Resin: is defined as a highly viscous substance that can be converted to polymers. They are usually mixtures of organic compounds.

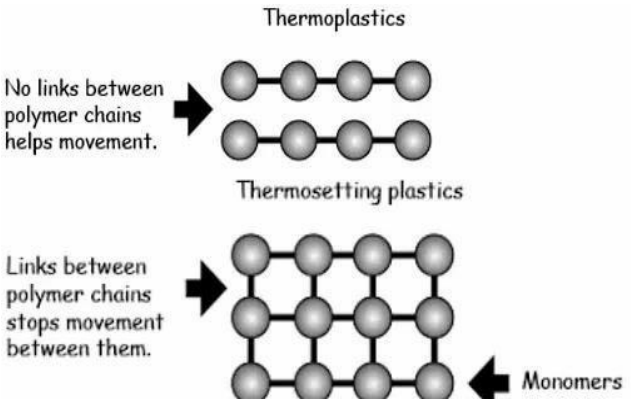
Classification of resins

1. Thermoplastic resin

These are resins that can be repeatedly softened and molded under heat and pressure without any chemical change occurring. They are usually soluble in organic solvents. Most resins used in dentistry belong to this group, e.g. polymethyl methacrylate, polyvinyl acrylics and polystyrene.

2. Thermosetting

These resins can be molded only once. They set when heated. These cannot be softened by rehe**ating** like the thermoplastic resins. They are generally insoluble.



Uses of resins in dentistry

1. Fabrication of dentures (denture base resins).
2. Artificial teeth.
3. Tooth restoration, e.g. fillings (composite resins).
4. Orthodontic
5. Provisional restorations in fixed prosthodontics

Acrylic resins

Denture base resin material (Known as polymethylmethacrylate (PMMA):

These are widely used in dentistry to fabricate various appliances because it is easy to process and use, cheap and good esthetic. the polymer (powder) is mixed with the liquid (monomer) to produce a dough-like consistency which is easily molded.

The ideal requirements of denture base material: Dental resins, both restorative and denture base should be:

1. tasteless, odorless, nontoxic and nonirritant to the oral tissues.

2. Natural appearance.

3. dimensionally stable.

4. Have enough strength, resilience and abrasion resistance.

5. Insoluble in saliva or other fluids.

6. Have a low specific gravity (light in weight).

7. Be easy to fabricate and repair.

8. Have good thermal conductivity.

9. Be radiopaque.

10. Inexpensive.

Types of resins (Based on the method used for its activation)

1. ***Heat activated resins***

2. Chemically activated resins

3. Light activated resins

Heat activated denture base acrylic resin

Heat activated polymethyl methacrylate resins are the most widely used resins for the fabrication of complete dentures.

• Polymerization is achieved by application of heat and pressure.

Powder	+	Liquid	+	Heat	⟶	Polymer	+	Heat
(Polymer)		(Monomer)		(External)				(Reaction)

Chemically activated denture base acrylic resin

The chemically activated acrylic resins polymerize at room temperature. They are also known as 'self-curing', 'cold-cure' or 'auto-polymerizing' resins.

Polymer (Powder)	+	Monomer (Liquid)	⟶	Polymer	+	Heat
(Peroxide initiator)		(Amine accelerator)				(reaction)

Light activated denture base acrylic resin

It is supplied in sheets having a clay like consistency and provided in light proof packages to avoid premature polymerization. It is polymerized in a light chamber (curing unit)

Thermoplastic polymer (flexible dentures)

Thermoplastic resins are used for the fabrication of flexible denture. A thermoplastic is a plastic which becomes moldable above a specific temperature and returns to a solid state when cooled.

Uses of flexible dentures:

1. Partial and complete denture when we have undercut
2. Tilted teeth.
3. Patient allergy to acrylic monomer
4. patient allergic to nickel.
5. When we need high esthetic

Heat cure denture base resin

Compositions of heat cure acrylic resin:

The heat cure acrylic resin supplied as powder and liquid.

Powder	Liquid
1- Poly methyl methacrylate beads or granules so they are already polymerized not monomer (Main ingredient which will polymerize).	1-Methyl methacrylate monomer
2-Benzoyl peroxide (initiator to produce free radicals).	2-Cross linking agent that improves the mechanical properties (add strength)
3-Dibutyl phthalate (Plasticizer to make it softer and added flexibility).	3-Hydroquinone: Inhibitor prevent setting while storage
4-Zinc or titanium oxide (opacifier to make it radio-opaque).	
5-Pigments.	
6- Synthetic fibers (nylon acrylic to look like blood vessels and to give the gingival tissues natural appearance).	

