A. Overview of Waxes:

1. Definition of dental wax = thermoplastic molding material that is solid at room temperature.

2. General Composition of Waxes:
   a. BASE Wax: (1) Hydrocarbon or ester types; (2) High or low MW
   b. MODIFIER Waxes: (1) Hydrocarbon or ester types; (2) High or low MW
   c. COLORANT:

3. Properties of Natural Waxes:

<table>
<thead>
<tr>
<th>Name</th>
<th>Origin</th>
<th>Composition</th>
<th>Melting (°C)</th>
<th>Density (20 °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PARAFFIN</td>
<td>Mineral</td>
<td>Hydrocarbon mixture</td>
<td>50-57</td>
<td>0.90</td>
</tr>
<tr>
<td>CERESIN</td>
<td>Mineral</td>
<td>Complex hydrocarbons</td>
<td>61-78</td>
<td>0.91-0.92</td>
</tr>
<tr>
<td>BEEF WAX</td>
<td>Animal</td>
<td>Ester mixture</td>
<td>62-65</td>
<td>0.95-0.96</td>
</tr>
<tr>
<td>CANDELILLA</td>
<td>Plant</td>
<td>Hydrocarbons</td>
<td>68-70</td>
<td>0.95-0.99</td>
</tr>
<tr>
<td>CARNAUBA</td>
<td>Plant</td>
<td>Hydrocarbon, Ester, Fatty Acid</td>
<td>82-86</td>
<td>0.99-0.999</td>
</tr>
<tr>
<td>GUM DAMMAR</td>
<td>Plant</td>
<td>Aromatic resin</td>
<td>ca 120</td>
<td>1.040-1.120</td>
</tr>
<tr>
<td>ROSIN</td>
<td>Plant</td>
<td>Aromatic resin acid</td>
<td>100-150</td>
<td>1.08</td>
</tr>
</tbody>
</table>

*Do not overheat – or else the composition is constantly changed.
*Dental waxes must pyrolyze to CO2 and H2O so can not include fillers or resin.

B. Classification of Dental Waxes:

1. Methods of Classification: General Class; Design (or Application); ADA Spec

<table>
<thead>
<tr>
<th>General Class of WAXES</th>
<th>Dental Name</th>
<th>A.D.A. Specification Name</th>
<th>General Application</th>
<th>General Form</th>
<th>General Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATTERN</td>
<td>• Inlay Wax</td>
<td>Type A (Hard)</td>
<td>Direct patterns in mouth</td>
<td>Sticks, Cones</td>
<td>Blue, Green, Purple</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type B (Med)</td>
<td>Indirect patterns on dies</td>
<td>Sticks, Cones, Other</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Type C (Soft)</td>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Casting Wax</td>
<td>Acrylic buildups, clasps, bars, etc.</td>
<td>Blue, Pink, White</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Baseplate Wax</td>
<td>Type I Impr in cool climates</td>
<td>Sheets</td>
<td>Pink</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type II Impr in warm climates</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Type III &quot;</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>IMPRESSION</td>
<td>• Corrective Wax</td>
<td>Edentulous Impr.</td>
<td>Sheets, sticks</td>
<td>Or, Wh, Gr</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Biteplate Wax</td>
<td>Occlusal Regist.</td>
<td>&quot;</td>
<td>&quot;</td>
<td></td>
</tr>
<tr>
<td>PROCESSING</td>
<td>• Boxing Wax</td>
<td>Denture master casts, Impr tray borders</td>
<td>Sheets, ropes</td>
<td>Gr, Black</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Utility Wax</td>
<td>Impr tray borders</td>
<td>Ropes</td>
<td>Or, Dark red</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Sticky Wax</td>
<td>Sprues, wax connection</td>
<td>Sticks</td>
<td>Dark colors</td>
<td></td>
</tr>
</tbody>
</table>

