TSC Ferrite International

Ferrite Manufacturing Overview

Test raw material (MnO, ZnO. Fe_2O_3)
Inspect for purity
↓
Weigh & mix raw materials
Control Composition
↓
Spray dry
Obtain a powder form
Control bulk density
↓
Calcine Powder (Pre-firing)
Control magnetic saturation
↓
Wet mill
Control particle size
↓
Spray dry to obtain a pressable powder
Control bulk density
↓
Form
(Compact powder into “green cores”)
Control pressed density
↓
Sinter
(fire “green cores” to obtain a ceramic with a spinel crystal lattice structure)
Control grain growth
↓
Finish (grind, tumble, coat)
Control gap and surface finish
↓
Audit to insure that all parts meet all the customers requirements
↓
Pack & Ship

The process of manufacturing Soft Ferrites is made up of four basic steps: powder preparation, forming, sintering and finishing. At Ferrite International raw materials (manganese oxide, zinc oxide and iron oxide) are tested for purity levels. After the raw materials are approved they are weighed and wet mixed, and spray dried to a powder form then calcined. Calcining is pre-firing the material at a selected temperature between 800 degrees and 1100 degrees C thus creating a partial spinel structure and partially densifying the powder so that the pressed part will shrink less during the final sintering process. The calcined material is then wet milled to a specific particle size range. This particle size reduction enables better control of grain growth that occurs during the final sintering process. An organic binding agent is added to the slurry for the purpose of holding the pressed part intact. The slurry is then spray dried to provide a dry moldable powder composed of discreet spherical agglomerates with uniform characteristics.

The forming operation transforms the powder into a soft "clay like" material in the desired configuration. In this form they are called "green cores". The forming is done using presses and powder compaction tools. Because tool steels do not last under the wear of the abrasive Ferrite powder, carbide tools are used for large quantity items. The size, weight and thus the density of the green compact are all controlled within very tight tolerances.

To create the desired physical and magnetic characteristics the "green cores" are sintered in large kilns at temperatures between 1300 and 1450 degrees Centigrade. Close temperature and atmospheric control during sintering is critical. The sintering is divided into three stages. In the first stage the binders are driven off. The second stage is when the actual sintering takes place. The spinal crystal latus structure forms, the product shrinks and the magnetic characteristics are realized. The final stage is devoted to reoxidation and cool-down. Volume shrinkage is affected by the size, shape and the chemical composition. Each part must be molded oversize. A typical material may shrink 15% in any one linear dimension (approximately 50% of total volume).

Cores that will be assembled require machining. This process is critical to removing the final surface layer of reactive Ferrite (called skin) that result from sintering and to minimize any air gaps by insuring smooth flat and parallel surfaces. Some cores sets require gaps with tight tolerances in their flux path. This can be accomplished by grinding a pot core's center post or an E core's center leg. Because of the extremely hard, brittle and abrasive nature of the ceramic material diamond wheels and large amounts of liquid coolant are required for all machining operations.

Sintered toroidal cores are tumbled and sometimes coated with epoxy to eliminate any sharp corners or burrs that could damage wire insulation during the ensuing operation.

Finally the cores are tested electrically, inspected for dimensional and visual conformance and packed to be shipped to our customer.