DR ROHIT BARGAH

PAINTS AND VARNISH

Paint

Introduction: Paint is liquidated colour pigment which is applying on the surface to reduce the defect of cracking happening due to the corrosive dust and weather conditions. The purpose of paints is primarily to prevent corrosion and wear. Paint coating is given to both metallic and wooden articles to protect them from corrosion and to give better surface appearance. Paint covers the manufacturing defects in the articles. When paint is applied to a metal surface, the thinner evaporates while the drying oil slowly oxidizes forming of pigmented film. Paint is a dispersion of pigment in drying oil. They provided a protective coating to the surface. This help in preserving and protecting the materials used in the building construction from environmental effects like heat, frost and rain water.

Paint can be applied to almost any kind of object. Paints can be divided into three categories according to their drying or curing mechanism.

(i) ***Physically drying paints:*** The drying process consists exclusively of the evaporation of solvents.

(ii) ***Chemically curing paints***: The drying process involves a chemical reaction between the base and a hardener. Before use the two components must be mixed properly.

(iii) ***Oxidative drying paints:*** The drying process combines evaporation of solvents with a chemical reaction process between the oil in the paint and the oxygen(O_2) in the air.

Characteristic of Ideal Paint: Characteristics of good paint will increase the life of the building. The following points are the characteristics of good paint.

1.The paint should be cheap and it should be easy and harmless to the user.

2. The paint should be such that it can be easily and free applied on the surface.

3. The paint should not be affected by weathering actions of the atmosphere.

4. Paint should possess a good spreading power.

5. Its film should be glossy and Paint must resist corrosion.

6. The paint should possess high adhension capacity.

7. It should give a stable and decent colour on the metal surface.

8. The surface coated with paint should not show cracks when paint dries.

9. The colour of the paint should not fade in a short period.

10. It must form a tough, elastic & durable film when it is dry.

11. It should have good resistance capacity against moisture.

12.The paint must be present a good attractive appearance.

13.The colour of the paint should not fade in a short period.

Function:

(i)It protects wood from decaying.

(ii)It prevents corrosion of metals.

(iii)It renders surface hygienically safe and clean.

(iv)It gives decorative and attractive appearance to the surface.

(v) Paint also protects the surface from harmful effects of atmospheric agencies.

Components of paints:

There are different main constituents of paint. The important constituents of paint are as follows.

1. **Pigments:** A pigment is a solid and colour-producing substance which gives desired colour to the paint. The hiding power of a pigment is determined by properties of the interaction of light with solid surface i.e; absorption, transmission, reflection and diffraction. Particle size, particle density and refractive index of the pigment also affect the properties f the paint.

   Pigments can be classified are natural and synthetic types.

   (a) Natural pigments including various clays, calcium carbonate,mica, silica and talc.

   (b) Synthetic pigments include white lead, red lead, titanium dioxide, phthalo-blue, red iron oxide, chrome green, copper sulphate ,synthetic silicas and many others. Table shows the colouring pigments which are used to create a particular tint of paints.

Table: Colouring pigments for paints

Tint of paint	***Pigments***
Blue	Prussia blue, indigo, cobalt blue, phthalo-blue
Black	Vegetable black, graphite, lamp black, manganese dioxide,
Brown	Burnt umber
Green	Copper sulphate, chrome green
Red	Venetian red, red lead, carmine, vermillion
Yellow	Zinc chrome, barium chromate, chrome yellow
White	Zinc oxide, white lead, lithopone, barium sulphate

Functions: The following are the functions of the pigment:

(a) A pigment gives strength to the film.
(b)It covers the manufacturing defects.
(c) A pigment gives opacity and colour to the film.
(d) It protects the film by reflecting the destructive ultraviolet rays.

2. Vehicle or drying oils or medium: The liquid portion in which the pigment is dispersed is called a medium or vehicle. Vehicles are the film-forming constituent o the paint.

Example: Linseed oil, dehydrated castor oil, soybean oil , tung oil ,nut oil and fish oil.