2. Descriptions of Categories:
   a. Inlay Wax: Used for inlay, onlay, and crown patterns
   b. Casting Wax: Used in patterns for frameworks of partials
   c. Baseplate Wax: Used as a baseplate tray for full dentures
   d. Bite Registration Wax: Used for occlusal registry
   e. Corrective Impression Wax: Used for edentulous impression
   f. Boxing Wax: Used to box impressions before pouring
   g. Utility Wax: Adhesive wax for custom waxing
   h. Sticky Wax: Adhesive when heated for joining other waxes
C. **Inlay Waxes:**

1. **Overview:**
   a. **Objective:** Pattern material to accurately represent desired mold space.
   b. **Requirements for Inlay Waxes:**
      1. Good adaptation to dies
      2. Thermal stability at low temperatures
      3. Complete pyrolysis at high temperatures

2. **Inlay Wax Composition:**
   a. 60% Paraffin (and Microcrystalline) Wax = **BASE Wax**
   b. 25% Carnuba (and Candelilla) Wax = **MODIFIER Wax**
   c. 10% Ceresin = **MODIFIER Wax**
   d. 5% Beeswax = **MODIFIER Wax**
   e. <1% Colorants = **COLORANT**

3. **Properties:**
   a. **Physical Properties:**
      1. Melting Range (see pseudo-binary phase diagram below):

         ![Melting Range Diagram](image)

      2. Thermal Expansion Coefficient (result of coefficients of components):
         Kerr Hard Wax: $\alpha = \Delta L / \Delta T = 1.1\% / 25\ C = 0.011 / 25 = 440\ ppm/C$

         ![Thermal Expansion Diagram](image)

   b. **Mechanical Properties:**
      1. Flow < 1%
      2. Ductility = moderate
      3. Residual Stress = none

   c. **Chemical Properties:**
      1. Homogeneity: Good
      2. Contact Angle: Low
      3. Oxidation: Complete
MULTIPLE CHOICE STUDY QUESTIONS:

Which ONE of the following is NOT one of the three main categories of components in waxes?
- a. Base wax
- b. Modifier wax
- c. Colorant
- d. Filler

Which ONE of the following is NOT a general class of dental waxes?
- a. Pattern Waxes
- b. Inlay Waxes
- c. Impression Waxes
- d. Processing Waxes

Which ONE of the following is a pattern wax?
- a. Boxing Wax
- b. Utility Wax
- c. Sticky Wax
- d. Corrective Wax
- e. Inlay Wax

What is the typical color coding for Type II inlay waxes?
- a. Blue or Green
- b. Pink or White
- c. Orange or White
- d. Green or Black
- e. Orange or Red

Which ONE of the following is the correct ADA classification for regular inlay wax?
- a. Type A
- b. Type B or Type I
- c. Type C or Type II
- d. Type D
- e. Type III

Which type of wax is used routinely for patterns for partial denture frameworks?
- a. Inlay Wax
- b. Casting Wax
- c. Boxing Wax
- d. Utility Wax
- e. Baseplate Wax

Which ONE of the following is NOT a typical component of inlay wax?
- a. Paraffin
- b. Carnuba
- c. Rosin
- d. Ceresin
- e. Beeswax

What is the temperature of the liquidus for most paraffin-carnuba compositions?
- a. 50 °C
- b. 60 °C
- c. 80 °C
- d. 100 °C
- e. 120 °C
What is the typical value for the coefficient of thermal expansion of hard inlay wax?

a. 20 ppm/°C
b. 70 ppm/°C
c. 140 ppm/°C
d. 440 ppm/°C
e. 900 ppm/°C

To minimize the amount of distortion of wax patterns at room temperature the flow should be less than what value?

a. 1%
b. 4%
c. 5%
d. 8%
e. 10%

Which ONE of the following is NOT a requirement for inlay waxes?

a. Good adaptation to dies
b. Good flow at room temperature
c. Low temperature resistance to oxidation
d. Complete pyrolysis at high temperature

Which ONE of the following is the KEY component governing the structure and properties of most waxes?

a. Carnuba
b. Paraffin
c. Ceresin
d. Beeswax
e. Candelilla

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