Chapter 3

Objectives

Considering the demand of porous ceramics in wide range of technological applications and on the basis of the trend towards development of cost effective products with either comparable or even better properties than the existing one, the following broad objectives were identified:

i. To fabricate porous alumina ceramics with wide range of tailored porosity and microstructure via dry processing route through burnout of pore former such as rice husk.
ii. To explore sucrose as an alternative binder in fabrication of porous alumina through dry processing.
iii. To optimization of the composition (i.e. size and fraction of rice husk) and process parameters in order to get defect free compacts.
iv. To study the influence of composition as well as microstructure on various properties of the porous alumina ceramics.

The detailed objectives of the present study are listed below:

1. **To investigate sucrose as an alternate binder in dry processing of alumina ceramic through:**
   - Examining the binding ability of sucrose through study of the following properties of dry pressed green compacts:
     - Mechanical properties such as density and strength,
     - Microstructure
     - Machinability in the green stage.
   - Characterization of sucrose binder.
   - Optimization and standardization of sucrose content by co-relating with correlation with the corresponding microstructure of the green compacts.
   - Examining the pore forming ability of sucrose by characterization of porosity of sintered compacts.
2. **To study processing and fabrication of porous ceramics with tailored pores microstructure using risk husk and sucrose by:**

- Processing and characterization of rice husk
- Fabrication of porous ceramics with a wide range of pores' microstructures through:
  - Composition formulation, Optimization of sample composition (RH content and RH size)
  - Optimization of process parameters
- Studying and analyzing various defects observed during processing.
- Characterization of physical properties of green and sintered compacts.
- Phase identification and analysis.

3. **To characterize microstructure and mechanical properties of RH based porous alumina ceramics for studying:**
   - The effect of composition such as RH content and its size in controlling the pore microstructure.
   - The effect of pores microstructure such as volume fraction porosity and pores' size on various mechanical properties.
4. **To study thermal properties of RH based porous alumina ceramics through:**
   - Measurement of **thermal conductivity** of porous alumina as a function of porosity and pore size.
   - Comparison of the experimental thermal conductivity with the predicted values based on EMT theory.
   - Investigate the thermal shock resistance of porous alumina in terms of the degradation in the strength of samples.
   - Measurement of the post quench retained strength and determination of ΔT_c (critical temperature difference) as a function of sample composition.
5. **To study electrical properties of RH based porous alumina through:**
   - Study of the effect of porosity and pore size on **dielectric constant** of porous alumina.
   - Study of the effect of frequency and temperature on value of dielectric constant, ε of porous alumina samples with varying microstructure.
   - Study of the effect of porosity and pore size on tan δ of porous alumina.

- Study of the effect of frequency and temperature on loss tangent, tan δ of porous alumina samples with varying microstructure.
- Compare the experimental data of dielectric constant and tan δ with the predicted values obtained using theoretical models.

6. To study permeability behaviour of RH based porous alumina by:

- Studying the pressure drop characteristics with nitrogen gas flow rate for porous alumina samples with varying pore microstructure
- Studying the behavior of permeability constant (Darcian and Non-Darcian) of porous alumina as a function of microstructure of samples