CHAPTER 4

MATERIAL PREPARATION AND EXPERIMENTAL PROCEDURE

- **For agricultural products, raw materials like rough rice, canola, wheat, corn are taken directly from farms or markets for experimental purposes**.
- **<u>Preparation of ceramic material for production as well as experimentation</u>.**

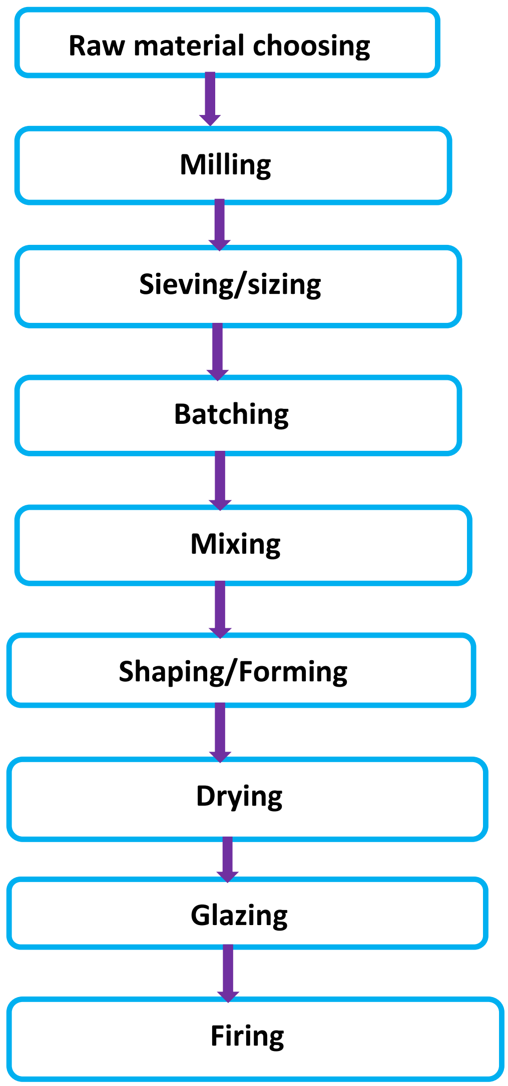


Figure 4.1. Block diagram of key step of the ceramic processing.

4.1. Steps in ceramic processing.

Step 1: Milling & Raw Material Procurement

The raw materials used in the process are milled materials. Ball mill is generally used to mill the material. The goal is to free any impurities in the components, allowing for better mixing and shaping and, as a result, a more reactive material when fired.

Step 2: Sieving/sizing

The materials that have been milled and procured must be sized in this stage in order to differentiate useful material from non-usable substances. The effect of managing the particle size is appropriate bonding and a smooth surface on the completed product. Fine mesh vibrator equipment can be used to accomplish this. Mesh sizes come in a variety of sizes. The size of the screen deck is determined by the thickness of the slurry and the proportion of particles in the mix.

Step 3: Batching

This procedure, also known as "mixing," involves calculating quantities, weighing, and blending the basic elements in the beginning. Vibratory feeders can be used to provide continuous material flow into a pub mill hopper.

Step 4: Mixing

Prior to forming, the ingredients of the ceramic powder are mixed or blunged together to create a more chemically and physically homogenous material. When working with dry mixtures, pug mills are frequently the chosen piece of equipment. It is also necessary to include binders or plasticizers.

Step 5: Forming

For this step, materials such as dry powders, pastes, or slurries are consolidated and molded to produce a cohesive body for the desired product. In the particular case of dry forming, vibratory compaction can be used to achieve the desired shape. For molds of a smaller scale with a lighter load, Vibratory Jogger Tables may be desired. Providing the weight of the mold/materials and scale of the mold will help make choosing a proper compaction table easier.

Step 6: Drying

The formed materials hold water and binder in their mix that can cause shrinkage, warping, or distortion of the product. Generally, convection drying is the most commonly used method in which heated air is circulated around the ceramic piece that alleviates the risk of such imperfections in the final product.

Step 7: Glazing

Referring back to traditional ceramic processing, this step is added to the process prior to firing. Typically, the glaze consists of oxides that give the product the desired finish look. The raw materials are ground in a ball mill or attrition mill.. The glaze can be applied using spraying or dipping methods.

Step 8: Firing

Also known as sintering or densification, the ceramics pass through a controlled heat process where the oxides are consolidated into a dense, cohesive body made up of uniform grain. Some general considerations for various sorts of firing end products:

1. A short firing time results in a porous and low-density end product.
2. A short to intermediate firing time produces fine-grained, high-strength results.
3. A long firing time results in a coarse-grained, creep-resistant product. This indicates that the material will not warp if subjected to a load for a lengthy period of time.

