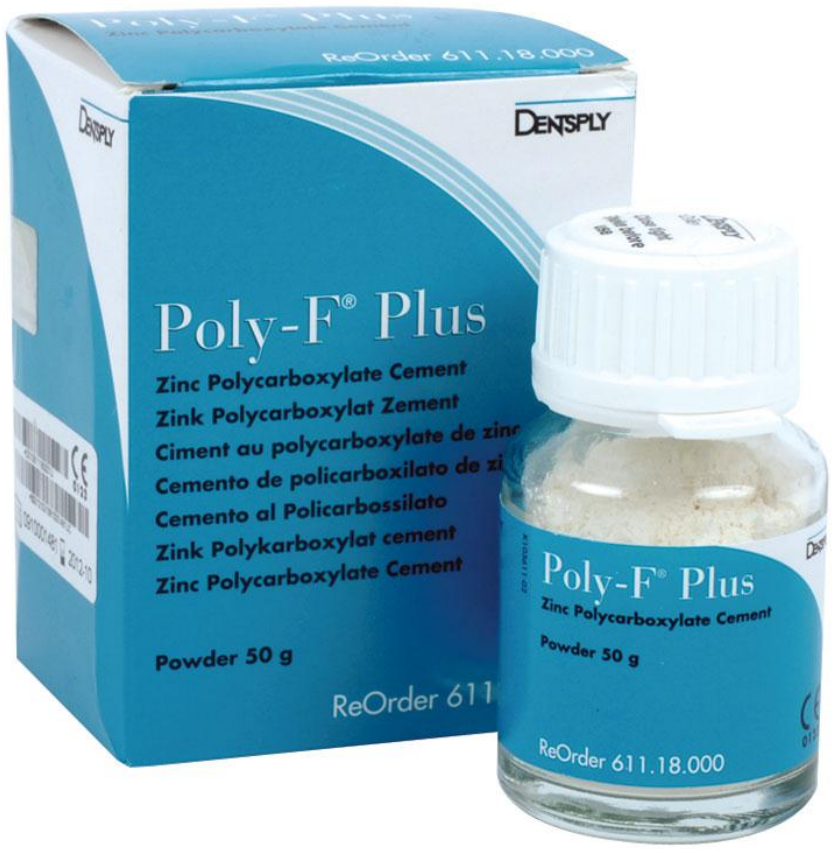
ZINC POLYCARBOXYLATE CEMENT



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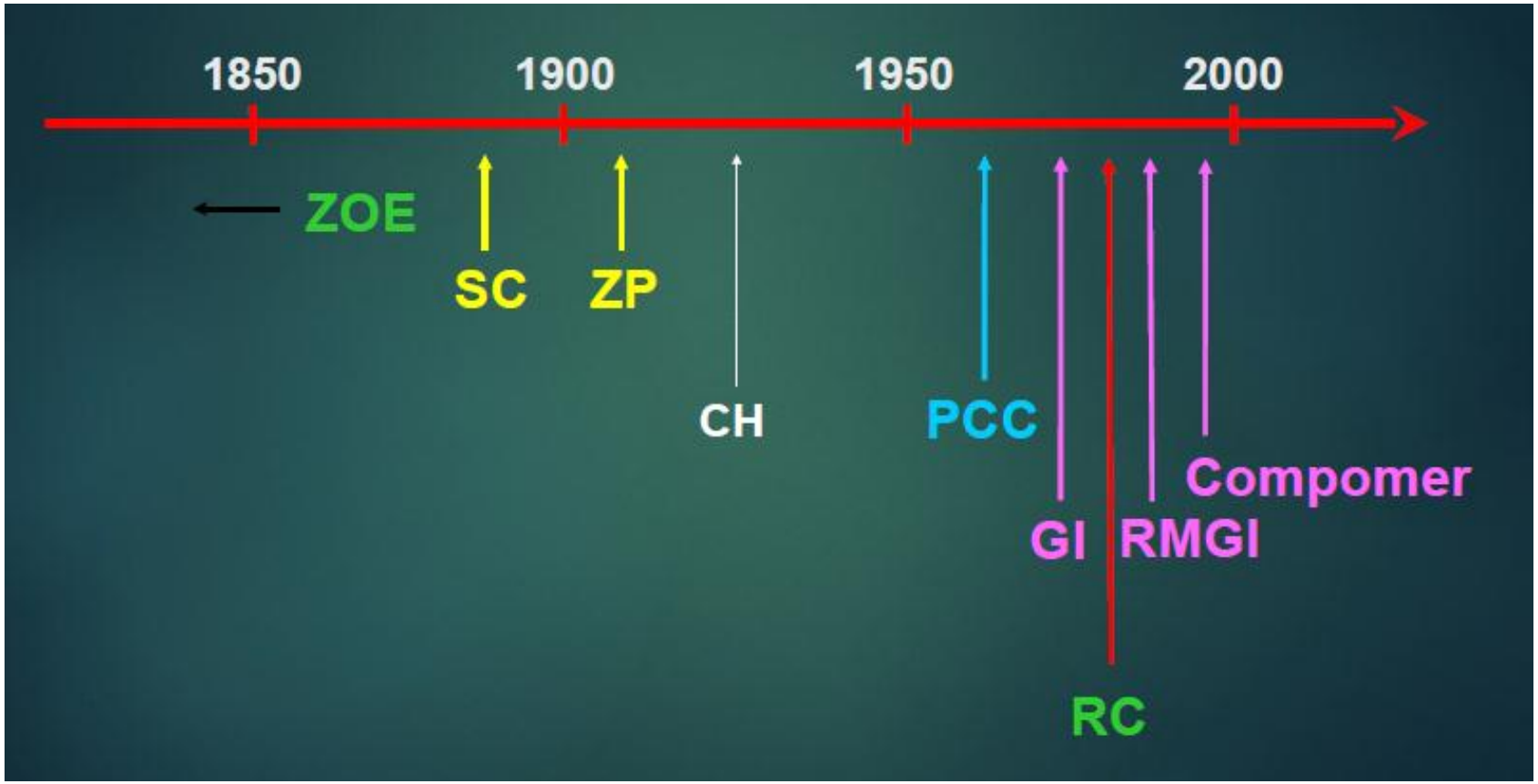
History…



