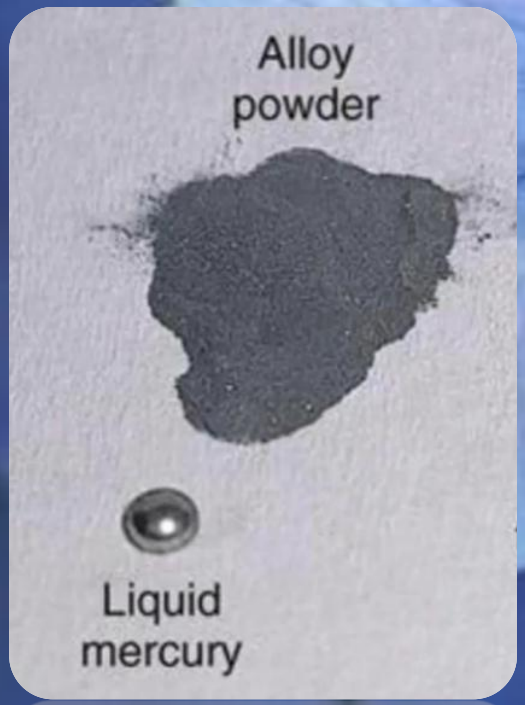
AMALGAM

Dr.Ban Al Bayati

- **DEFINITION**

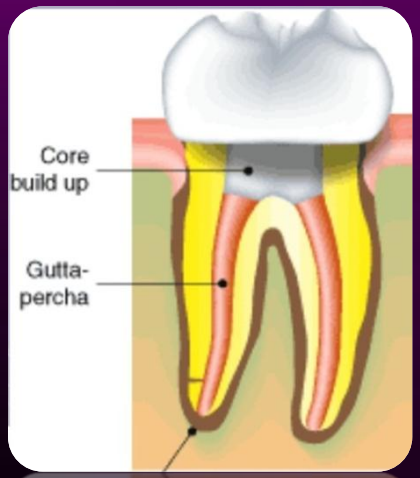
• Dental amalgam is an alloy produced by mixing liquid mercury with solid particles of silver, tin, copper and sometimes zinc, palladium and selenium; this combination of solid metals is known as the amalgam alloy.

