Introduction

- Experimental technique used for catalysts and sorbents
- Results for ‘state-of-art’ Cabot carbon black
- Results for Cabot carbon black mixed with soil
- Results for commercial charcoal subjected to freeze-thaw cycles
- Future application potential for biochar samples

Analytical Technique

- Volumetric dosing N₂ adsorption at liquid nitrogen temperature gives accurate ‘map’, or ‘blue print’, of both size and amount of voids in materials < 3000 Å diameter
- When combined with Hg porosimetry detailed structure of porous materials produced from 500 micrometer diameter to about 5 Å or 0.5 nm
- Two techniques are complimentary and provide complete detail of void structure in porous materials
- Total analysis time per sample: 16 hours

Commercial Charcoal Results

Sample BET Surface Area (m²/g) Total Pore Volume (cc/g) Micromerit Micro-

Sample BET Surface Area (m²/g) Total Pore Volume (cc/g) Volume Area (m³/g)

Charcoal 2.9 0.006
Charcoal with 8-cycles 5.5 0.009
Freeze-thaw cycles

BP 2000 Transformed by Freeze-Thaw Cycles

- As received charcoal (red) and following eight freeze-thaw cycles (blue)
- Large 3-7 micron size particle are being fractured into smaller size particles following freeze-thaw cycles

BP 2000 mixed with Mississippi Loess

- Surface area variation tracks well with amount of Black Pearl 2000 in mixture
- Pore volume variation tracks well with amount of Black Pearl 2000 in mixture

“Blue-Print” of BP 2000 in Loess Soil

- Complex and detailed pattern of void spaces related to “bunch-of-grapes” structure about 800 nm size made from strings of primary particles

BP 2000 mixed with Mississippi Loess

- Calculated BET surface areas of 35 and 65 m²/g and total pore volume of 0.05 and 0.11 cc/g for two samples agree with experimental results

Future Direction

- Prove applicability to biochar samples aged in soils
- Find partners with Micromeritics to apply HRPDA technique to historic biochar beds in Amazon Basin
- Soil samples
- Ceramic green ware in these soils
- Use technique to aid development of structure-function relationships for understanding biochar crop yield improvements
- Application of techniques to synthetic soils

Conclusions

- Micromeritics analysis proves mixture of carbon black with soil can be analyzed by HRPDA
- Commercial charcoal has low surface area and low pore volume and is shown to be unstable to ‘freeze-thaw-freeze’ cycles
- Hg porosimetry (combined) with HRPDA give complete ‘blue print’ of micro-, meso-, and macropores
- Biochar analysis possible for moderate surface area samples