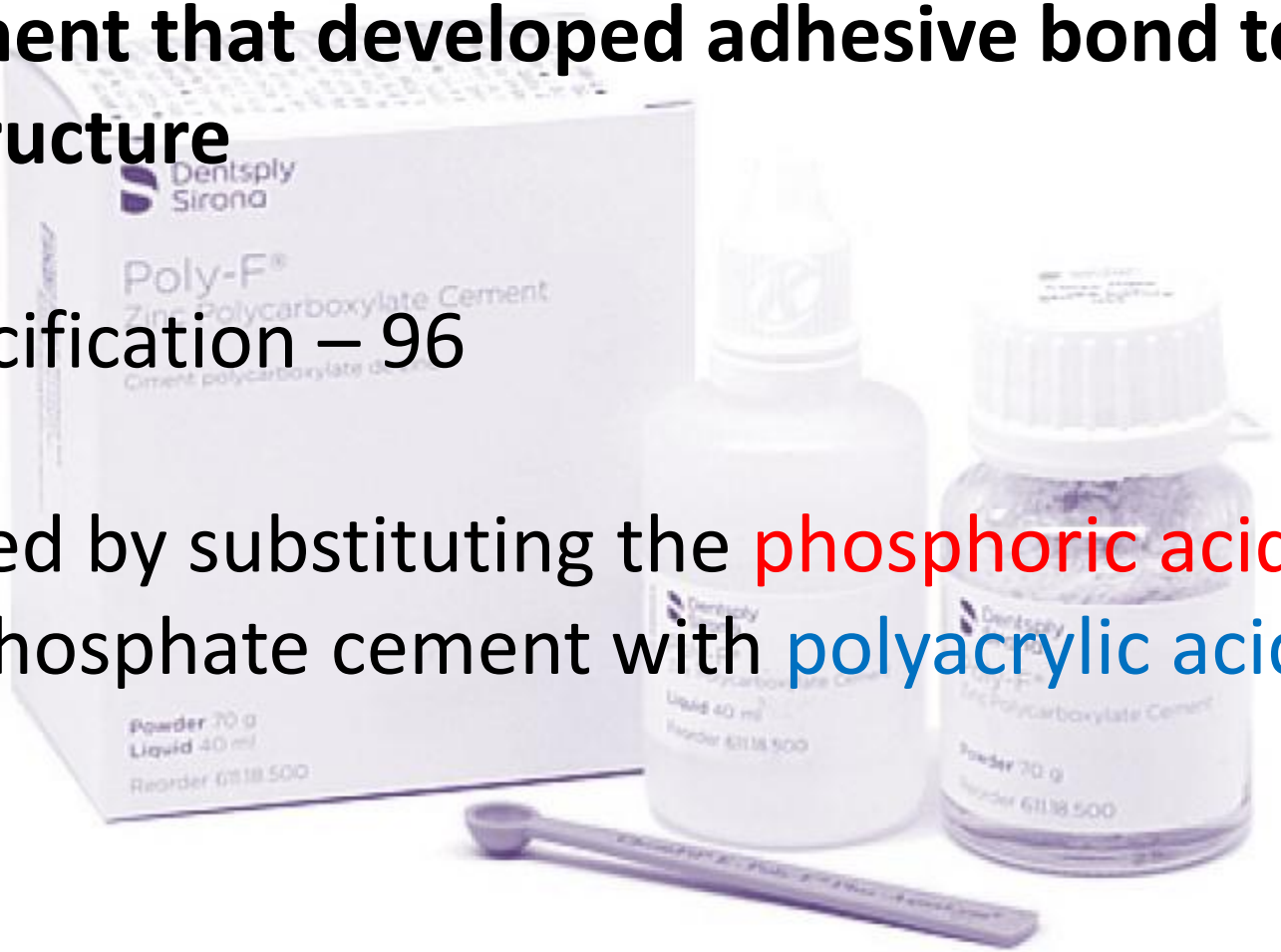
*1968-**Polycarboxilic cement by Dennis Smith***

ZINC POLYCARBOXYLATE CEMENT

First cement that developed adhesive bond to tooth structure

ADA specification – 96

Developed by substituting the phosphoric acid of Zinc Phosphate cement with polyacrylic acid.