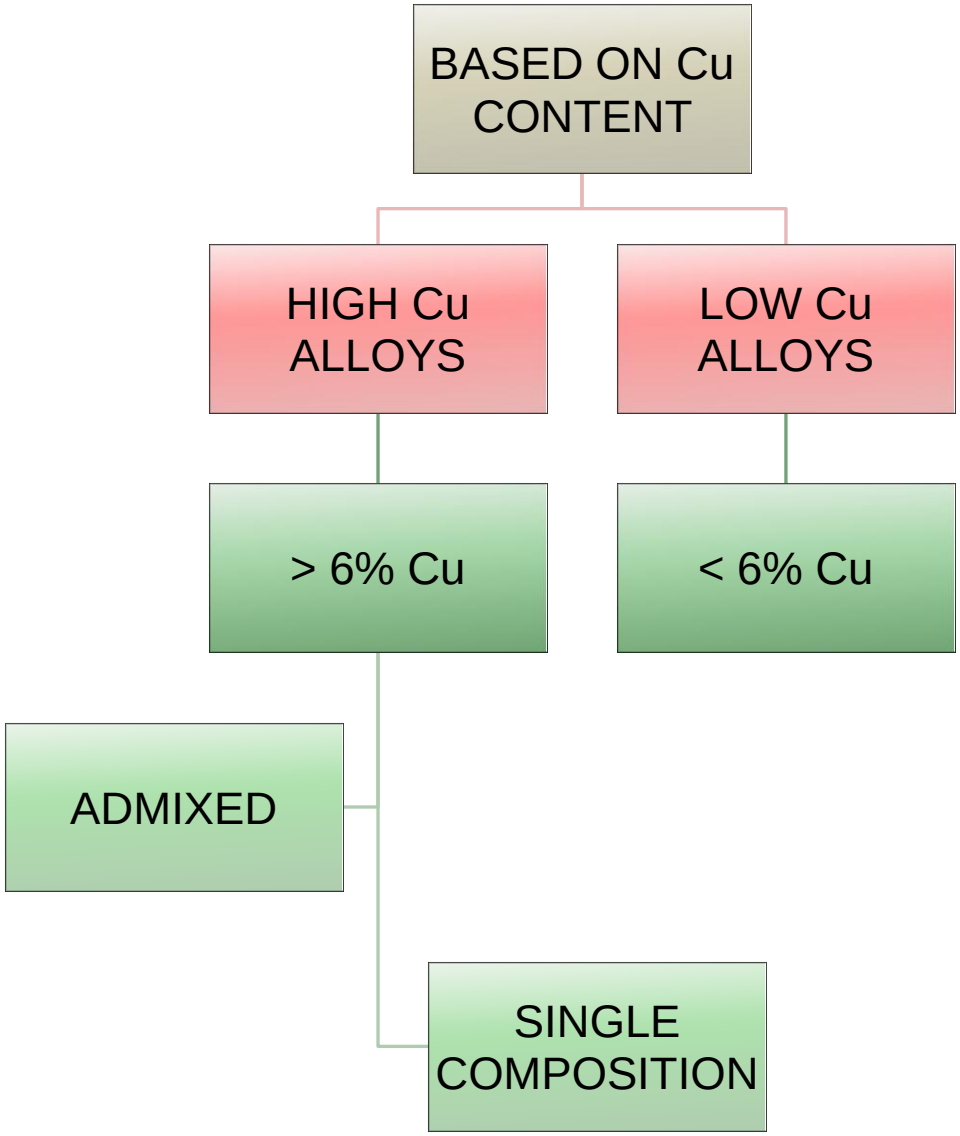


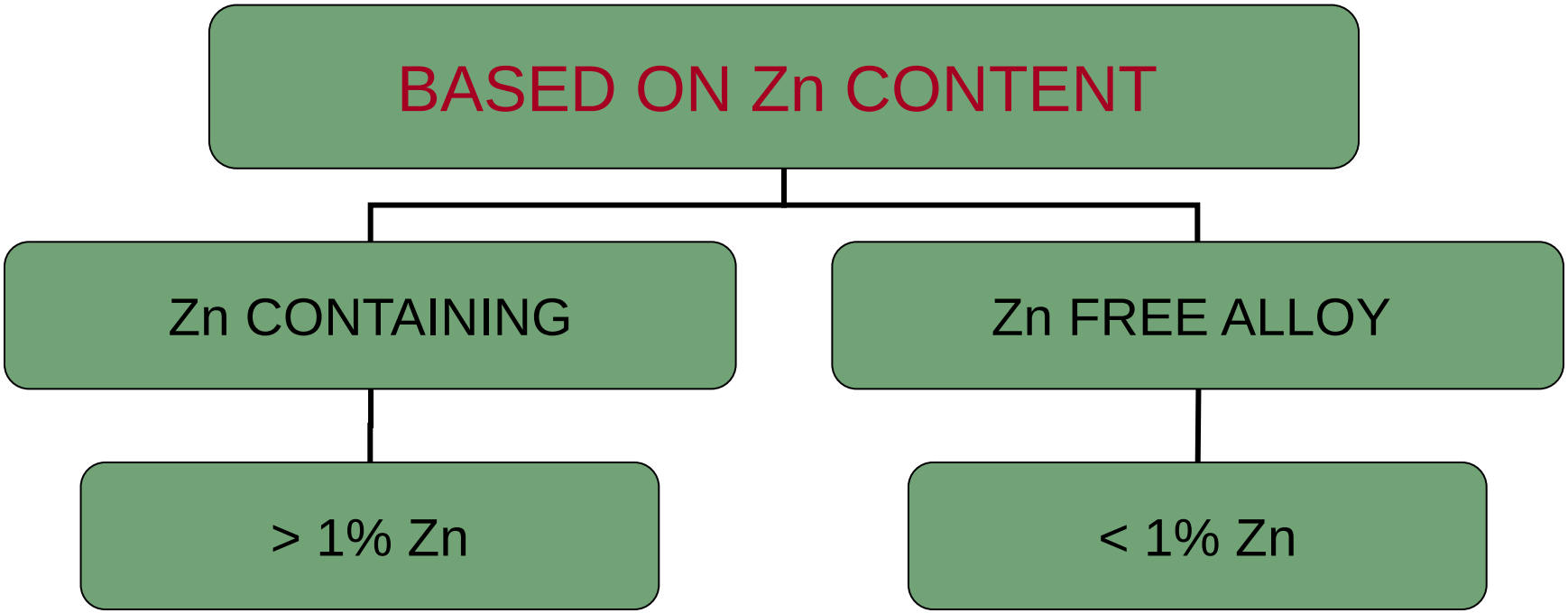
Application of amalgam

1. Permanent filling material.
2. For making dies.

3. In retrograde root canal filling.
4. As a core materials.

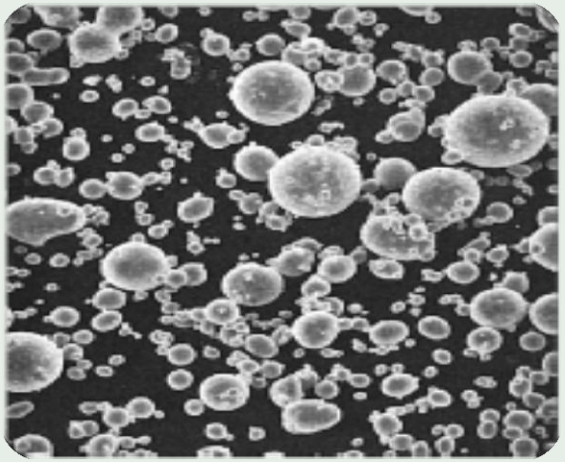



BASED ON Cu CONTENT
HIGH Cu ALLOYS
LOW Cu ALLOYS
> 6% Cu
< 6% Cu
ADMIXED
SINGLE COMPOSITION

