaseous fission product from high temperature gas cooled nuclear reactors. At both temperatures the extent of adsorption follows the order: 5A CMS > low-activated charcoal > 6A CMS > medium activated charcoal > 4A CMS > 5A zeolite sieve. At low pressures, adsorption follows Henry's law.

The results have been plotted according to the Dubinin equation:

$$\log V = \log V_o - \frac{0.434BT^2}{\beta^2}[\log(\tau^2)(p_{cr}/p)]^2$$

where:

V = amount adsorbed at equilibrium pressure, p
p_{cr} = critical pressure
τ = T/T_{cr} = reduced temperature
V_o = micropore capacity
β = affinity coefficient relative to benzene
B = constant which indirectly characterizes the micropore dimensions.

The plots of log V vs. $[\log (\tau^2)(p_{cr}/p)]^2$ are linear from about 5 torr to 500 torr; deviation occurs at lower pressures. Over much of the pressure range, sorption is reversible. Heats of adsorption, micropore areas and the parameters of the microporous structure of the adsorbents (W_o, the limiting volume of the adsorption space characterizing the volume of the micropores, and B) have been calculated. The activated carbons have appreciable micropore areas, comparable to those of 5A and 6A CMS. For each microporous solid, with the exception of 4A CMS, the adsorption values at the two temperatures fit the characteristic curve, i.e., a plot of W against $2.303RT \log[(\tau^2)(p_{cr}/p)]$,

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where:

W = ab = filled volume of the adsorption space
a = amount adsorbed in millimoles/g
b = constant of the van der Waals equation.

This indicates that adsorption of 4A CMS involves activated diffusion, which is also indicated by the heat of adsorption data. For all other samples, the heat of adsorption varies in the same order as the extent of adsorption and inversely as the slopes of the linear regions of the Dubinin plots.

Recently, the use of low adsorption temperatures has been advocated for the removal of krypton released from nuclear reactors. Therefore, adsorption at 77 and 195°K has been studied on the 5A CMS, low-activated charcoal, and 5A zeolite sieve. Results have been plotted according to the Dubinin equation:

$$\log V = \log V_o - \frac{0.434BT^2}{\beta^2}[\log(p_s/p)]^2$$

where p_s = saturation vapor pressure of the adsorbate at adsorption temperature. All other notations have their usual significance.

The results of the present investigation show that although 5A CMS is slightly more efficient than activated carbons for the removal (adsorption) of krypton, the latter will continue to be preferred because of their ready availability and much lower cost of production.