MODE OF SUPPLY

Powder and liquid system

Capsule of preproportioned powder and liquid

Powder mixed with water [water settable cements]

COMMERCIAL NAMES

Durelon: 3M/ESPE

Poly F Plus: Dentsply

COMPOSITION

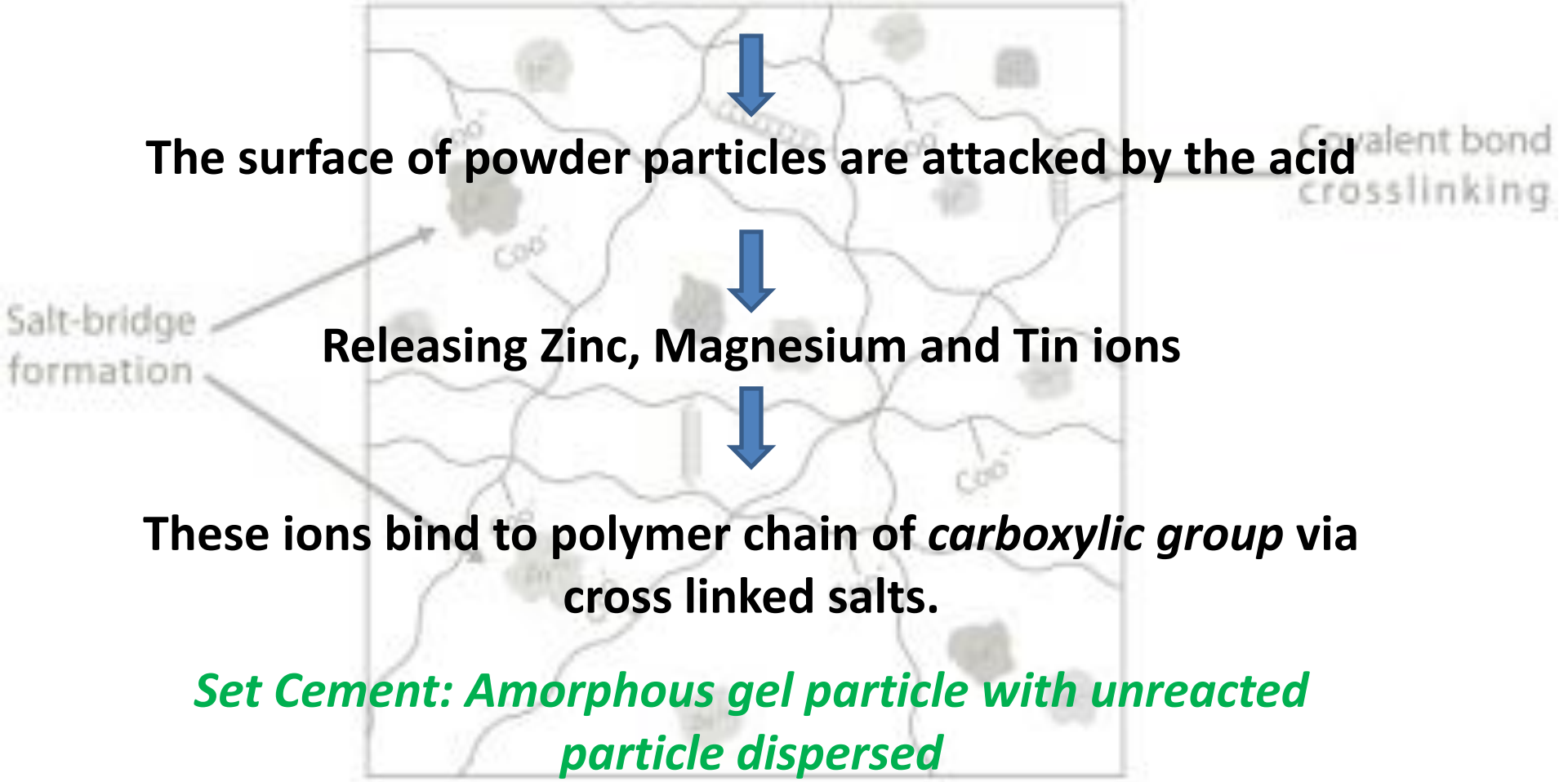
Powder	
Zinc oxide	90% - Principal constituent
Magnesium oxide/ Stannous Oxide	10% - Aids in sintering
Bismuth/Alumina	Modifies the setting time and enhances the manipulation properties
Stannous fluoride	Small amount(15-20%) of fluoride is released, improves manipulation [*Increases strength*]

COMPOSITION

Liquid
Aqueous solution of Polyacrylic acid or a copolymer of Acrylic acid with other carboxylic acid [Itaconic acid]
Acid concentration 32% to 42% by weight Molecular weight of polyacid 30,000 to 50,000 range