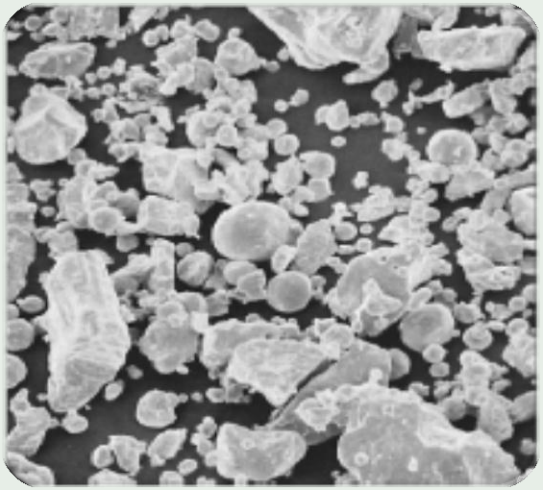

BASED ON Zn CONTENT
Zn CONTAINING
Zn FREE ALLOY
> 1% Zn
< 1% Zn

BASED ON SHAPE OF ALLOY

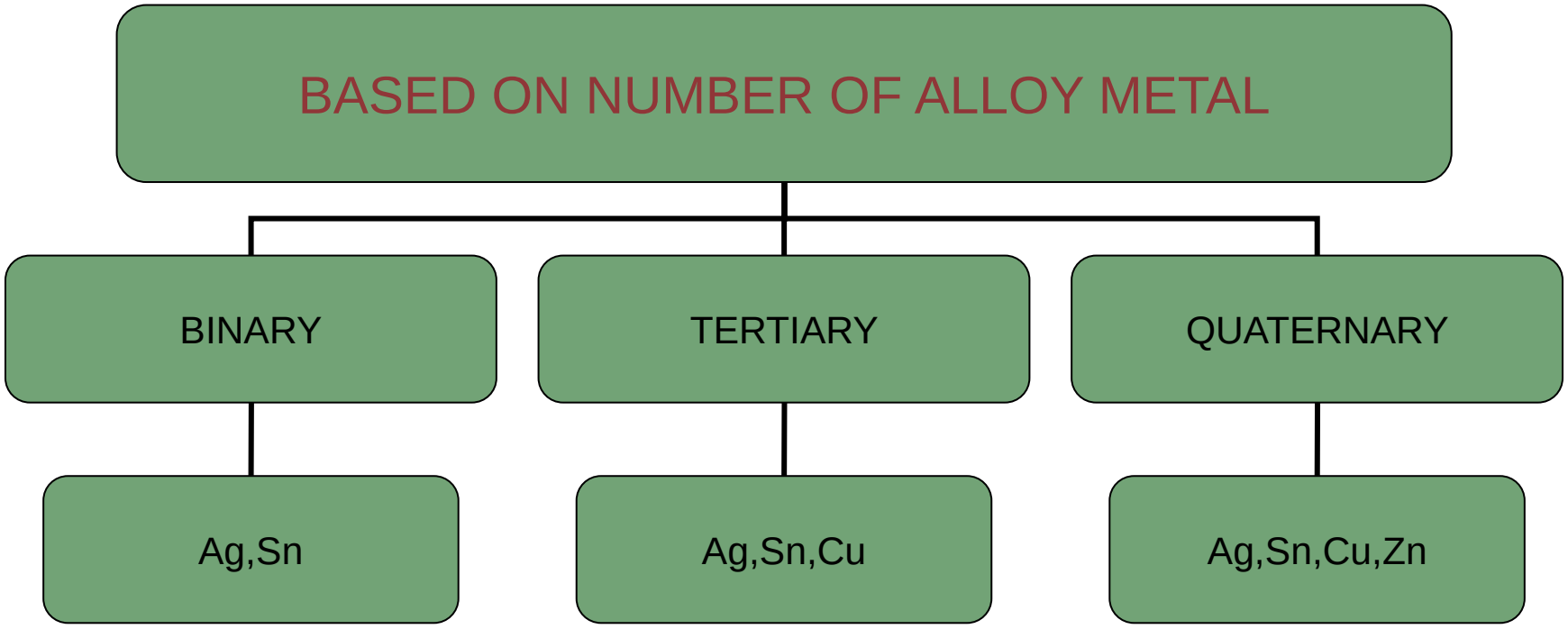
irregularly shaped

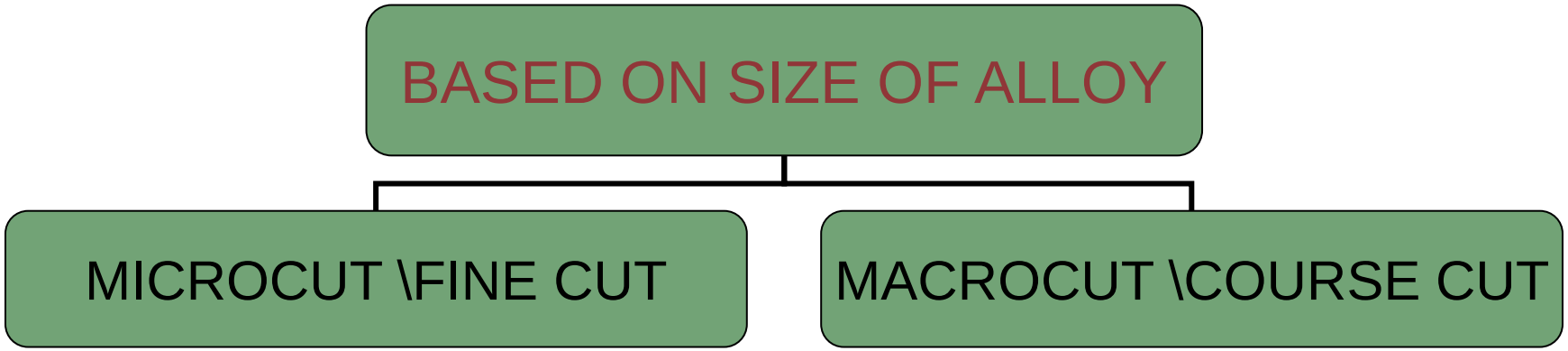


as spherical particles



as a mixture of both lathe-cut and spherical particles


BASED ON NUMBER OF ALLOY METAL
BINARY
TERTIARY
QUATERNARY