Functions:

(a) Vehicles hold the pigment particles together on the metal surface.

(b) They form the protective film by evaporation or by oxidation and polymerization of the unsaturated constituents of the oil.

(c) Vehicles give better adhesion to the metal surface.

(d) They impart water repellency, durability and toughness to the film.

(e) They are good water repellent property.

3. Thinners: Thinners are added to paints to reduce the viscosity of the paints in order to make it easy to apply on the metal surface. It is volatile and does not become part of the paint film.

Example: Petroleum sprit, Turpentine, alkyl benzene and kerosene.

Functions:

1. They increase the elasticity of the film.

2. Thinners evaporate rapidly and help the drying of the film.

3.Thinners reduce the viscosity of the paint to render it easy to handle and apply to the metal surface.

4. They dissolve the oil; pigments etc. and produce a homogeneous mixture.

4. Driers: Driers are oxygen –carrier compounds and used to speed up the drying process and accelerate the drying of the oil film by oxidation, polymerization and condensation.

Example: Naphthenate ,borate, linoleate and Resinates of lead, cobalt and manganese etc.

Functions: Driers act as oxygen carrier catalysts which help the absorption of oxygen and catalyze the drying of the oil film by oxidation, polymerization and condensation.

5. Fillers or extenders: Fillers are used to increase the volume of the paint and to reduce the cost. It increases the durability of the paint. Filters are usually comprised of cheap arid inert materials.

Example: China clay, barite ,lime asbestos, talc, calcium sulphate and calcium carbonate.

Functions:

(i) Fillers increase the durability of the paints.

(ii)They reduce the cost of the paint.

(iii) Fillers serve to fill the voids in the film.

(iv) They reduce the cracking of the paints.

6. Plasticizers: Plasticizers are chemicals added to increase elasticity of the film and to prevent cracking of the film.

Example: Triphenyl phosphate, triglyceryl phosphate and tertiary amyl alcohol.

7. Anti-skinning agents: They are chemicals added to the paint to prevent skinning of the paint.

Example: Guaiacol, polyhydroxy phenols etc.

Manufacture of Paints:

The manufacture of paints involves only are-

(i) Raw materials: raw materials are used as resins, pigments and additive agent's generally major component of paint.

(ii)Mixing of the ingredients: Resins, pigment and solvent are mixed to produce an mill base.

(iii)Milling : Mill base produced at the pre mixing process is sent to the disperser to finally disperse the pigment particles.

(iv) Proper grinding : Resin, additive agent and so on are added to the mill base, the dispersion of which is completed also, the colour phase is adjusted with colour materials.

(v)Filtering : Blended and toned paint is filtrated.

(vi)Packing: filtrated paint is packed into a container.

