1. Energy efficient materials

Ultra-high porosity (>70%) castable refractories yield energy efficiency of insulating boards with improved mechanical integrity.

Significant improvements in energy efficiency achieved with an order of magnitude increase in strength.

Especially suited for the small ladles used in foundries which require significant superheat.
2. Accretion resistant materials

- **Process Conditions**
  - Graphs showing mass (kg) to CF = 0.50 for different materials.
  - Data points for C, Al, Ti, Superheat, Graphite, and Silica.

- **Refractory Types**
  - Diagram of refractory types with materials including Al₂O₃, C, and SiO₂.
  - Image of an alumina-graphite nozzle with deposits.
  - Scale bars indicating 1 inch and 200μm.
3. Inclusion Identification

- **Spinel Inclusions**
- **Alumina Inclusions**
- **Massive Alumina and Spinel Inclusions**
4. Dewatering of Castables

Modeling and testing related to rapid dewatering of castables:

- Refinement of existing models
- Design, construction and operation of equipment which effects rapid one-side heating
- Permeametry to precisely measure low permeability materials
- Studies on polymeric fibers and explosive spalling
5. Slag resistant materials

Reaction chemistry of graphite containing refractories with a variety of “antioxidant” additions, oxide grains and binders

Corrosion / Penetration Resistance
  Isothermal / gradient evaluation

Thermal-mechanical behavior
  Tensile strength by diametral compression
  Creep above 1500°C

Oxidation Resistance
  Effect of additives
  Development of Protective Coatings
6. Inert lining materials

ULC-AK Steel Refractory steel Interface

Base refractory

~6.5 mm

Solid inclusions (log moles*)
- Magnesia-Graphite (ULC-Al)
- Alumina-Silica-Graphite (ULC-Al)
- Alumina-Graphite (ULC-Al)

Temperature ºC
1550 1575 1600 1625 1650

Graph showing solid inclusions (log moles*) vs. temperature.
7. Free open sands

Develop a method for determining sintering rates of sand formulations – dilatometer based approach

Evaluate the impact of sand chemistry on sintering

Identify chrome ore free sands and determine sintering behavior at steelmaking temperatures
Potential Topics/Areas of Refractory Research

• Recycling and reuse of oxides
  – evaluation / identification

• Cleanliness / Quality Issues
  – non-wetting / inert / corrosion resistant

• Energy / Environmental
  – heat containment / bio fibers / pitch & resin

• High Temperature Process Simulations
  – evaluation / validation / certification