Ag,Sn
Ag,Sn,Cu
Ag,Sn,Cu,Zn


BASED ON SIZE OF ALLOY
MICROCUT \FINE CUT
MACROCUT \COURSE CUT

COMPOSITION

Components of dental amalgam

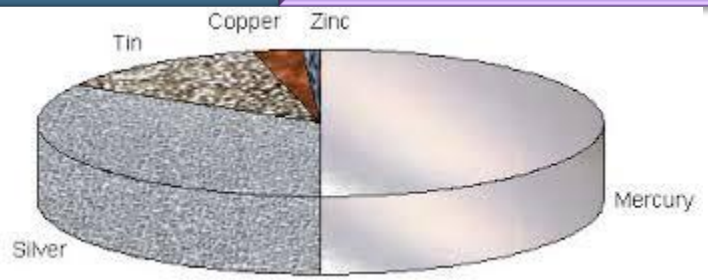
Silver

Tin

Basic

Copper

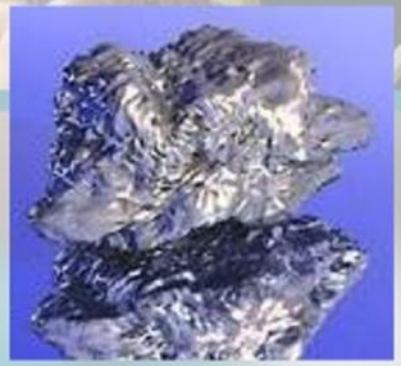
Mercury



Basic Constituents

- **Silver (Ag)**
  - Increases strength
  - Increases expansion
  - Decrease creep
