Gypsum
Plaster of Paris (1800 – 1850)

\[
\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O} + \text{Heat} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}
\]
Plaster Bandages
Cotton : crinoline and leno cloth
Synthetic Resin – 1970’s

Polyurethane
Cellulose acetate
Aluminosilicate glass
Thermoplastic linear polymer
# Activation of Resin

<table>
<thead>
<tr>
<th>Material</th>
<th>Activator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyurethane</td>
<td>Water</td>
</tr>
<tr>
<td>Cellulose acetate</td>
<td>Acetone solvent</td>
</tr>
<tr>
<td>Aluminosilicate glass</td>
<td>Water</td>
</tr>
<tr>
<td>Thermoplastic polymer</td>
<td>Hot Water</td>
</tr>
</tbody>
</table>
Polyurethane Resin

The prepolymer urethane resin
Stabilizer
Anti-foaming agent
Surfactant

\[ \text{C}_6\text{H}_5.\text{NCO} \]
# Resin Bandages

<table>
<thead>
<tr>
<th></th>
<th>Fabric Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glass Fibre</td>
<td>Fibre Glass</td>
</tr>
</tbody>
</table>
| Nonglass Fibre | a. Cotton  
                 |   b. Polyester  
                 |   c. Polypropylene |
Physical Properties

- Strength of POP and Synthetic Cast
  - Factors Affecting strength of POP
  - The Effect of Gauze on the Strength of POP
- Breaking of Below-Knee cast
- Consistency of Materials
- Deformation to Failure
- Water Immersion
- Vapour Permeability
- Stickiness
- Adhesiveness
- Conformability
- Friction
- Weight
- Wear
- Setting Properties
- Activation
- Recommendations
Strength of POP and Synthetic Cast

The strength of these materials is anisotropic
Factors Affecting Strength of POP

Water Content
Setting Time
Temperature of Soaking Water
Factors Affecting Strength of POP

- Water Content
- Setting Time
- Temperature of Soaking Water
The Effect of Gauze on the Strength of POP

TS: tensile strength
CS: compressive strength
Breaking of Below-Knee Cast

To reduce the chance of breaking
  Adequate setting time
  Thicker POP at ankle and thinner at calf or sole
  Position of walking heel
  Design of walking heel
Fig. 2.8 An improper below-knee cast

Too thick at the calf

Too thin at the ankle

Walking heel too anterior
Consistency of Materials

POP is found to have a greater variability in strength than synthetic materials
Deformation to Failure

The deformation to failure of synthetic materials is usually gradual while that of plaster is usually sudden.
Water Immersion

POP casts deformed permanently after water immersion
# Vapour Permeability

<table>
<thead>
<tr>
<th>Material</th>
<th>Moisture Vapour Permeability (mg/hr/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>POP</td>
<td>62.9</td>
</tr>
<tr>
<td>Glass fibre / resin 2</td>
<td>68.32</td>
</tr>
<tr>
<td>Glass fibre / resin 1</td>
<td>79.63</td>
</tr>
<tr>
<td>Polyester / resin</td>
<td>86.1</td>
</tr>
<tr>
<td>Cotton / resin</td>
<td>112.30</td>
</tr>
</tbody>
</table>
Stickiness

A. Deltacast
B. Deltalite
C. Deltalite S
D. Dynacast XR
E. Scotchcast Plus
F. Scotchflex
G. Zimflex
Adhesiveness

A. Deltacast
B. Deltalite
C. Deltalite S
D. Dynacast XR
E. Scotchcast Plus
F. Scotchflex
G. Zimflex
H. Gypsona
Conformability
Friction
Weight

Weight (Grams)

A. Deltacast  
B. Deltalite  
C. Deltalite S  
D. Dynacast XR  
E. Scotchcast Plus  
F. Scotchflex  
G. Zimflex  
H. Gypsona

Casting Tape

Weight of typical cast required to resist a certain load
Wear

A. Deltacast
B. Deltalite
C. Deltalite S
D. Dynacast XR
E. Scotchcast Plus
F. Scotchflex
G. Zimflex
H. Gypsona
Setting Time

Fig. 2.28 Setting time

<table>
<thead>
<tr>
<th>Material</th>
<th>Maximum Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynacast XR</td>
<td>6</td>
</tr>
<tr>
<td>ZIMFLEX</td>
<td>3</td>
</tr>
<tr>
<td>SCOTCHCAST PLUS</td>
<td>3</td>
</tr>
<tr>
<td>DELTA-LITE ‘S’</td>
<td>3</td>
</tr>
<tr>
<td>DELTA-LITE CONFORMABLE</td>
<td>3</td>
</tr>
</tbody>
</table>

Setting Time (mins)
Setting Properties

![Moulding Time Graph]

- **Moulding Time (mins)**
  - **Time (min)**: 0, 1, 2, 3, 4, 5, 6
- **Products**:
  - Dynacast XR
  - ZIMFLEX
  - SCOTCHCAST PLUS
  - DELTA-LITE 'S'
  - DELTA-LITE CONFORMABLE

---

**Optimum Limits**
### Activation Recommendations

<table>
<thead>
<tr>
<th>Material</th>
<th>Activation Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delta-Cast</td>
<td>Immerse in cold water</td>
</tr>
<tr>
<td>Deltalite</td>
<td>Immerse in water at between 21°C and 27°C</td>
</tr>
<tr>
<td>Dynacast XR</td>
<td>Dip of 2-5s in warm water</td>
</tr>
<tr>
<td>Plaster-of-Paris</td>
<td>Dip for 10s in water of 20-25°C</td>
</tr>
<tr>
<td>Scotchast Plus</td>
<td>Dip in water at 21-24°C</td>
</tr>
</tbody>
</table>
Advantages of Non-fibre glass casting materials over Fibre-glass

- Lighter
- More X-ray lucent
- Less sharp edges
- No carcinogenic dust
# Price differential per cast

<table>
<thead>
<tr>
<th></th>
<th>Non-fibre glass</th>
<th>Fibre-glass</th>
<th>POP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Price (¥)</strong></td>
<td>3.5</td>
<td>2.5</td>
<td>1</td>
</tr>
</tbody>
</table>
HAPPY LEARNING