

## Dental waxes

Waxes are one of the many essential materials used in dentistry. Fabrication of artificial restoration of soft and hard tissues of the oral cavity requires use of wax in one form or the other. Waxes are, essentially, soft substances with poor mechanical properties.

### Composition of waxes

Waxes are organic polymers consisting of hydrocarbons and their derivatives. These are composed of mixtures of thermoplastic materials (softened by heating then hardened by cooling) which are normally solid at room temperature but melt without decomposition to form mobile liquids. The waxes that used in dentistry normally consist of two or more components which may be natural or synthetic waxes, resins, oils, fats and pigments.

### Requirements of dental waxes:

1. Must conform to the exact size and shape and contour of the appliance which is to be made.
2. Should have enough flow when melted to reproduce the fine details.
3. No dimensional change should takes place once it's formed.
4. Boiling out of the wax without any residue.
5. Easily carved and smooth surface can be produce.
6. Definite contrast in color to facilitate proper finishing of the margins.

**Applications**

1. Used in the formation of wax pattern.
2. Used in the dental laboratory to box impressions prior to cast pouring with gypsum.
3. Used as a base plate for the registration of jaw relationships.
4. Used as a casting wax to establish minimum thickness to certain areas.
5. Used as a utility wax to prevent distortion of impression materials.
6. Used as a sticky wax to join fractured parts together.
7. Used as a corrective impression wax to contact and register the detail of soft tissues.

**Classification of waxes**

- Classification of waxes according to their origin
- Classification of waxes according to the Application in Dentistry

**Classification of waxes according to their origin**

According to their origin waxes are classified as:

**1. Synthetic Waxes**

Synthetic wax is a man-made wax synthesized from appropriate monomers. The synthetic waxes differ chemically from the natural waxes. The synthetic waxes have specific melting points and are blended with natural waxes. These are more often refined when compared to the natural waxes. For example, polyethylene waxes.

## 2. Natural waxes

Type	Example	Source	Properties
1. mineral	Paraffin wax	Obtained during the distillation of crude petroleum	<ul style="list-style-type: none"> <li>• Brittle at room temperature.</li> <li>• Softening temperature: 37–55°C</li> <li>• has relatively low melting point range: 40–71°C</li> </ul>
	Ceresin wax	From natural and mineral petroleum	Added to increase the melting range of paraffin wax.
	Microcrystalline wax	Obtained from petroleum	<ul style="list-style-type: none"> <li>• Less brittle than paraffin wax due to their oil content.</li> <li>• Melting range: 60–80°C</li> <li>• Added to modify the softening and melting ranges of wax blends.</li> <li>• Less volumetric change during solidification</li> </ul>
2. Plants waxes	Carnauba wax	from trees and plants	<ul style="list-style-type: none"> <li>• Melting temperature: 84–91°C.</li> <li>• Added to increase the melting range and hardness of paraffin wax.</li> </ul>
	Candelilla wax	from trees and plants	<ul style="list-style-type: none"> <li>• Melting temperature: 68–75°C</li> <li>• Added to harden paraffin waxes.</li> </ul>
3. Animal waxes	stearin wax	obtained from animal fat	• has low melting point 50 °C
	Spermaceti Wax	Obtained from the whale.	• Used as a coating in the manufacture of dental floss.
	Bees wax	obtained from honeycomb	<ul style="list-style-type: none"> <li>• Less brittle.</li> <li>• Melting temperature: 63–70°C.</li> </ul> often blended with paraffin wax in order to modify the properties of the paraffin. The effect of adding beeswax to paraffin wax is to render the material less brittle and to reduce the extent to which it will flow under stress at temperatures just below the melting point.

### Classification of waxes according to their Application in Dentistry

**1. Pattern wax:** the primary uses of the wax in dentistry are to form *patterns* of appliances prior to casting.

Following the production of a stone model or die, the next stage in the formation of many dental appliances, dentures or restorations is the production of a wax pattern of the appliance on the model. The wax pattern defines the shape and size of the resulting appliance and is

eventually replaced by either a polymer or an alloy using the *lost-wax technique*. Methods which involve the production of a model followed by the laying down of a wax pattern are known as *indirect techniques*. Some dental restorations, may be produced by a *direct wax pattern technique* in which the inlay wax is adapted and shaped in the prepared cavity in the mouth.

Waxes used in the production of patterns by either the direct or indirect technique must have very precisely controlled properties in order that well-fitting restorations or appliances may be constructed. The Pattern wax divided to the following types which are:

A. **Inlay wax:** Should be hard and brittle in order to fracture rather than to distort when removed from undercut areas. The wax is mostly blue in color. They are used to make inlays crowns and pointic replicas. They are mostly paraffin with carnauba wax. There are 2 types.