SETTING REACTION

When powder and liquid are mixed



The surface of powder particles are attacked by the acid

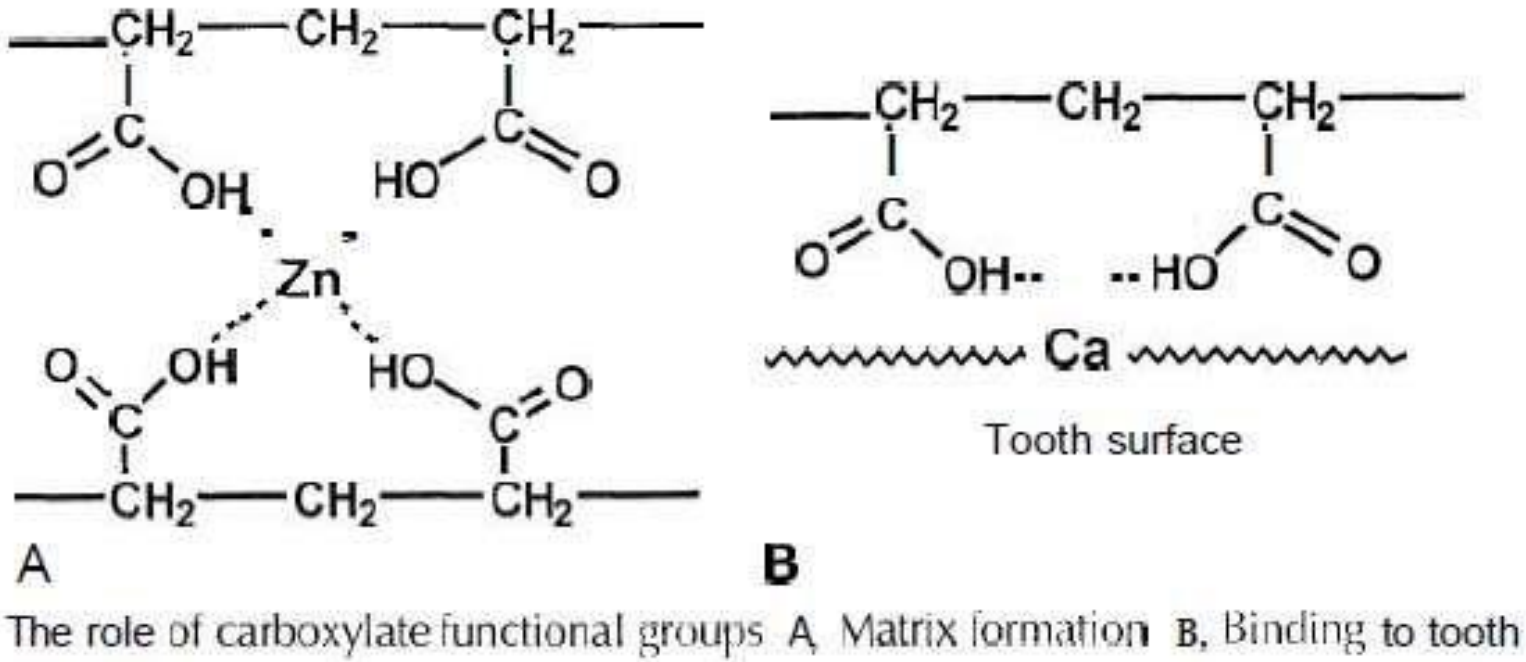
Releasing Zinc, Magnesium and Tin ions

These ions bind to polymer chain of *carboxylic group* via cross linked salts.

Set Cement: Amorphous gel particle with unreacted particle dispersed

Powder + liquid = Zinc polyacrylate

Adhesion to the tooth structure



The role of carboxylate functional groups A, Matrix formation B, Binding to tooth

Chemical Bonding - React with the calcium ions of the enamel or dentin through carboxyl ions.

PROPERTIES

Mechanical properties

Compressive strength : 55-67Mpa, Inferior to zinc phosphate cement (103 Mpa)

Diametral tensile strength: 6.2 Mpa, slightly higher than zinc phosphate (5.5MPa)

Modulus of elasticity: 2.4 – 4.4 Gpa *(less stiffer & less brittle than ZnPo4) (13.5GPa)*

PROPERTIES

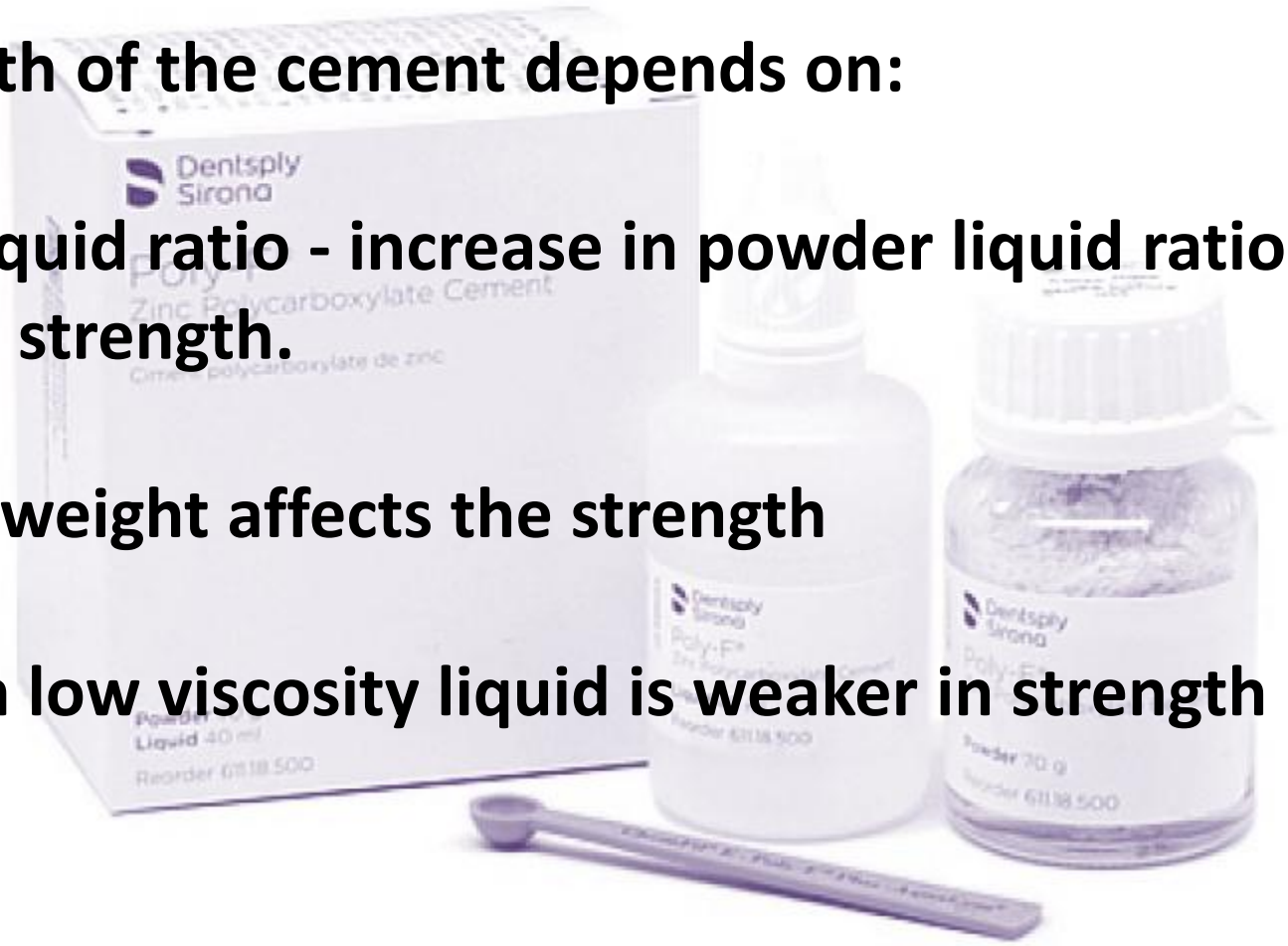
STRENGTH:

