Breakout Session 3: Mixing and Mass Transfer

A - Mixing Technology Needs, Barriers, & Challenges for Mixing and Mass Transfer Processes

- **Models and simulation to enable product design**
- Advanced characterization capability of materials and process during operations
- Challenge of mass transfer = heat transfer = dispersion = attrition (physical versus chemical properties)
- **Balance R&D on material property vs. process**
- Identify possible disruptors
- Functional interface challenges, contamination impact on surface chemistry
- Provide industry key models and analytics – “modular” vs “economy of scale”
- Metrology scaled up to support “in-situ” process monitoring and characterization
- Sensors capable of surviving harsh environments
- Continuous versus batch process routes

Breakout Session 3: Mixing and Mass Transfer

B - R&D Needs for Mixing and Mass Transfer Processes

- Continuous versus batch process routes
- **Help enable high-risk high-payoff products (high cost process versus low value products (such as water)**
- Tomography (kg to grams), short measurement data collect times
- Rapid gas – gas separations, such as N2 extraction from a gas stream
- Surface morphology
- **Metrology and predictive modelling enabled without need for HPC**
- Heating without fossil to temperatures approaching 2000oC
- Processing materials of vastly different physical properties, such as thixotropics with dilatants, high mass with low mass, varying PSD, etc.
- Development of ultra-high surface materials processing in constrained volumes
- Cost of modification of existing systems to gain advantages of RD&D

Breakout Session 3: Mixing and Mass Transfer

C - Metrics and Impacts for Mixing and Mass Transfer Processes

- Reasonable volume or quantity needed to assess results
- Establish key rules, standards and metrics for quality and reliability
- **Help industry complete the R&D cycle**
- **Amount of energy use and savings**
- Amount of plant floor “foot-print”
- Unit of energy versus volume of product or development and/or time
- Modularity vs flexibility vs “down-time”
- Modular for module alone is not useful, unless enabling placement at or near customer
- Process time vs energy vs $
- Enabling versatility of use
- All have impact on process and energy and $/value and environment
- Measurement of waste heat
- Reduction of process steps

Breakout Session 3: Mixing and Mass Transfer

D - Other Technology Advancement Considerations for Mixing and Mass Transfer Processes

- Workforce, commercialization, small vs medium vs large business
- **Encourage HPC availability at a National Laboratory, readily accessible by private and public users**
- **An MDF model would allow industry to prototype and demonstrate process and products prior to expenditure of $ to facilitate and establish a plant (especially at higher TRL)**
- Consideration of industrial interaction and cooperation within pre-competitive space
- Incremental improvement through use of a center of excellence delving into discrete issues
- Develop modular systems to address secondary effluents, by-products, etc. which are generated during course of primary process
- Workforce must be capable to understand and use these new advanced manufacturing tools. Training begins at college, all must be aware and understand needs for the future. (5yrs, 10yrs, 15yrs?)
- Extricate from the “process” to enable consideration of radical advancements