Manipulation of heat cure acrylic resin (Polymer-monomer interaction)

- The liquid is placed in clean and dry mixing jar then powder is added slowly and mixed in proper proportion
- (Powder /liquid ratio is 3:1 by volume or 2.5:1 by weight)
- allow each powder particles to become wetted by monomer and workable mass is formed and left until it reaches a consistency suitable for packing.
- During this period, a cover should be placed above the mixing jar to avoid monomer evaporation.
- The type of the reaction is addition polymerization reaction (it is extremely exothermic reaction).
- **The resultant mixture will pass into 5 stages:**

• **Sandy stage**	the monomer wets the outside of the polymer's particles
• **Sticky stage**	the monomer attaches the surface of the polymer beads, some polymer chains are dispersed in the liquid monomer, the viscosity of the mixture was increased, this stage is characterized by stickiness when the materials is touched
• **Dough like stage**	when the monomer diffuses further into the polymer particles and the mass become saturated. The mass does not adhere to the walls of the mixing jar; clinically the mass behaves like as pliable dough
• **Rubber or elastic stage**	The monomer is dissipated by evaporation and by further penetration into the remaining polymer beads. The mass is no longer plastic, its rubber like
• **Stiff stage**	the mixture becomes stiff, this may be attributed to the evaporation of free monomer. Clinically the mixture appears very dry.

Dough forming time:

the time from beginning of mixing of polymer with monomer until reaching the dough like consistency less than 10 min.

Working time:

The time that the mixture remains in dough like stage. The dough remains moldable for at least 5mins. the working time is affected by temperature.

In warm weather when the working time is insufficient can be extended by refrigeration (the resin store in refrigerator in air tight container to avoid moisture contamination).

- The complete Polymerization not occurs until the denture flask is heated to above 70 C. (In heat activated acrylic resin),
- The chemically activated materials (Cold cure) start to polymerization soon after the powder and liquid are mixed and proceed more rapidly through the various consistency stages than the heat accelerated types.

Polymerization cycle or curing cycle:

is the technical name for the heating process used to control the initial propagation of polymerization in the denture mold.

There are two recommended curing cycles

1. Long curing cycle:

Curing in a constant temperature water bath (8hr-10hr at 74 C). (The satisfactory processing).

2. Short curing cycles:

Curing for 2hr at 74 C then 1hr at 100 C^0.

Chemically activated resin (auto polymerized or cold cure or self-cure

Composition same as the heat cure version with following differences:

1) The powder contains small particles size beads of polymer of poly methyl methacrylate that have a lower molecular wt. and contain ***benzyl peroxide (initiator).***

2) The liquid contains a ***chemical activator ((1-2%) tertiary aromatic amine***) which activated the benzyl peroxide (initiator) to produce free radicals so that polymerization is initiated in manner similar to that describe for heat cure acrylic.

(Upon mixing tertiary amine causes activation of benzyl peroxide).

Cold cure	Heat cure
Heat is not necessary for curing	Heat is necessary for curing
Porosity is greater	Porosity of material is less
Has lower molecular weights	Higher molecular weights
Higher residual monomer content	Lower residual monomer content
Material is weaker	Material is stronger
Poor color stability	Color stability is good
Shorter working time	Longer working time

Artificial Teeth Materials

The materials most widely used for manufacturing artificial teeth are acrylic resin and porcelain.

Requirements

1. Good appearance
2. Should be indistinguishable from natural teeth in shape, color and translucency.
3. Should be good attachment between the artificial teeth and the denture base.
4. They should be hard enough to resist abrasive forces in the mouth and during cleaning, but should allow grinding with a dental bur.

Acrylic resins teeth

1. Give less realistic appearance than porcelain teeth.
2. Attachment of the teeth to the base is through a chemical union.
3. Low density and less brittleness.
4. Does not produce clicking.
5. Low hardness leading to abrasion.
6. Can be used with small inter ridge space.

Porcelain teeth

1. Give more realistic appearance.
2. Produce clicking
3. High density and brittleness
4. High hardness leading to less abrasion.
5. Attachment of the teeth to the base is through a mechanical means.
6. Transmit higher forces to the supporting soft tissues than acrylic teeth.