The strength of the cement depends on:

Powder /liquid ratio - increase in powder liquid ratio increase in strength.

Molecular weight affects the strength

A mix from low viscosity liquid is weaker in strength



PROPERTIES

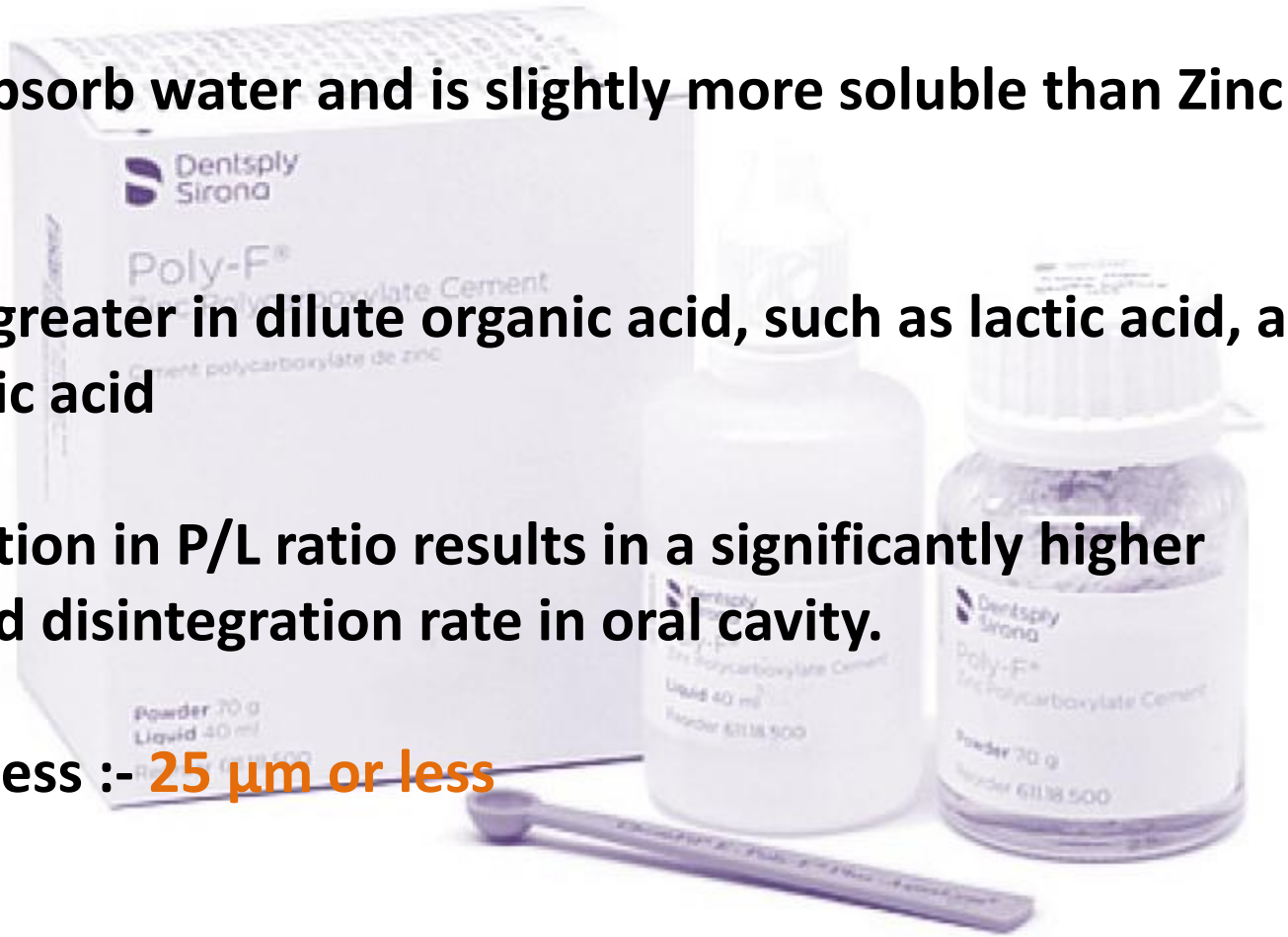
SOLUBILITY: ADA -0.06%

It tends to absorb water and is slightly more soluble than Zinc phosphate.

