The processing of raw ceramics into ceramic products requires the preparation of ceramic powders. The application and quality of the product defines the type of powder preparation required. The application spectrum of ceramics ranges from household items to space-shuttle. The raw materials for powder preparation are generally natural minerals such as Quartz, Zircon, fireclay. The raw materials need to be processed in order to convert them into the desired products with special characteristics. The type and nature of processing may be different for different products and applications.

**Characteristics of powders**
Every raw material should possess some desirable characteristics for further processing. Some of the important characteristics of powders which define the quality of the final ceramic product should be kept in mind. Desirable characteristics depend upon the quality of product and application.
These characteristics are:

- Chemical composition
- Phase composition
- Particle size
- Particle size distribution
- Particle shape
- Agglomeration

**Ceramic powder processing**
Ceramic powder processing can be broadly divided into two categories. One is chemical processing of powders using the products of chemical reaction which are in the form of powders. Second processing technique is mechanical preparation methods in which a direct contact of particles takes place with some agents (such as Grinding/milling).
Mechanical preparation method: Milling/Crushing/Grinding

Mechanical preparation method involves crushing, milling in a ball mill or grinding ceramic raw materials into small particles. A ball mill is a machine with a rotating hollow cylinder partly filled with steel or white cast iron balls. Depending on the powder amount and the powder properties, different types of mills are used for dry and wet grinding.

Ball Milling

Ball Mill grinds a material by rotating a cylinder with hard balls, causing them to fall back into the cylinder and onto the material to be ground. The impact of balls is important for reduction in size of the particles. Ball milling is mostly used for brittle materials. The diameter of the mill decides the speed of the mill. Generally, the rotational speed does not exceed 20 RPM. Diameter of cylinder is inversely proportional to the rotational speed. The larger the diameter, the slower the rotation. If the speed is too high, it begins to act like a centrifuge and the balls do not fall back, but stay on the perimeter of the mill. Figure 1 shows the schematic of various mechanisms of crushing the ceramic powder. These are roll crushing (figure 1a), ball mill (figure 1b) and hammer milling (figure 1c).

In roll crushing method, there are basically two rollers; one is fixed roller and the other is adjustable roller on which the lumps of ceramic raw material are dropped through hopper. When roller starts rotating, the raw material is pressed inside the roller as shown in figure 1a and fine particles of ceramic powder are obtained on the other side. The size of the powder can be varied as per the requirement. This can be done by changing the space between the rollers through adjustable roller using adjustable screw.

In case of ball milling as shown in figure 1b, black sphere represents balls of some harder material and the green balls represent the ceramic particles. The ball mill rotates continuously and the collision between harder balls and ceramic particles occurs repeatedly and ceramic powder is prepared.

In hammer milling process, a hammer is rotated inside the chamber and large size lumps of raw ceramic are crushed into very fine ceramic powder. As shown in the figure 1c, there is a grain hopper from where raw material is moved into the chamber through delivery device. There are four independent hammers attached to the rotor. Raw material is hammered down and fine ceramic powder is taken away.
Figure 1 Mechanical preparation method, to obtain ceramic particles: (a) roll crushing (b) ball mill and (c) hammer milling