  - Whitens the Alloy
  - Increase tarnish resistance

- **Tin (Sn)**
  - Decreases expansion
  - Decreased strength
  - Increases setting time



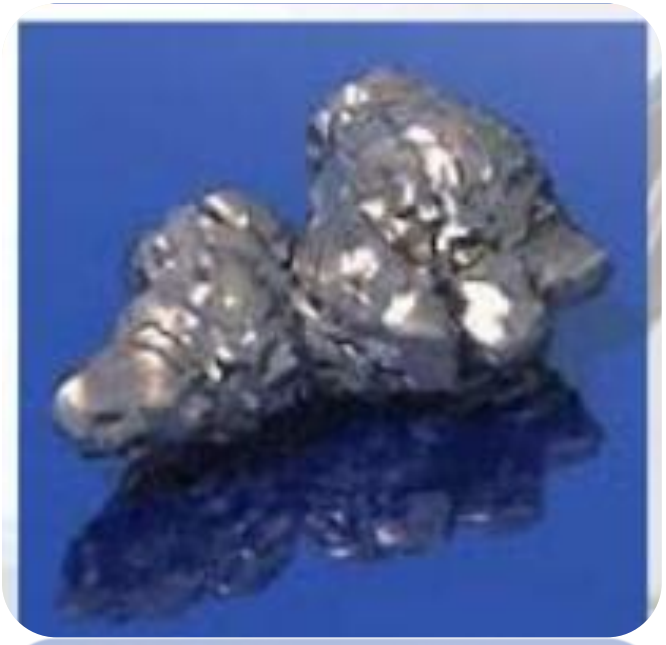
❖ ***Copper*** **(Cu)**

- Increases hardness and strength.
- Increases setting expansion.

❖ ***Mercury (Hg)*** activates reaction only. Pure metal that is liquid at room temperature.