Solubility is greater in dilute organic acid, such as lactic acid, acetic acid and citric acid

Also a reduction in P/L ratio results in a significantly higher solubility and disintegration rate in oral cavity.

- **Film Thickness :- 25 µm or less**



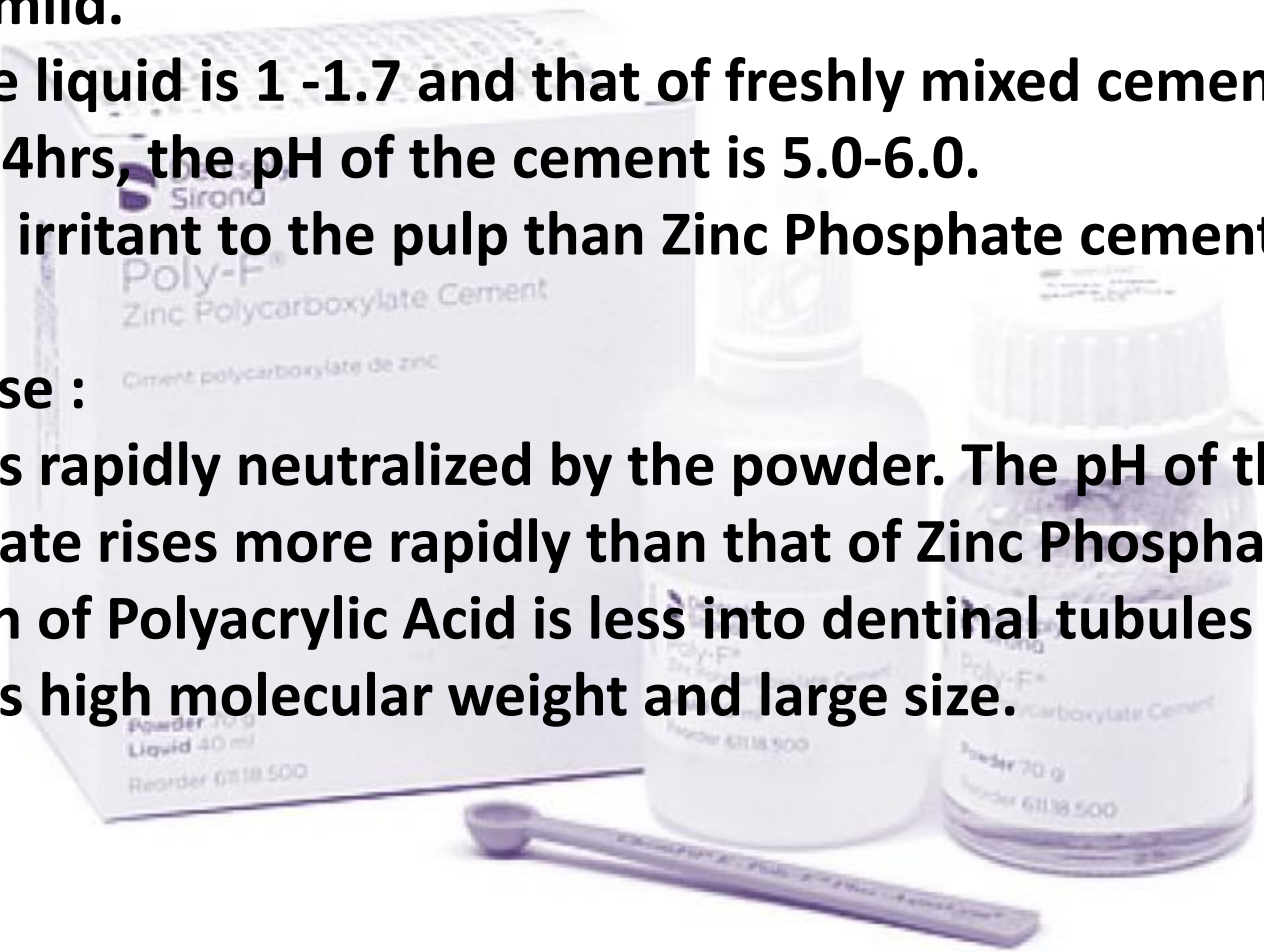
PROPERTIES

BIOCOMPATIBILITY

Despite the initial acidic nature of the cement, pulp response is classified as mild.

The pH of the liquid is 1 -1.7 and that of freshly mixed cement is 3.0 – 4.0. After 24hrs, the pH of the cement is 5.0-6.0.

They are less irritant to the pulp than Zinc Phosphate cement.



This is because :

1.The liquid is rapidly neutralized by the powder. The pH of the polycarboxylate rises more rapidly than that of Zinc Phosphate.

2.Penetration of Polyacrylic Acid is less into dentinal tubules because of its high molecular weight and large size.

PROPERTIES

ADHESION

Cement bonds chemically with the tooth structure. This is due to ability of carboxylic group in the polymer molecule to chelate with the calcium of tooth structure.

