



# **SNS COLLEGE OF TECHNOLOGY**



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**COIMBATORE**

## **DEPARTMENT OF CIVIL ENGINEERING**

**19CEB204 – CONSTRUCTION MATERIALS**

**II YEAR / III SEMESTER**

**Unit 5 : Modern Materials**

**Topic : Ceramics**



# Ceramics

- A ceramic is an inorganic non-metallic solid made up of either metal or non-metal compounds that have been shaped and then hardened by heating to high temperatures. In general, they are hard, corrosion-resistant and brittle.
- Pottery is one of the oldest human technologies. Fragments of clay pottery found recently in Hunan Province in China have been carbon dated to 17,500–18,300 years old.



# Types



- The major types of pottery are described as
  1. earthenware,
  2. stoneware and
  3. porcelain.



# Earthenware

- Earthenware is used extensively for pottery tableware and decorative objects. It is one of the oldest materials used in pottery.
- The clay is fired at relatively low temperatures (1,000–1,150°C), producing a slightly porous, coarse product. To overcome its porosity, the fired object is covered with finely ground glass powder suspended in water (glaze) and is then fired a second time. Faience, Delft and majolica are examples of earthenware.



# Stoneware

- Stoneware clay is fired at a high temperature (about 1,200°C) until made glass-like (vitrified).
- Because stoneware is non-porous, glaze is applied only for decoration.
- It is a sturdy, chip-resistant and durable material suitable for use in the kitchen for cooking, baking, storing liquids and as serving dishes.



# Porcelain

- Porcelain is a very hard, translucent white ceramic. The earliest forms of porcelain originated in China around 1600BC, and by 600AD, Chinese porcelain was a prized commodity with Arabian traders.
- Because porcelain was associated with China and often used to make plates, cups, vases and other works of fine art, it often goes by the name of 'fine china'.
- To make porcelain, small amounts of glass, granite and feldspar minerals are ground up with fine white kaolin clay.
- Water is then added to the resulting fine white powder so that it can be kneaded and worked into shape. This is fired in a kiln to between 1,200–1,450°C. Decorative glazes are then applied followed by further firing.



# Bone china

- Bone china – which is easier to make, harder to chip and stronger than porcelain – is made by adding ash from cattle bones to clay, feldspar minerals and fine silica sand.



# Advanced ceramics – new materials

- Advanced ceramics are not generally clay-based. Instead, they are either based on oxides or non-oxides or combinations of the two:
  - Typical oxides used are alumina ( $\text{Al}_2\text{O}_3$ ) and zirconia ( $\text{ZrO}_2$ ).
  - Non-oxides are often carbides, borides, nitrides and silicides, for example, boron carbide ( $\text{B}_4\text{C}$ ), silicon carbide ( $\text{SiC}$ ) and molybdenum disilicide ( $\text{MoSi}_2$ ).





# Advanced ceramics – new materials

- Production processes firstly involve thoroughly blending the very fine constituent material powders. After shaping them into a green body, this is high-temperature fired (1,600–1,800°C). This step is often carried out in an oxygen-free atmosphere.
- The high temperature allows the tiny grains of the individual ceramic components to fuse together, forming a hard, tough, durable and corrosion-resistant product. This process is called sintering.



# Applications

- Advanced ceramic materials are now well established in many areas of everyday use, from fridge magnets to an increasing range of industries, including metals production and processing, aerospace, electronics, automotive and personnel protection.
- In modern medicine, advanced ceramics – often referred to as bioceramics – play an increasingly important role. Bioceramics such as alumina and zirconia are hard, chemically inert materials that can be polished to a high finish. They are used as dental implants and as bone substitutes in orthopaedic operations such as hip and knee replacement.



***Thank You!!***