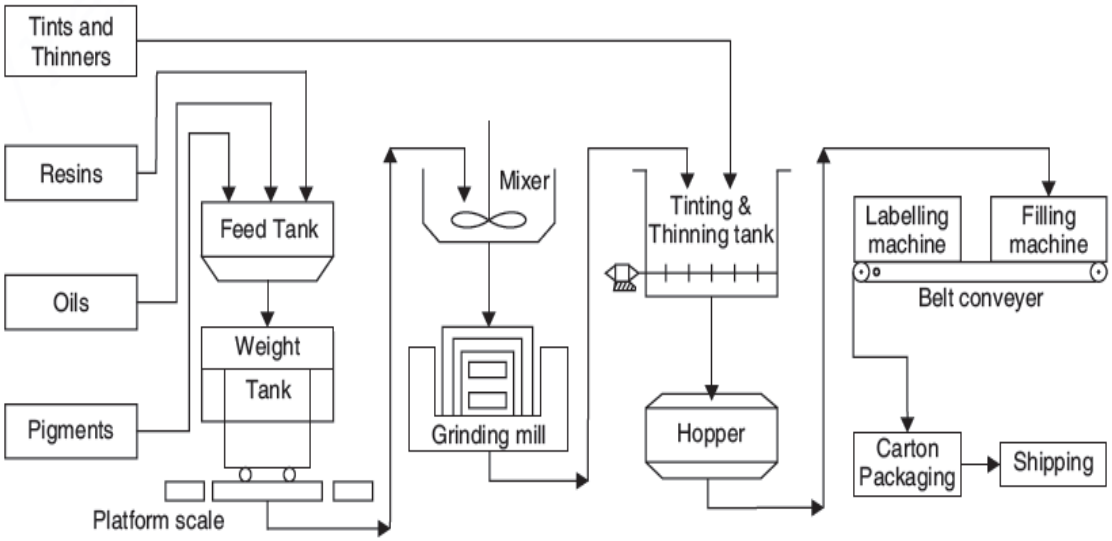

Fig: A flow diagram of mixing of Paint

Types of Paints:

All paints are not suitable for all conditions. For different conditions, different types of paints may be useful. The different types of paints and their applications in construction are explained below.

1. Luminous paints:

Luminous paints are visible in the dark. Since it contain luminophor pigments (like CdS, ZnS) that are used for visibility in the dark .They absorb light radiations and emit them in the dark. The active components in luminous paint are specially prepared phosphorescent materials like CdS, ZnS, etc. For colour effect in luminous paints, certain chemicals like copper salts (green), silver salts (blue), cerium and uranium salts (yellow), etc. are added.

Uses:

They find application in inks, advertising signboards, road marks, road traffic signs, number plates of vehicles, watch dials, map, chart, etc.

2. **Fire retardant paints:**

The paints which retard the fire are called as fire-retardant.

This paint contains the chemicals PVC, Chlorinated rubber, urea formaldehyde and carbonate pigments which are fire-resistant in nature. These substances at higher temperatures breakdown to give the noninflammable gases like CO_2,NH_3, HCl and HBr. These gases are noncombustible and do not support combustion. Thus the fire is retarded.

Uses:

(i)Mainly used in defence, industrial, commercial, education and residential complexes.

(ii)The most frequent source of a fire in any hotel, restaurant or residence. The walls, doors and even kitchen counters should be protected against the spread of fire.

(iii)False ceiling, Lift, Equipment Rooms, Aircraft Safe deposit vaults, lockers, Computer Server rooms, Power plants Chemical Plants, Storage Tanks, structures in Sugar Mills, Textile Mills and Floorings.

3. Aluminium Paint:

The base material in aluminium paint is a fine powder of aluminium. The ground fine powder of aluminium is suspended in either spirit varnish or an oil-varnish depending on the requirement. When paints are applied, the thinner evaporates and oil, if any, undergoes oxidation and polymerization.

A bright adhering film of aluminium is obtained on the painted surface.

Uses: Wooden and metallic article for interior and exterior decoration.

Advantages of aluminium paint:

1. It possesses a good covering power.
2. It imparts very attractive appearance to the surface.
3. It has fairly good heat-resistance.
4. It has very good electrical resistance
5. The painted film is waterproof.
6. The electrical surface is visible even darkness.
7. Corrosion protection for iron and steel surface is better than all other paints.

4. Distempers

Distempers are water paints. They contain chalk powder, glue and pigment dissolved in water. They are very cheap and can be easily applied on walls. They are durable and give pleasing finish to walls. The ingredients of distemper are-

1. Whiting agent or chalk powder (the base)
2. Glue or casein (the binder)
3. Colouring pigment and

4. Water (the solvent or thinner)

Advantages

1. Distempers are cheaper than paints and varnishes
2. They can be applied easily on plasters and wall surfaces in the interior of the buildings.
3. They are durable.
4. They give smooth and pleasing finish to walls.