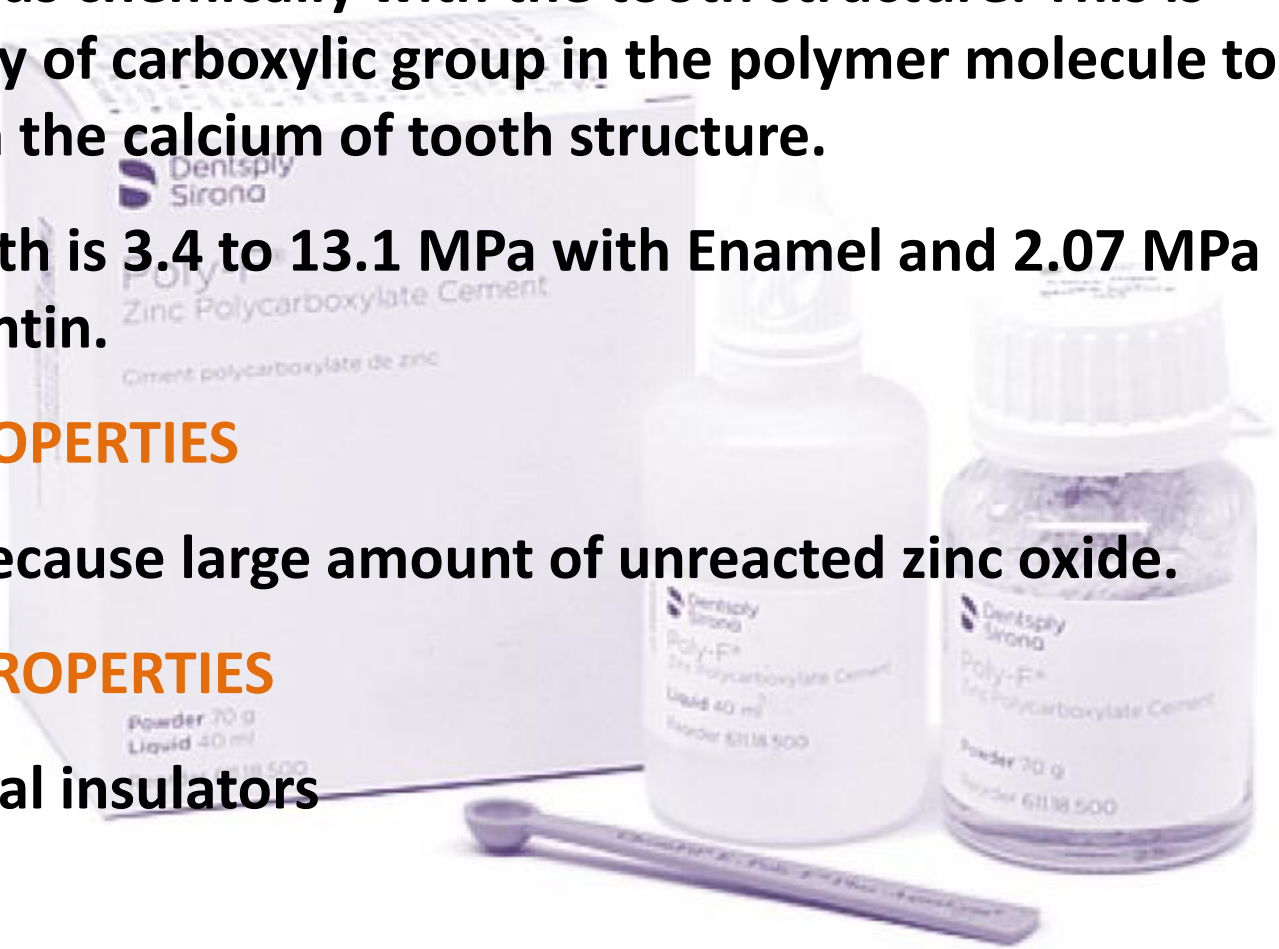
Bond strength is 3.4 to 13.1 MPa with Enamel and 2.07 MPa with the Dentin.

OPTICAL PROPERTIES

Is opaque because large amount of unreacted zinc oxide.

THERMAL PROPERTIES

Good thermal insulators



MANIPULATION

Powder-liquid ratio: 1.5 parts of powder to 1 part of liquid

1.The tooth should be meticulously cleaned to provide intimate contact and interaction between cement and the tooth.

2.Mixing is done on a glass slab or treated paper pad.

3.The powder may be cooled, but the liquid should not be cooled since the viscosity of the liquid increases.

4. Cool glass slab is used in order to delay the setting and allow more powder to be incorporated before the matrix formation occurs.

