## Questions for Class 6 (May 11) Physical Properties, Particle Heatup Chemical Engineering 733

Reading Assignment:

- a. Lee Smith Book, 154-168
- b. Article by Merrick (*Fuel*, **62**, 540-546, 1983)
- c. Richards, A., D. Haycock, J. Frandsen, and T. H. Fletcher, "A Review of Coal Heating Value Correlations with Application to Coal Char, Tar, and Other Fuels," Fuel, 118942:1-16 (2021). DOI: 10.1016/j.fuel.2020.118942
- 1. Discuss Figure 4.50 in the Lee Smith book.
- 2. What is meant by porosity, true density, apparent density, and internal surface area? Why are these quantities important in coal combustion? How do they vary as a function of coal rank? How do these properties vary between chars and coals?
- 3. Please use your group to find and discuss the model proposed by Merrick for heat capacity.
- 4. Please compute the heat capacity in J/kg/K of the dried Argonne Premium Wyodak coal at temperatures from 300 K to 700 K.
- 5. Please show the transient particle energy equation in terms of particle temperature, with appropriate terms for a single coal particle injected into a hot inert gas. Be prepared to describe all of the terms, including thermal radiation.
- 6. Please compute the number distribution (# vs. diameter in microns) for the following mass distribution, as well as the number mean and mass mean diameters:

Tyler Mesh Size (passing)	400	325	270	250	200	170	150
Weight (%)	5	10	20	30	20	10	5

- 7. Search the web for the DuLong formula, which is used to compute the heating value of coal from the elemental composition. Calculate the heating value of the Illinois #6 Argonne Premium coal and compare the calculated value with the measured value.
- 8. Recalculate the heating value in problem #7 using the Mott-Spooner re-fit correlation in the paper by Richards et al. (2021).