5.Emulsion Paints (Latex paints):

Emulsion paints are those paints in which water is used in place of organic solvents thinner. Emulsion paints is two phases viz:

(i) water phase

(ii) (ii) The vehicle of film forming material

The synthetic resin is dispersed in water by means of dispersing agent which acts as binder. Pigments and extenders are dispersed in such an emulsion. Emulsifying agent or surface active agents, stabilizers, driers, antifoaming agents and preservatives are also added.

Constituents of emulsion paints:

Constituents of emulsion paints these are-

(i) Resin: Polyvinyl acetate, polystyrene

(ii) Stabilizer: Methyl cellulose, dextrin, casein.

(iii) Preservative : Thymol, Chlorothymol and mercuric chloride.

(iv) Antifoaming agent: pine oil and Kerosene.

Advantage:

(i) Emulsion paints dry quickly.

(ii) They are free from fire risk.

(iii) They can be applied simply with a brush.

(iv) They can be applied on the surface of the metal or wood.

(v) It is more durable and more impermeable to dust and dirty.

6. Cement Paints:

Cement paint has marked water-proofing capacity and gives a stable and decorative film. The dispersion medium is water or oil. In case of brick

structure the dispersion medium is water. In case of metal surface the dispersion medium is boiled linseed.

Cements paint contains are white cement, colouring or pigments, hydrated lime and fine sands as inert filter.

7. Synthetic Rubber Paints:

Synthetic rubber paints are made by dissolving synthetic resins in the suitable solvents. By adding suitable pigments to this mixer, the color can vary. This type of paint is widely used on cement concrete surfaces like concrete walls etc. This paint is less affected by rain, sunlight etc. It has good resistant properties against acids, alkalis and moisture conditions. It dries very quickly and maintains uniform color throughout the surface.

Defects of Paints:

The following defects may occur in painted surface.

(i) ***Fading :*** The paint may loss some of its colour due to effect of sunrays on colouring pigments.

(ii) ***Flaking:*** Due to poor adhesion, paint may peel off from the surface.

(iii) ***Grinning:*** If the opacity of the final coat is insufficient, the back ground of the painted surface is clearly visible. This defect is known as grinning.

(iv) ***Bloom:*** Due to bad ventilation or defective paint, dull patches are developed on the painted surface.

(v) ***Blistering:*** This defect occurs due to trapped moisture behind the painted surface.

(vi) ***Running:*** This defect occurs when the surface to be painted is very smooth. In this defect , small area of the surface are left uncovered with paint.

(vii) ***Wrinklig:*** This defect occurs in thickly painted surface.

(viii) ***Sagging:*** Thickness of painting should not be excessive. If too much thick coat of paint is applied , the defect is known as sagging.

VARNISHES:

Varnish is a homogenous colloidal dispersion of natural or synthetic resin in oil or spirit medium.

If the medium is oil it is known as oil varnishes. If the medium is spirit it is known as spirit varnishes. It is used as a protective and decorative coating to the wooden surfaces. It provides a hard, transparent, glossy appearance and durable film to the coated surface.

Varnish is applied to the painted surface to increase its brilliance and to protect it from the atmospheric action and to the unpainted wooden surface with a view to brighten the ornamental appearance of the grains of wood.

Characteristic of Good Varnish:

1. It should be dry quickly and soft.
2. On drying it should form a hard, tough, aesthetical attractive and durable film.
3. It should have good weathering properties, resist abrasion and wear well.
4. It should be able to retain its colour and shine.
5. It should be uniform and pleasant looking on drying.
6. It should not develop crack after drying.
7. Surface n the film do not reflect heat and light.

Composition of Varnishes:

There are five main constituent of varnish. These are drying oils ,resins, driers, thinners or solvents and antiskinning agents.

(i) Dying oils: Drying oils are the film formers in oil varnishes. These are many different type of drying oil such as linseed oil, tung oil and walnut oil. These drying oils contain high level of polyunsaturated fatty acids.

(ii) Resins: Resins provide excellent adhesion, elasticity glossiness, and colour to the varnish film. Resins that are used in varnishes include opal, amber, kauri gum, rosin, sandarac, balsam, dammar and elemi etc.