5. The liquid should be dispensed just before mixing

MANIPULATION

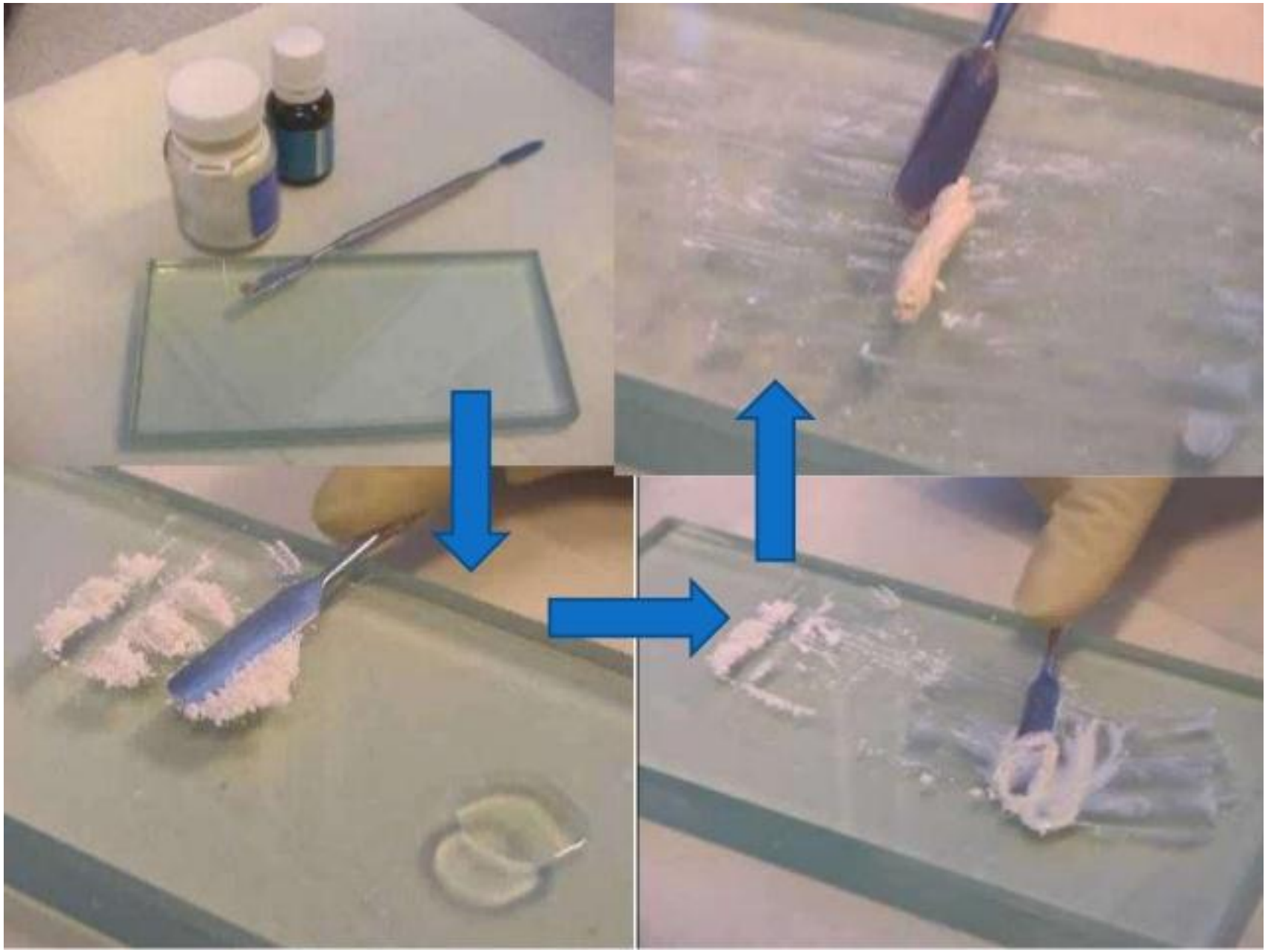
5.Powder is incorporated into the liquid in large quantities(90%) with a stiff spatula and remaining powder is added to adjust the consistency. The mixing should be completed in 30 to 40 sec in order to provide sufficient working time. The mix appears quite thick but it will flow readily into a thin film when placed under pressure.

6.The cement should be used when the surface is still glossy. Loss of luster and dull, stringy, rubbery consistency indicates that the setting reaction has progressed to an extent that proper wetting of the tooth surface by the mix is no longer possible.

7.When placed in the cavity, do not remove excess, as it passes through the rubbery stage it tends to get lifted from the cavity. Remove the excess cement only when it is hard.

MANIPULATION

MANIPULATION



MANIPULATION

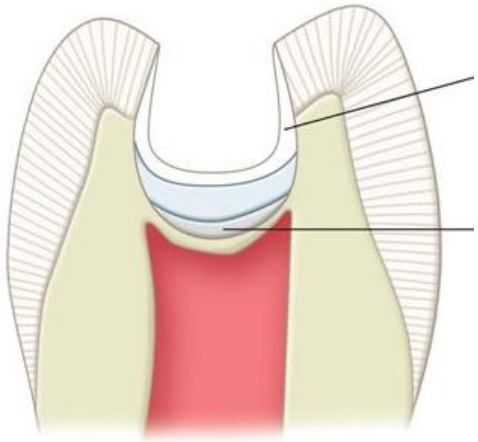
Mixing Time: 30-60 sec

Working Time: 2.5 min

Setting Time: 6 -9 min

APPLICATIONS

1) Luting of permanent restorations
2) Bases and liner
3) Luting of orthodontic bands and brackets
4) Masking agent under thin enamel to prevent metallic restoration from being seen through



PRECAUTIONS

Polycarboxylate cement adheres to instruments, so

1. Use alcohol as release agent for mixed cement.

2. Instrument should be cleaned before the cement sets.

3. From spatula it can be chipped off and remaining material is removed by boiling in Sodium Hydroxide solution.

Zinc Polycarboxylate Cement

- ***Advantages :***
- *Low level of irritation*
- *Good adhesion to tooth substances & alloys.*
- *Good strength, solubility & film thickness compare to Zinc Phosphate.*

- ***Disadvantages:***
- *Need for accurate proportion, more critical manipulation*
- *Lower compressive strength & greater viscoelasticity than Zinc Phosphate.*
- *Short working time & need clean surface to use adhesion potential (technique sensitive).*

WATER SETTABLE CEMENTS

In this the polyacid is freeze dried and that powder is then mixed with the cement powder.

Water is used as a liquid.

When powder is mixed with the water, the polyacrylic acid goes into the solution and the reaction proceeds as described for conventional cement.

Eg.TYLOK®-PLUS™ (Caulk)

MANUFACTURING

The powder mixture is sintered at high temperature in order to reduce the reactivity and then ground into fine particles.