

## EXPERIMENT 4

### Subject

Density Analysis

### Objective

To learn how to measure the density of sintered ceramic bodies by archimedes method.

### Theory

In almost all ceramic based processing, especially in high strength or high temperature required applications, the density of the materials constitutes great importance. Porosity affects a material's mechanical properties, thermal properties (especially heat transfer, especially for refractory materials), and corrosion, mechanical wear behavior due to the materials present in the different environment. Porosity in ceramic materials is also important depending on the application area in which they are used (floor and wall tiles, ceramic filters). Since it is difficult to detect closed pores, in most cases determining only the proportion of open pores in ceramics is important and useful in practice. In principle, the volume of pores in a sample is calculated from the weight of the liquid required to fill them (water will be used in this experiment). Since this method is based on the Archimedes Principle, it is also called the Archimedes Method.

In SI unit system, density unit is  $\text{kg/m}^3$ ,  $\text{g/cm}^3$ .

$$1 \text{ kg/m}^3 = 0.001 \text{ g/cm}^3$$

$$1 \text{ g/cm}^3 = 1 \text{ kg/dm}^3 = 1000 \text{ kg/m}^3$$

### Experimental Calculations

$$\text{Volume (V) (cm}^3\text{)} = W_w - W_s$$

$$\text{Water Absorption (\%)} = \frac{W_w - m}{m} \times 100$$

$$\text{Bulk Density (g/cm}^3\text{)} = \frac{m}{V}$$

$$\% \text{ Apparent Porosity} = \frac{W_w - m}{V} \times 100$$

$$\text{Apparent Specific Gravity} = \frac{m}{m - W_s}$$

*In this calculations;*

**m** = Weight of sample (sintered) (g)

**V** = Volume of the (water absorbed) sample

**W<sub>w</sub>** = Weight (water absorbed) saturated sample (g)

**W<sub>s</sub>** = Weight (water absorbed) suspended sample (g)

**m** = mass of dry sample (g)

## Experimental Setup

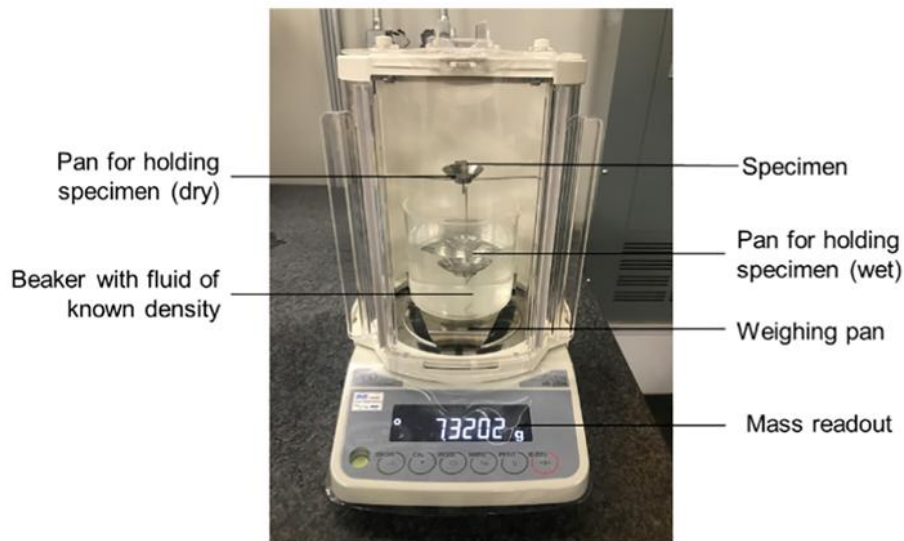


Figure 1. Archimedes density measurement setup.[1]

## Content of the Report

- Use report cover page template for 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.
- Draw a table with your calculated data.
- Calculated data table includes; Water absorption, Bulk density, Apparent specific density, Theoretical Density, % Apparent Porosity
- You can use photos that taken from experiment day in your report.

1. Bruce, D., Paradise, P., Saxena, A., Temes, S., Clark, R., Noe, C., ... & Bhate, D. (2022). A critical assessment of the Archimedes density method for thin-wall specimens in laser powder bed fusion: Measurement capability, process sensitivity and property correlation. *Journal of Manufacturing Processes*, 79, 185-192.