Quantity of varnish depends much upon the quality of resin used. Copal is considered to be the best, toughest, and hardest and is very durable for external work.

(iii) Thinners or Solvents: Thinners reduce the viscosity of the varnish and help in drying process. The natural turpentine was used the thinner or solvent, but has been replaced by white sprit or paints thinners, or mineral sprit. Other thinners are kerosene, alcohols etc.

(iv) Driers: These should be added only in small quantities as an excessive injures varnish and impairs its durability. Litharge or lead acetate is the commonly used driers in varnish added to accelerate drying process.

Types of Varnishes:

There are two main types of varnishes-

1. Oil Varnish:

Oil varnish is a homogeneous solution of one or more synthetic or natural resins in a drying oil and volatile solvent. These are made by dissolving hard resins like amber or copal in oil. They are slow to dry but are hardest and most durable of all varnishes. There are suited for being used on exposed surfaces requiring polishing or frequent cleaning and for superior works.

Preparation of oil Varnish:

Oil varnishes are more difficult to manufacture. Resins that are used in the preparation of oil varnishes are high molecular weight substances and are not easily soluble in oil. The resin is taken in an aluminium vessel and heated over a fire pit or in a small furnace. When resin melts , the temperature is slowly increased to about 300^0C. This process is known as gum running. Some cracking or depolymerization of the resin takes place and about 25 percent of the resin is lost in the form of fumes. The required quantity (about 25 percent of the weight of the resin) of boiled oil or linseed oil along with driers is separately heated to 200 to 220^0C and is slowly added to the heated resin with constant stirring until thorough combination has taken place. This operation is known as cooking. Over heating must be avoided as it causes discoloration of the varnish.

The kettle is removed from the furnace and allowed to cool, white spirits then added (which is a petroleum fraction, boiling between 150^0C and 200^0C). It is the most common thinner.

The varnish is stored in tanks for some days for maturing. Foreign matter and particles of resin, which have not dissolved, settle during this period. During maturing, the colour of the varnish also improves and it becomes more homogenous. The varnish is filtered and packed for marketing.

2. Sprit Varnishes:

Varnishes in which spirit is used as a solvent as known as spirited varnish or French Polish. A Spirit varnish is a dispersion of resin in spirit. Shellac is dissolved in spirit and the product is applied in a thin layer. This varnish gives a transparent finish thus showing the grains of the timber. These however, do not weather well and as such are used for polishing wood work not exposed to weather.

Preparation

The resin and spirit are placed in a cylindrical drum plasticizer and other components are added. The resin is dissolved by agitating the mixture or by rotating the drum. It is then filtered and used. The final product is called spirit varnish.

Advantage of Varnish:

(i) Limited or zero solvent pollution.

(ii) Better product quality.

(iii) Lower capital costs compared to thermal curing.

(iv)Lower maintenance costs.

(v) Excellent process control.

(vi)Lower labour costs.

(vi)After curing the wood is immediately ready for other processing steps (cutting, joining with other materials, etc.

Cellulosic, synthetic, polyurethane, polyester and nanolacke UV varnishes were used according to the producer's instructions. The type, selection, preparation and surface application system of the varnish to be used and the post-application processes as recommended by the manufacturers and the techniques used are very important to make varnish layers durable against various effects and to ensure the desired properties. Varnishes were checked to confirm they had the properties specified in their descriptions and they were used after seeing that they were appropriate for the tests (viscosity control).

The technical specifications of the conventional varnishes are given in Table 1.

Table: Some technical specifications of the conventional varnishes.