- Type 1: for direct technique
- Type 2: for indirect technique



**B. Denture casting wax:** used to produce the metal components of cobalt – chromium partial denture. It is based on paraffin wax with bees wax to give softness necessary for molding and stickiness necessary to ensure adhering to an investment material. It is mostly green sheet.



**C. Modeling waxes (Denture base plate wax, sheet wax):** It is used to form the base of the denture and in setting of teeth. Modeling waxes consist mainly of mixtures of paraffin wax and bees wax and have melting points in the range 49–58°C. They are generally supplied in pink sheet form. Modeling waxes are tough enough to resist fracture when withdrawn from shallow undercuts.

Three types of material are available, designated as follows:

- Type 1 soft wax
- Type 2 hard wax
- Type 3 extra hard

These products differ primarily in regard to their softening temperature.



**D. White wax:** to make pattern simulate veneer facing in crowns.

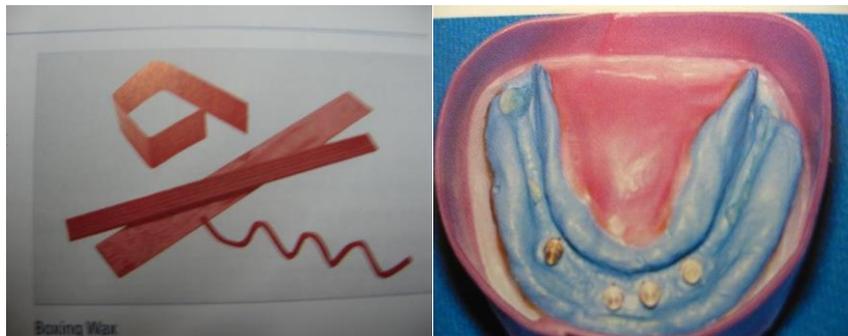


**2. Processing wax:** used during processing of the appliance like:

A. **Beading wax:** used to make beading around the impression before pouring gypsum to protect the margins



B. **Boxing – in wax:** used to make box around the impression to make pouring gypsum into the impression easier and more perfect.



C. **Block – out wax:** to block – out undercut areas on cast during processing of Co/Cr metal frame work.



D. **Sticky wax:** used for temporarily joining two components of an appliance and join the broken pieces of the denture before repair.



3. **Impression wax:** They are previously used to make impression but distort when removed from undercut, they have high flow.



**Wax Properties:**

1. They are **thermoplastic materials** that are soft when heated and are solid at room temperature.
2. **High coefficient of thermal expansion and contraction** it is the **highest** of dental materials.  $300 \times 10^{-6}/^{\circ}\text{C}$  –  $1000 \times 10^{-6}/^{\circ}\text{C}$ . shrinkage of wax from liquid to solid at room temperature is 0.4% thermal contraction of wax is compensated by expansion of investment.
3. **Poor thermal conductivity** after softening of the wax it is allowed to cool, which is accompanied by contraction. because of poor thermal conductivity only the outer layer solidify and the inner solidify later which will produce internal stress. Relief of the stresses accrues later especially when temp. increases, greater stresses may be incorporated if the wax is not properly softened.
4. Methods for softening wax prior to using include a **water bath, an infra-red lamp and a Bunsen burner**. The best way to soften the wax is to be held in the warm raising air above the flame and not in the flame itself. While The ideal method for softening wax is to use a **wax annealed** (This is a thermostatically controlled oven which keeps the wax at a constant temperature, just above the softening point, ready for use).
5. **Flow:** should have high flow when softened but should have little or no flow at room temp. or mouth temp. in order not to distort.
6. **Brittleness:** inlay wax should be brittle in order to fracture rather than distort when removed from undercut of the cavity.

**Wax Distortion**

Distortion is one of the most serious problems faced when forming the pattern and removing it from the mouth or die specially in the direct technique.

**Reasons for wax Distortion**

The wax distorted by:

1. Thermal changes, using of the wax at not uniform temperature. Some parts of the wax pattern may thermally contract more than others when stresses are introduced.
2. Releasing of internal stresses. The stresses are induced from the natural tendency of the wax to contract on cooling, from occluded gas bubbles, change of shape during moulding and due to carving, etc.
3. Distortion may also take place due to flow of wax under its own weight particularly at a higher temperature.
4. During carving operation, some molecules of wax will be disturbed and the stresses will be introduced.
5. Time and temperature of storage before investment may result in stress release.
6. If the wax has to be melted and added to the pattern in order to repair some parts that were not accurately obtained, the added wax will introduce stress during cooling.
7. If the wax is not held under uniform pressure during cooling.

**Avoidance of wax distortion:**

1. Minimal carving
2. Minimal change in temperature.
3. Minimal storage of the pattern (Invest immediately).
4. Use warm instruments for carving.
5. Store in fridge if necessary.