EXPERIMENT 2

Subject

Dry Pressing

Objective

To show how to form ceramic powder (with/without binder) by pressing with various pressures.

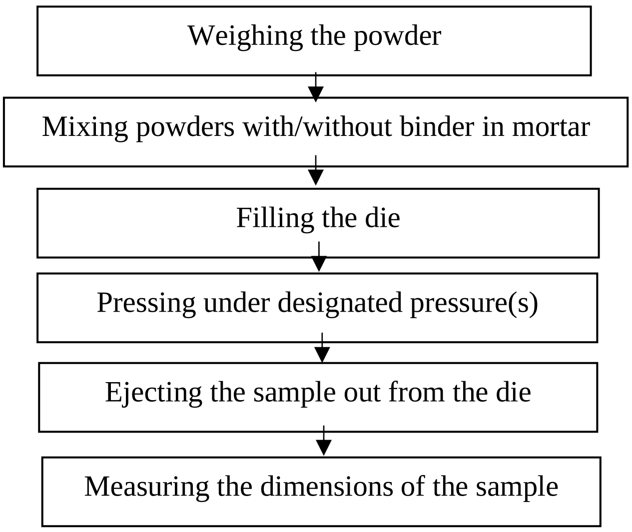
Theory

Die compaction is one of the most widely used operations in the ceramics industry. It allows the formation of relatively simple shapes rapidly and with accurate dimensions. The agglomeration of dry powders combined with the nonuniform transmission of the applied pressure during compaction leads to significant variations in the packing density of the green body. To minimize the density variations, die pressing is used for the production of relatively simple shapes (e.g., disks). Isostatic pressing produces better uniformity in the packing density and can be used for the production of green bodies with complex shapes and with much higher height-to-diameter ratios. The green body has irregularities in both shape and surface quality and often requires considerable machining.

In the forming of ceramics, the use of certain additives, sometimes in concentrations as low as a fraction of a percent by weight, is often vital for controlling the characteristics of the feed material, for achieving the desired shape, and for controlling the packing uniformity of the green body.

Binders are typically long chain polymers that serve the primary function of providing strength to the green body by forming bridges between the particles Powders, often mixed with a small amount of binder (less than 5 vol%), are commonly used as the feed material in laboratory experiments. In industrial practice, the flow properties of the feed material become an important factor when efficient die filling, fast pressing rates, and reproducible green body properties are required. Fine powders do not flow very well and are difficult to compact homogeneously, so it is often necessary to granulate them, commonly by spray drying of a slurry.

Stages of Experiment



Compaction Faults

Springback is almost instantaneous on release of the pressure. The amount of springback depends on several factors, including the powder, the organic additives, the applied pressure, the rate of pressing, and the gas permeability of the powder compact. Generally, it is higher for higher amounts of organic additives and for higher applied pressure. While a small amount of strain recovery is desirable to cause the compact to separate from the punch, an excessive amount can lead to flaws. Ejection of the powder compact from the die is resisted by friction between the compact and the die wall. Lubricants added to reduce die-wall friction during the compaction process have an additional benefit in that they reduce the pressure required for ejection.

The common defects in compacts formed by die pressing are illustrated in Fig. 1. They are caused by springback and by friction at the die walls. The use of a binder to increase the compact strength, reduction of the applied pressure to reduce the extent of the springback, and the use of a lubricant to reduce die wall friction can significantly reduce the tendency for defect formation.

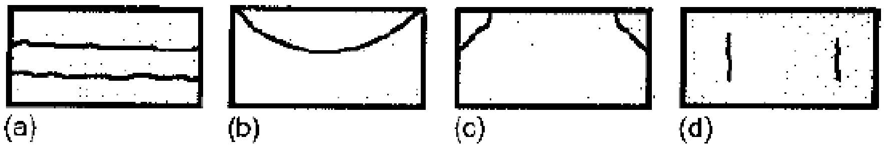


Figure 1. Illustrations of typical defects in die compaction of dry or semidry powders: (a) delamination, (b) end capping, (c) ring capping, and (d) vertical cracks.

Equipments and Materials

Ceramic powder (Al_2O_3)

Poly Ethylene Glycole (PEG)

Pressing Die

Mechanical Press

References of Theory

Rahaman, M.N., "Ceramic Processing and Sintering", Second Edition, 2003

Content of the Report

- Use report cover page template fort the first page of report. (You can download from web site of department)
- Every page should have page number. Text size should be 12 punto.
- Briefly explain the experiment's aim and theory with your own words.
- Draw a table with your experiment data. Weight, dimensions, green density, and Show your calculations with formula.
- Draw pressure (MPa) and green density graph, and make your own comment with results.
- You can use photos that taken from experiment day in your report.