4.2 Experimental set-up

Figures 4.2 and 4.3 provide a schematic representation of the setup. The drying chamber is constructed of plexiglass and has a cylindrical shape with a radius of 12.5 cm and a bed height of 20 cm. The heated air enters the column at the base through a 2mm thick plate with 2mm diameter holes. A thin wire mesh is a spot welded over the plate. The electric heater is made up of several heating components with a capacity of 2 KW. The hot air from the blower is delivered into the air chamber and subsequently into the drying column. For the working temperature range of 35°C-150°C, a thermostat is equipped to control air temperature to within 0.5°C. A timer is used to control the drying process. An airflow controlling knob maintains the required airflow rate in the drying chamber. This dryer's air velocity ranges from 0.95 m/s to 4 m/s. Thermocouples are used to measure the temperature of the grain as well as the intake and exit temperatures of drying air. At the bottom of the drying chamber, an adjustable nob is provided to control the mass flow rate of the material in the drying chamber.

4.3. Experimental Procedure

Experiments were carried out on various materials in various ways and with various parameters. Using the knob supplied, the input air velocity has been set in the range of 0.6 m/s to 1.5 m/s for deep bed drying and will depend on the type of material taken for fluidized-bed drying. The temperature controller in the device sets the heated air temperature to the required value. For continuous deep bed drying, we continuously put the material into the chamber so that the drying chamber couldn't get empty. With the help of an adjustable knob, we can control the mass flow rate, which is the counterpart of the residence time of material inside the drying chamber. At desired intervals, the weight of the sample was recorded. The difference in weight between two successive weights was used to calculate moisture content loss.

And the experiments were carried out in batch mode for fluidized bed dryer. The inlet air velocity was brought to the required fluidization level, as reported in input data with the help of the knob provided for the purpose.

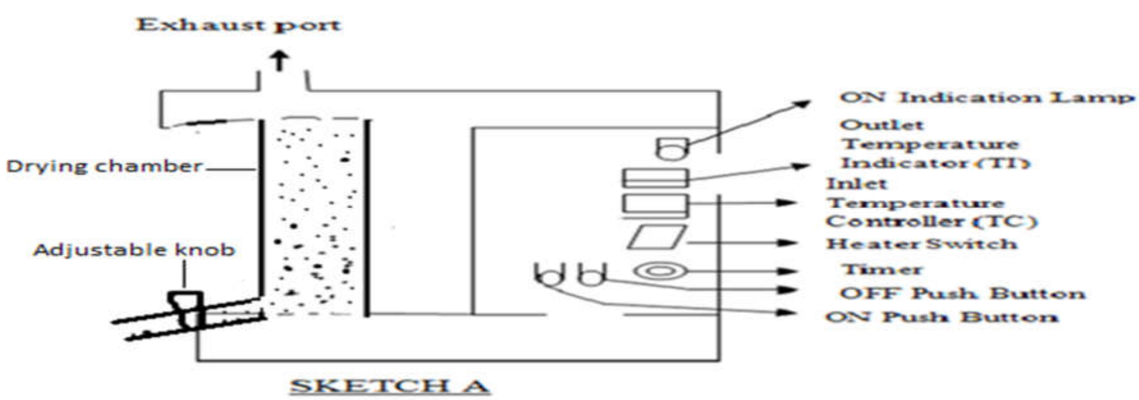
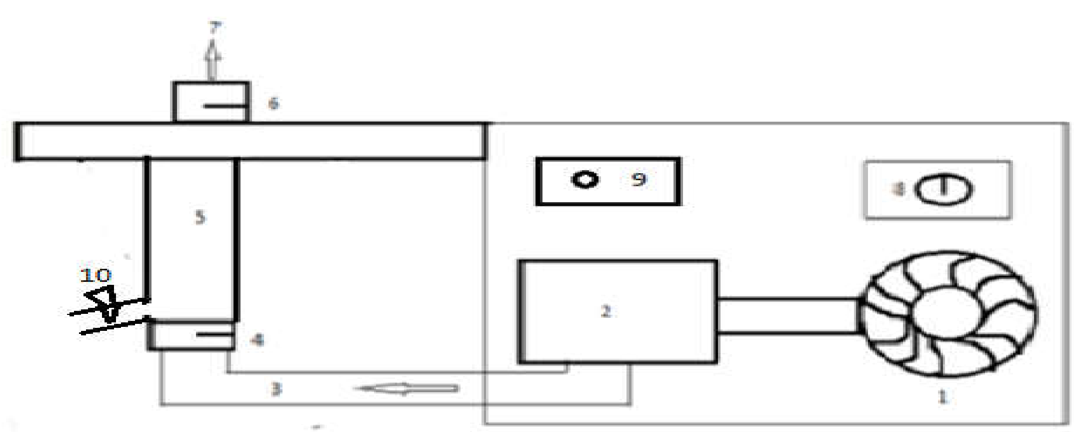


Figure 4.2. Front views of the dryer



1. Air blower 2. Electric heater 3. Air inlet pipe 4. Thermocouple for inlet air 5. Drying chamber6. Thermocouple for outlet air 7. Hot air outlet 8.Drying timer 9. Airflow controller 10. Adjustable knob.

Figure 4.3. The sectional view of the dryer.