**Title:** Modeling Gas Effects on Fluidized Bed Reactors for Biomass Fast Pyrolysis

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**Journal:** any suggestions?

1. Introduction
   1. Background on biomass fast pyrolysis
   2. Examples of recycled gas into fluidized bed reactor
   3. Overview of paper
2. Experimental apparatus
   1. NREL 2FBR fluidized bed pyrolyzer
3. Modeling approach
   1. Parameters used for models and computations
   2. Calculating gas properties of mixtures
   3. Fluidization equations
   4. Hydrodynamics equations
   5. Coarse grain DEM for simulations
   6. Pyrolysis kinetics
4. Results and discussion
   1. Comparison of single gas vs gas mixture
      1. Is this comparing a set global viscosity vs a local viscosity based on composition and temp like Charles discussed?
      2. Compare a local viscosity based on composition and temp
   2. Effects of gas on fluidization conditions
      1. Comparison can be done across 4 different particle sizes and for biomass volume averaged values
      2. Mixing – Shannon entropy and/or Lacey mixing index
      3. Circulation – how to quantify circulation?
      4. Expanded bed height
      5. Bubbling frequency
      6. Particle RTD
      7. Pyrolysis number
      8. Velocity – Umf, Ut, Ub, etc.
   3. Effects of gas on pyrolysis yields
      1. Lumped kinetic scheme (Di Blasi) or detailed kinetics (Ranzi)?
5. Conclusion
   1. Summary of results
   2. Suggestions for next steps
6. Open source code and data
   1. Python code on CCPC GitHub
   2. CFD simulation code on CCPC GitHub
7. Acknowledgement
8. References