		Type of varnish		
Technical specifications	Synthetic	Cellulosic	Polyurethane	Polyester
Density (g/cm^3)	0.94–0.95	0.94–0.95	0.95–0.96	-
Viscosity (second/DIN CUP 4 mm/20°)	18	20	16	18
Amount applied ($gram/m^2$)	100	125	12	300-600

Nozzle gap (mm)	-	1.8	1.8-2.0	1.8
Nozzle gap (mm)	-	3	2	3
Drying type	physical	physical	chemical	chemical
Drying time (20°)	6-8 hours	20-30 mnutes	2-3 hours	4 hours
Dry film thickness (µm)	100	90	120	210

Difference between paint and varnish:

Paint and varnish are two commonly used finishes applied to wood and other materials. Here is a difference between them in terms of appearance, application, protective properties, and drying time.

Difference between paint and varnish

S.N	Paint	Varnish
1.	Paint has pigment.	There is no pigment in the Varnish.
2.	It can be applied to both metals and wooden articles.	It can be applied only to the wooden articles.
3.	It is Opaque.	It is transparent.
4.	Paint can be applied with a brush, a roller, or a spray gun.	It can also be applied with sprayed or wiped on.
5.	A brushed on oil-based paint can take up to 8 hours to dry where as a sprayed on paint may dry in less than 1 hour.	Varnish is long drying time than paints .
6.	Paint is more protective and longer lasting than varnish.	Varnish is less protective and less lasting than paint.
7.	Paint will last to 7 to 10 years.	Varnish will last only 1 to 2 years on wood exposed to full sun.

ENAMEL PAINTS:

Enamel is a pigmented varnish. Enamel are hard , washable and usually glossy paints. They can be oil based or alkyd based and come in several sheens, from eggshell or low luster to satin, semi-gloss and high-gloss. They find application not only on metal surfaces but also on interior walls and wooden surfaces. It consists of white lead or zinc white, petroleum, spirit and resinous matter. It is not affected by gases acids, alkaline, hot water and cold water, steam and temperature. Functional, multipurpose and dry to shiny finishes.

Available in water or solvent base-Urethane and polyurethane.

Types of Enamel Paints:

1.Floor enamel paints.

2.Fast dry enamel paints.

3.High temperature enamel paints.

4.Nail enamel paints.

5.Model building

These used on different places or materials.

Ingredients of Enamel Paint:

Enamel paints are made by adding varnish in ordinary oil-based paints.

(i) **Solvent:** The solvents are usually aromatic hydrocarbons toluene($C_6H_5CH_3$) and methyl ethyl ketone ($CH_3COC_2H_5$) .
(ii) **Binders**: The binders are vegetable oils,alkyds, acrylics and vinyl acrylics .
(iii) **Pigments:** The pigments constituents clay, calcium carbonate, mica, silica, and talcs.
(iv) **Additives:** The additives are diatomaceous earth, talc, lime and brite.

Advantages of Enamel Paint:

(i)They are provides a glossy and smooth finish surface.

(ii) It can be applied on both interior and exterior surfaces.

(iii) Comes in container and ready t use.

(iv) Last for a long period of time as it provides a durable finish.

(v) Washing capability is better compared to plastic paint.

(vi) It is touch durable and stain resistant.

Application of enamel paint:

(i) The surface should be clean an dust free.
(ii)The wood work to be painted should be dry.
(iii)All unevenness should be smooth,before painting woodwork priming coat shoul be applied.

Lacquer:

The term lacquer originates from the Sanskrit word l a k s h a meaning "one hundred thousand", which was used for both the Lac insect (because of their enormous number) and the scarlet resinous secretion it produces that was used as wood finish in ancient India and neighbouring ar areas.

In terms of modern products, lac-based finishes are referred to as shellac, while lacquer refers to other polymers dissolved in volatile organic compounds (VOCs), such as nitrocellulose, and later acrylic compounds dissolved in lacquer thinner , a mixture of several solvents typically containing butyl acetateand xyleneor toluene. While both lacquer and shellac are traditionalfinishes, lacquer is more durable than shellac.

Pure & Original lacquers are of exceptionally high quality. Lacquer is an especially excellent application for doors, window frames, wood, MDF, walls, and even radiators, PVC and metal.

