PREPARATION OF SPHERICAL, MONODISPERSE CARBON PARTICLES IN THE 1 TO 10 MICRON PARTICLE SIZE RANGE FOR USE IN VARIOUS FIELDS OF APPLICATION

W.R. Betz and M.J. Keeler
Supelco, Inc., Supelco Park
Bellefonte, PA 16823 USA

Introduction

A family of spherical, monodisperse carbon particles has been synthesized in the 1 to 10 micron particle size range. These carbons have been prepared using polymeric spheres which have been pyrolyzed and/or graphitized to produce carbon spheres of similar size distributions. Syntheses of the polymers using a modified microemulsion process to produce monodisperse particle size distributions, allow for the processing of the carbon spheres with subsequent monodisperse properties.

The use of both porous and non-porous polymer precursors allows for the processing of both porous and non-porous carbons. The tailoring of the polymer thus leads to carbons with different physical and surface chemistry properties. The range of furnace temperatures from 300ºC to 3000ºC augments the performance characteristics of the carbons formed. The variety of carbons prepared allows for adsorption applications in several fields of interest.

Experimental

The experimental approach to prepare two porous carbons consisted of two segments. In segment one, preparation of the polymers was performed using a modified microemulsion process. The first polymer was prepared to possess a multiporous (i.e., macropores, mesopores, and micropores) structure. The particle size distribution was optimized in the 3 micron particle size range. The polymer was subsequently converted to an ion-exchange resin, and pyrolyzed to produce the carbon molecular sieve. The porosity characterisitics of the carbon were determined using a Micromeritics ASAP2010 porosimeter[1]. The particle size distribution was determined using an optical image analyzer.

The second polymer was prepared to possess a monoporous, microporous structure. The particle size distribution range was also optimized in the 2-3 micron particle size range. The polymer was subsequently converted to an ion-exchange resin, and pyrolyzed to produce the carbon molecular sieve. Porosity and size measurements were performed as mentioned above.

Results and Discussion

The data obtained from the porosimetry analyses, for both carbons, are presented in Table 1. Plots of the particles size distributions for both carbons are presented in Graphs 1 and 2. The data obtained for the first carbon molecular sieve indicate that this multiporous carbon possesses micropores, mesopores and macropores. The distribution of these porosities has been shown to provide efficient kinetic properties in gas-solid adsorption processes[2].

The data obtained for the second carbon molecular sieve indicate that this monoporous, microporous carbon molecular sieve possesses a pore size distribution which is tightly distributed around a 7.0Å mean. This tight pore distribution has been shown to possess several advantages for gas adsorption, specifically the uptake of gases of molecular diameter(s) from 3 to 5Å.

Applications of these two carbons have focused on the gas-solid chromatographic separation of permanent gases, and sample concentration of gases for preparative work.

Conclusion

Two carbon molecular sieves have been synthesized from spherical, porous polymers in the 3 micron distribution range. These two carbons possess significantly different pore structures which allow for the application of each in differing modes of operation. For example, the multiporous carbon functions effectively in high velocity applications, and the monoprous, microporous carbon function well at optimum linear velocities for adsorption of a smaller molecular-sized range of adsorbates.

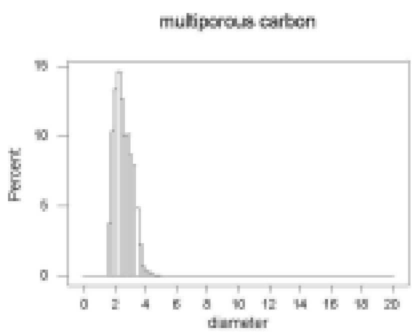
References

1. Webb, P.A. and Orr, C., *Analytical Methods in Fine Particle Technology*. Micromeritics, Norcross, GA, 1997.
2. Betz, W.R. and Lambiase, S.J., *J. Chromatogr.*, 556 (1991)433-440.

Table 1. Porosity data for the carbon molecular sieves

Carbon description	BET surface area (m2/g)	porosity (cc/g) micro	meso	macro
multiporous carbon	715	0.29	0.26	0.23
microporous carbon	675	0.35	0.00	0.00

Graph 1. Multiporous carbon



Graph 2. Monoporous carbon