Chemical Engineering 733
Review

This will be an oral final exam. The majority of questions will be from the second half of the class. However, there will be a few questions that are comprehensive, and hence require knowledge of the entire class. This is the review of the second half of the course.

A. Mineral Matter

- Occurrence
  - Analysis techniques (Chemical Fractionation, High & Low T Ashing, SEM/CCSEM, ...)
  - Organically-Associated
  - Included vs Excluded
- Transformations (Coalescence, vaporization, shedding, fragmentation, cenospheres)
- Deposition
  - fouling vs. slagging
  - thermophoresis
  - diffusion
  - impaction
  - management (sootblowing, coal switching, coal cleaning etc.)
  - disposal
- Effects of different elements (iron, calcium, etc.)
- Effect of biomass
- Disposal

B. Char Oxidation

- Rank dependence
- Film diffusion, pore diffusion
- χ factor
- CO/CO_2 ratio
- n^{th} order, iterate to get $P_{O2,s}$
- α (burning mode parameter)
- T and d_p dependence
- $CO \rightarrow CO_2$ in boundary layer
- Energy balance/iteration
- Thiele modulus
- Intrinsic reactivities (Ian Smith plot)
- TGA rate vs. high T rate
- Catalytic effects
- Pressure effects
- Correlations vs. chemistry
- Late burnout effects
- Gasification

C. NO_X & SO_x Control Strategies

- Why is NO_X bad?
- Types of NO_X formation (thermal, prompt, fuel, etc.)
- Chemical form and amount of N and S in coals of different types
- N release during devolatilization vs. char oxidation
- Combustion processes to control NO_x (low-NO_X burners, overfire air, reburning, ...)
- Post-combustion treatments for NO_x and SO_x (SNCR, SCR, limestone scrubber)
- Mercury forms and control strategies

D. CO_2 Emissions

- Rankine and advanced cycles (IGCC, USC, Oxy-Fuel) with their relative efficiencies
- CO_2 Capture
- Sequestration