In modern techniques, lacquer means a range of clear or coloured wood finishes that dry by solvent evaporation or a curing process that produces a hard, durable finish. It is also used for "lacquer paint", which is a paint that typically dries better on a hard and smooth surface.

Water based lacquers, mainly used for doors, windows and baseboards, or as a finish on wood and metal, are also a perfect finish to give a different and exclusive look to your walls. Our water-based Traditional Paint is especially suitable for walls, including those in bathrooms and kitchens.

Difference between Lacquer ad Enamel Paints

S.N.	Lacquer	Enamel
1.	Lacquer paint uses lacquer thinner	enamel paint uses paint thinner (also called white spirits).

2.	Lacquer paint uses lacquer thinner, it will soften any paint it is applied on top of.	Enamel paint will not.
3.	Lacquer paints soften over a period of time	Enamel paints remain hard for a long time.
4.	Lacquer paints develop bubbles if not applied by professionals.	It is not the case with enamel paints.
5.	Lacquer paints dry up quickly.	Enamel paints are harder to dry
6.	Lacquer paints are costly than enamel paint.	Enamel paints are cheaper.
7.	**Lacquer paints** are less toxic than enamel paints.	**Enamel paints** are more toxic .

Refractories

Introduction:

Refractories are the inorganic materials which can with stand very high temperature without softening or suffering deformation. Therefore they are used for the construction of kilns, ovens, crucibles, furnaces etc. employed for the manufacture of metals, cement, glass, steel, ceramics, paper, etc. The main function of refractories varies depending on the purpose to which they are subjected like confining heat with in the furnace, transmitting or storing heat in refrigerators.

Refractories are materials which can withstand very high temperature. They are resistant to heat and corrosive action of gases, metallic liquids and slags.
Examples: Fire clay, Silica.

Characteristics of Refractories:

1) High temperature resistance under working conditions.
2) Good abrasions resistance by dusty gases and melt on metals.
3) Low ability to contain heat.
4) High mechanical strength.
5) Thermal strength to with stand thermal shock due to rapid and repeated temperature fluctuations.

Classifications of Refractories:

Refractories are broadly classified into three categories on the basis of their chemical nature.

1. Acidic refractories: They are made from acidic materials such as aluminium and silica they are resistant to acid slags but attacked by basic materials.
Example - silica, alumina and fireclay refractories.

2. Basic Refractories:- Basic refractories are those which consist of basic materials, but attacked by acidic materials. They find extensive use in steel making open-hearth furnaces. Example- Magnesia , Dolomite

3. Neutral Refractories:- They are not completely neutral in chemical sense. They consist of weakly basic/acidic materials like carbon, zirconia (ZrO_2), chromites ($FeOCrO_2$), graphite, and silicon carbide.

Sl. No.	Type of refractory	Examples	Uses
1	Acid Refractories	. Zirconia, Silica	Used in furnaces where the charge and slag are acidic in nature.
2	Basic Refractories	Magnesia, Dolomite	Used in furnaces where the charge and slag are basic in nature.
3	Neutral Refractories	Chromite Alumina	Used in furnaces where the charge and slag are either acidic or basic in nature.

Uses of Refractory bricks:

Uses of a few refractory bricks:

a. Silica bricks: It contains 90-95% silica and about 2% lime.

1. They are used in open hearth furnaces, electric furnaces and glass furnaces.
2. They are used in coke-ovens and gas retort settings.
3. They are also used in lining of acid converters.

b. Fire clay bricks: It contains major portion of alumina and silica and small percentage of K_2O, FeO, CuO and MgO.

1. They are used in blast furnaces and open hearth furnaces.
2. They are used in stoves, crucibles, furnaces, kilns, regenerators and charging doors.

c. Alumina bricks: It contains more percentage of Al_2O_3.

1. They are used in vertical shaft kilns for burning lime.
2. They are used in linings of rotary kiln in cement manufacture.
3. They are used in brass melting reverberatories, lead-dressing reverberatory furnaces, and aluminium melting furnaces and in oil fired furnaces.