Resin-based Composites

It is introduced commercially in 1962 by Bowen of the National Bureau of Standards most popular tooth color material consist of a continuous polymeric or resin matrix in which an inorganic filler is dispersed.

Indications:

1. Classes I, II, III, IV, V, and VI restorations
2. Foundations or core buildups
3. Fissure sealants and conservative composite restorations (preventive resin restorations)
4. Esthetic enhancement procedures
   - Partial veneers
   - Full veneers
   - Tooth contour modifications
   - Diastema closures
5. Cements (for indirect restorations)
6. Temporary restorations

Contraindications:

1. An operating area that cannot be adequately isolated.
2. Class V restorations that are not aesthetically critical.
3. Restorations that extend into the root surface (may exhibit gap formation).

Advantages:

1. Aesthetics
2. conservative of tooth structure removal (less extension; uniform depth not necessary; mechanical retention usually not necessary)
3. less complex when preparing the tooth
4. low thermal conductivity
5. Bonded to tooth structure resulting in good retention, low micro-leakage, minimal interfacial staining, and increased strength of remaining tooth structure
6. Repairable

Disadvantages

1. This may result in gap formation, usually occurring on root surfaces as a result of the forces of polymerization shrinkage of the composite material

2. Restoration is more difficult, time-consuming, and costly (compared to amalgam restorations)
3. Are more technique sensitive because the operating site must be appropriately isolated and the placement of etchant, primer, and adhesive on the tooth structure (enamel and dentin) is very demanding of proper technique.
4. May exhibit greater occlusal wear in areas of high occlusal stress or when all of the tooth's occlusal contacts are on the composite material.
5. Have a higher linear coefficient of thermal expansion, resulting in potential marginal percolation if an inadequate bonding technique is utilized.

Composition

A. Organic Resin – forms the matrix
   - Dimethacrylate monomer (BIS-GMA)

B. Inorganic filler
   - Inhibits deformation of the matrix
   - Reduce the coefficient of thermal expansion of the resin matrix e.g. fused silica, crystalline quartz, lithium aluminum silicate, borosilicate glass
   - Better mechanical properties, such as compressive strength;
   - Greater aesthetics;
   - Confers radio-opacity

C. Coupling Agent
   - Unite the resin with the filler
   - Stress absorber of the filler and resin

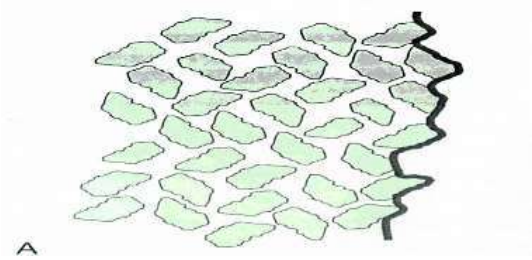
D. Initiator System – activate the setting mechanism
E. Stabilizers
F. Pigments

Classification

1. Conventional
2. Micro-filled
3. Hybrid -Flowable – Packable
4. Nano-composite (nanofilled) - Completely nanofilled – Nanohybrids
5. Reinforced

1. Conventional Composites

- ✓ Contains 75-80% inorganic filler by weight
- ✓ Average particle size 8μm
- ✓ large size particle and extremely hard filler
- ✓ Rough surface structure, strontium, and barium glass (radiopaque)

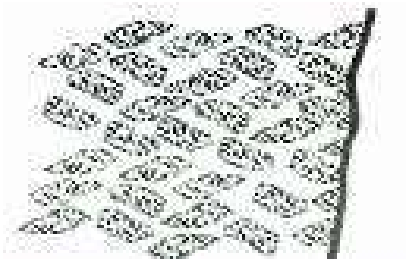


2. Micro-filled Composites

- ✓ Introduced in late 1970
- ✓ Polishable
- ✓ Smooth lustrous surface similar to tooth enamel
- ✓ Particle size is 0.01 – 0.04μm
- ✓ Contains 35-60% inorganic filler by weight
- ✓ Some of the physical and mechanical properties are inferior; wear resistant
- ✓ low modulus of elasticity (allow restoration to flex)
- ✓ High resin content results in an increased coefficient of thermal expansion and lower strength

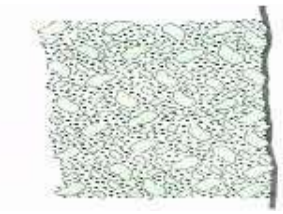
Use of Micro-filled Composites

- ➢ Used for low-stress restorations, buccal and lingual surfaces of class III and class V



3. Hybrid Composites

- ✓ Combines the properties of conventional and micro-filled
- ✓ Contains 75-85% inorganic filler by weight
- ✓ Particle size is 0.4 – 1μm
- ✓ Physical properties are superior to conventional
- ✓ Predominant direct aesthetic resin
- ✓ Have universal clinical applicability



Use of Hybrid Composites

- ➢ Used in moderate stress restorations where strength and wear resistance are more important than surface luster; Class I, class II, class IV

Flowable composites

- ✓ Flows into the cavity due to lower viscosity
- ✓ Have lower filler content
- ✓ Inferior physical properties (lower wear resistance, lower strength)
- ✓ Used in small class I, pit and fissure sealant, marginal repair materials, as the first increment placed as a liner under hybrid or packable composites
- ✓ Easy to use
- ✓ Good wet ability
- ✓ Favorable handling properties are popular features
- ✓ Clinical indications for their use are limited.

Packable (Condensable) composites

- ✓ More viscous, "thicker, stiffer feel"
- ✓ Have a filler particle feature that prevents sliding of the filler particle by one another
- ✓ Easier restoration of proximal contact
- ✓ Similar to the handling of amalgam

4. Nanofill composites

- ✓ Contain extremely small filler particles (0.005-001 microns.)
- ✓ Because of these small particles, high filler levels can be generated in the restorative material, resulting in good physical properties and esthetics
- ✓ Nanofills highly polishable
- ✓ These materials are likely to become a popular composite restorative material choice

Completely nanofilled resins

- ✓ Contain nano-meter-sized particles throughout the resin particles

Nanohybrids resins

- ✓ Consist of large partials surrounded by nano-meter-sized particles

5. Reinforced composites

- ✓ It consists of a combination of a resin matrix, randomly orientated E-glass fiber, and inorganic particulate fillers. Used as base filling material in high-stress bearing areas, especially in large cavities of vital and non-vital posterior teeth

Classification according to the method of activation:

1. **Chemically-activated composites:**
   Also, they are called self-curing composite resins. Most commonly available as a two-paste system composed of a catalyst and base materials. When these two components are properly mixed, the polymerization process is chemically activated. The rate of the set is uniform through the bulk of the material causing a gradual increase in viscosity at room temperature. Hence the material has a limited working time, making the technique time sensitive with the increased possibility of air bubble incorporation during the mixing of the two pastes and thus affecting the composite physical and mechanical properties.
2. **Light-activated composites**:
   Light-activated materials afford several advantages over chemically activated ones. The light-curable materials are single components and require no mixing, so have reduced porosity, and better resistance to wear and abrasion. The working time is virtually that chosen by the clinicians, and the material hardens rapidly when exposed to light. The components of light-activated composites are contained in a single paste system. The mixture is supplied in various shades in disposable syringes. These syringes are made of opaque plastic to protect the material from exposure to light.
3. **Dual cured composites:**
   Combine self-curing and light-curing materials. The self-curing rate is slow and is designed to cure only those portions that are not adequately light cured Especially in the interproximal areas where the access is limited and requires special approaches to guarantee adequate light-curing energy