15 June 2019

By- Rajamul Hdque

Non-Metallic Engineering Materials

Ceramics

Definition :- The word ceramics is derived from the Greek word keramos, which means burnt material. Ceramics are inorganic non-metallic materials which are used at very high temperatures. They contain nitrides, oxides, carbides & silicates etc.

Example :- Glass, cements, plasters, refractories, electrical insulators, electronic ceramics etc.

Properties :-

1. Hard, brittle, high melting point and excellent wear resistance.
2. Low electrical and thermal conductivity.
3. Good thermal and chemical stability.
4. High compressive strength and low tenside strength.

Applications :-

1. It is used for manufacturing of tiles.

2. It is used in electronics as capacitors and insulators.

3. It is used in cutting tools.

4. It is used in rocket industries.

5. It is used in medical technology like artificial bone, dental products etc.

Types :-

1. Structural Ceramics :- It is a research area in which the physical & mechanical properties of engineering ceramics are studies.

   e.g.:- alumina (Al_2O_3), silicon nitride (Si_3N_4) etc.

2. Facing Materials :- The materials which are used for external & internal facing of buildings and structures are called facing materials.

   e.g.:- facing bricks, tiles etc.

3. Refractories :- The materials which retain their mechanical properties even at higher temperatures (above 1000°C) are called refractories.

   e.g.:- SiO_2, Al_2O_3, MgO etc.

4. Fine Ceramics :- Fine ceramics, sometimes referred to as "advanced ceramics", are engeering materials that are used in advanced technology industries, including electronics.

e.g.:- cements, glass etc.

5. Special Ceramics :- The materials that are used in radio industry, instrument manufacture etc. are known as special ceramics.

e.g.:- clay, silica etc.

Refractories

Definition :- See on page no. 2.

Refractories are ceramic materials made from high melting oxides like SiO_2, Al_2O_3 and MgO, used to resist heat and protect furnaces.

Properties :-

1. It should be infusible at high operating temperature.
2. It should be chemically inert.
3. It shouldn't crack.
4. It shold have high refractoriness.
5. It should withstand the applied load on it at the operating condition.

Applications :-

1. Fire Clay Refractory (Chamotte) :- It has acidic chemical nature.

General Characteristics :-
- Low thermal conductivity
- low specific gravity
- low specific heat
- low thermal expansion coefficient.

Applications :- • Blast furnace
• Runner
• Hot stove checker bricks.
• Reheating furnace

2. Silica Refractory :- Acidic chemical nature.

Gen. Characteristics :-
• Resistant to acidic slag
• " " thermal shocks.
• low specific gravity.
• Higher strength at operating temperatures.

Applications :-
• Electric & furnace roof.
• Copper refining furnace.
•

3. Mansonry Bricks :-

Applications :-
• As bricks are light, they can be handled easily.
• It has a tendency to absorb moisture.
•

Composite Materials

Definition :- A composite material is a combination of two or more materials having different physical and chemical properties into a new material.

Example :- Concrete, wood, automobile tyres, ceramic matrix, fiberglass reinforced etc.

Properties / Advantages :-

1. The composite materials are lightweight.
2. Good electrical and thermal conductivity.
3. Excellent anti-friction and mechanability.
4. High tensile strength, toughness and corrosion resistance, etc.

Applications :-

1. Automobiles like automobile body parts, engine components.
2. Sports, and music like gold clubs, musical instruments etc.
3. Building construction such as roof construction etc.
4. Electronics and computer components like electronics circuit boards etc.

Adhesives

Definition :- Any substance that is capable of joining materials by attachment of their surfaces can be group as an Adhesive. The process of joining the materials using adhesives is called Adhesive Bonding, and is a class in itself, like welding, soldering and fastening.

Properties :-

1. Extremely good electrical properties.
2. Joint is often indirect.
3. Many adhesives decompose between 100°C to 200°C.
4. Materials needn't be deformed when screw used.
5. Quality control is difficult to carry out.

Advantages :-

1. It can be used for bonding the surfaces of glass, metals, plastics and wood.
2. It is possible to eliminate corrosion between different metals joined by adhesives.

3. The process of applying adhesive is easy, economical and speedy.
4. It provides adequate strength.
5. Modern plastic materials (like PVC pipes) are always joined by adhesives.

Disadvantages :-

1. It is not possible to use any adhesive for all substances.
2. It requires time to attain the desired strength.
3. Generally, it doesn't remain stable at high temperature.

Examples :-

1. Phenol-formaldehyde resin [PF] (Bakelite) :- It is the condensation polymer of phenol and formaldehyde. This resin is also known as bakelite.

Properties :-

(a) It is insoluble.
(b) It is water-resistant.
(c) It has good electrical insulating character.
(d) It is thermally stable.
(e) High degree polymerization :- hard
(f) Low " " :- soft

Applications :-

1. To make telephone parts, cabinets for TV, radio and automobile parts.
2. To prepare varnishes, paints and protective coatings.
3. To make insulators like switches, plug, switch boards.

2. Urea-formaldehyde Resins (UF) :- It is condensation polymerization product of urea & formaldehyde.

Properties :-

(a) They are highly resistant to chemicals.
(b) They are electrical insulators.
(c) They are highly stable to light.
(d) Desired colours can be introduced to these resins by adding a proper pigment & filler.

Applications :-

1. Manufacturing of bottons, household appliances.
2. Used as adhesive in the plywood industry and furniture.
3. In the paper industry
4. In the preparation of enamels.

3. Epoxy Resins :- The commonly used epoxy resin is prepared by the condensation of epichlorohydrin with bisphenol.

Properties :-

- Thermosetting polymer
- Strong mechanical properties.
- High temperature & chemical resistance.

Applications :-

1. They are used as good adhesives.
2. Used in electronic & electrical components.
3. They are mainly used as surface coating materials.
4. They are also used in industrial floorings.