❖ ***Zinc*** **(Zn)**

- Scavenger or deoxidizer, during manufacture, thus prevents the oxidation of important elements like silver, copper or tin. Zinc causes delayed expansion if the amalgam mix is contaminated with moisture during manipulation.
- In small amounts, it does not influence the setting reaction or properties of amalgam.



LOW COPPER ALLOY

- LOWCOPPER contains

SILVER -63 %

TIN -26-29%

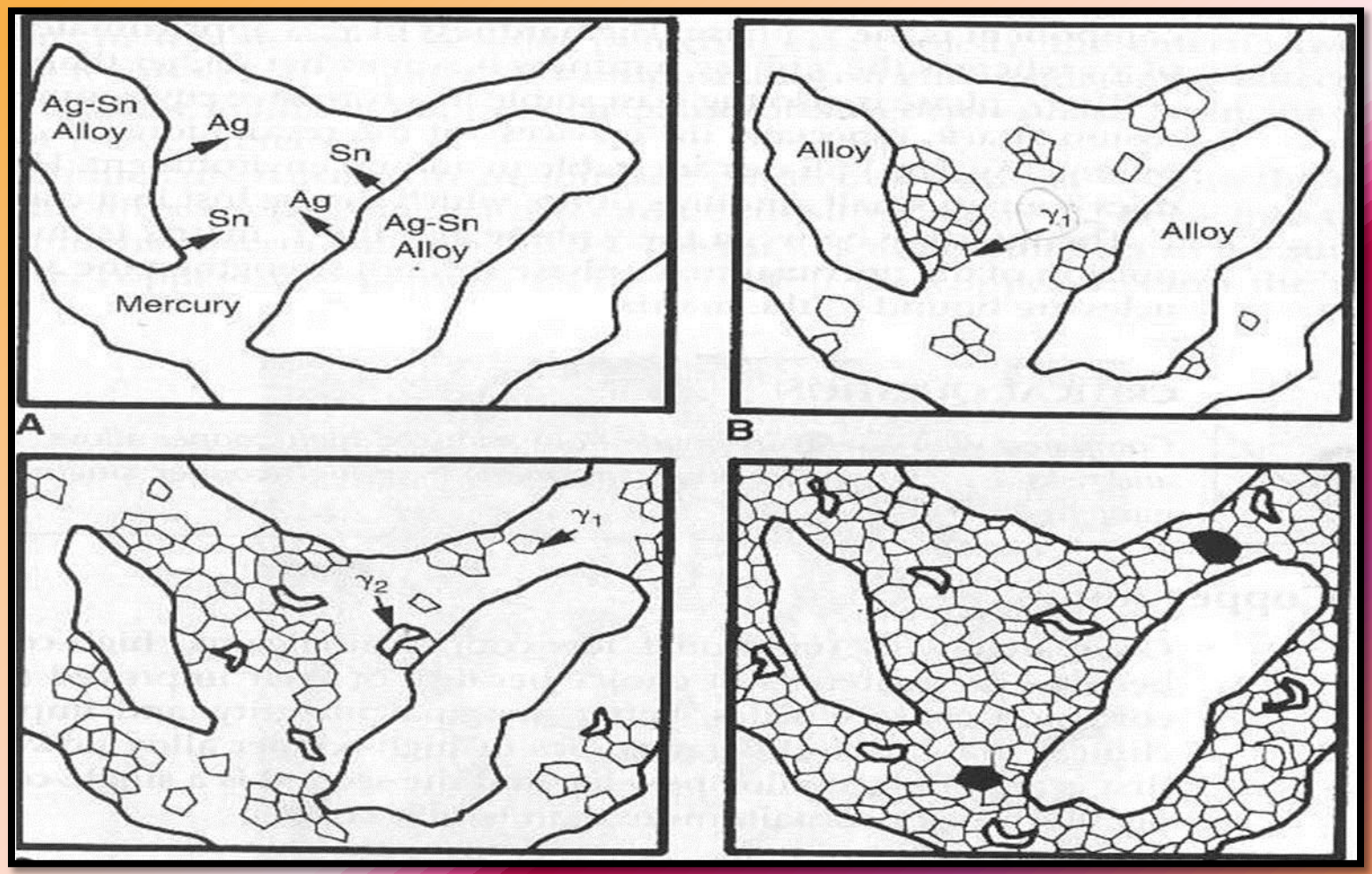
COPPER - 2-5%

ZINC - 0-2%

ALSO CALLED CONVENTIONAL AMALGAM ALLOY

SETTING REACTION IN LOW COPPER ALLOYS:

$$Ag_3Sn\ (Y) + Hg \longrightarrow Ag_2Hg_3\ (Y_1) + Sn_8Hg\ (Y_2) + Ag_3Sn\ (\text{unreacted } y)$$

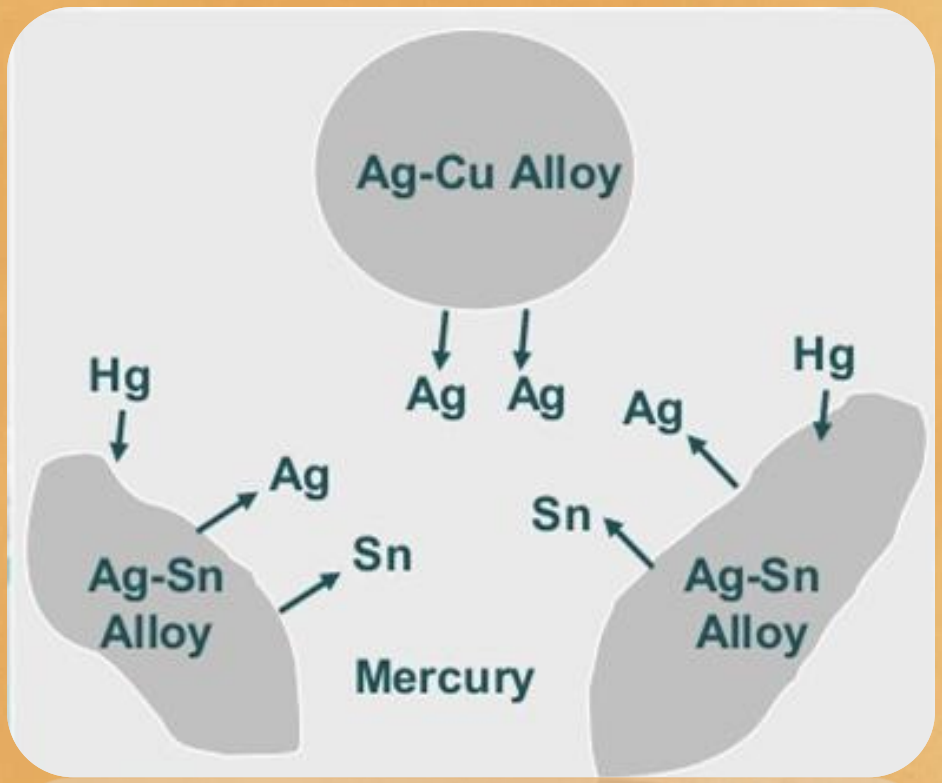


HIGH COPPER ALLOY

- HIGH CORROSION RESISTANCE
- COPPER content 12 - 30%
- TWO TYPES- ADMIXED
  - SINGLE COMPOSITION

ADMIXED AMALGAM ALLOY

- **Ag-Cu eutectic alloy (71.9% Ag and 28.1% Cu) particles are added to lathe cut low copper amalgam alloy particles.**



- **ELIMINATION OF γ 2 PHASE :**
- **REACTION 1 :**
- **Ag_3Sn** γ phase +**Ag-Cu** (Silver-Copper Eutectic) + **Hg** → **Ag_2Hg_3** (γ_1 Phase) + **Sn_8Hg** (γ_2 Phase)
  +**Ag_3Sn** (unreacted γ Phase) + **Ag-Cu**
  (unreacted Eutectic phase)

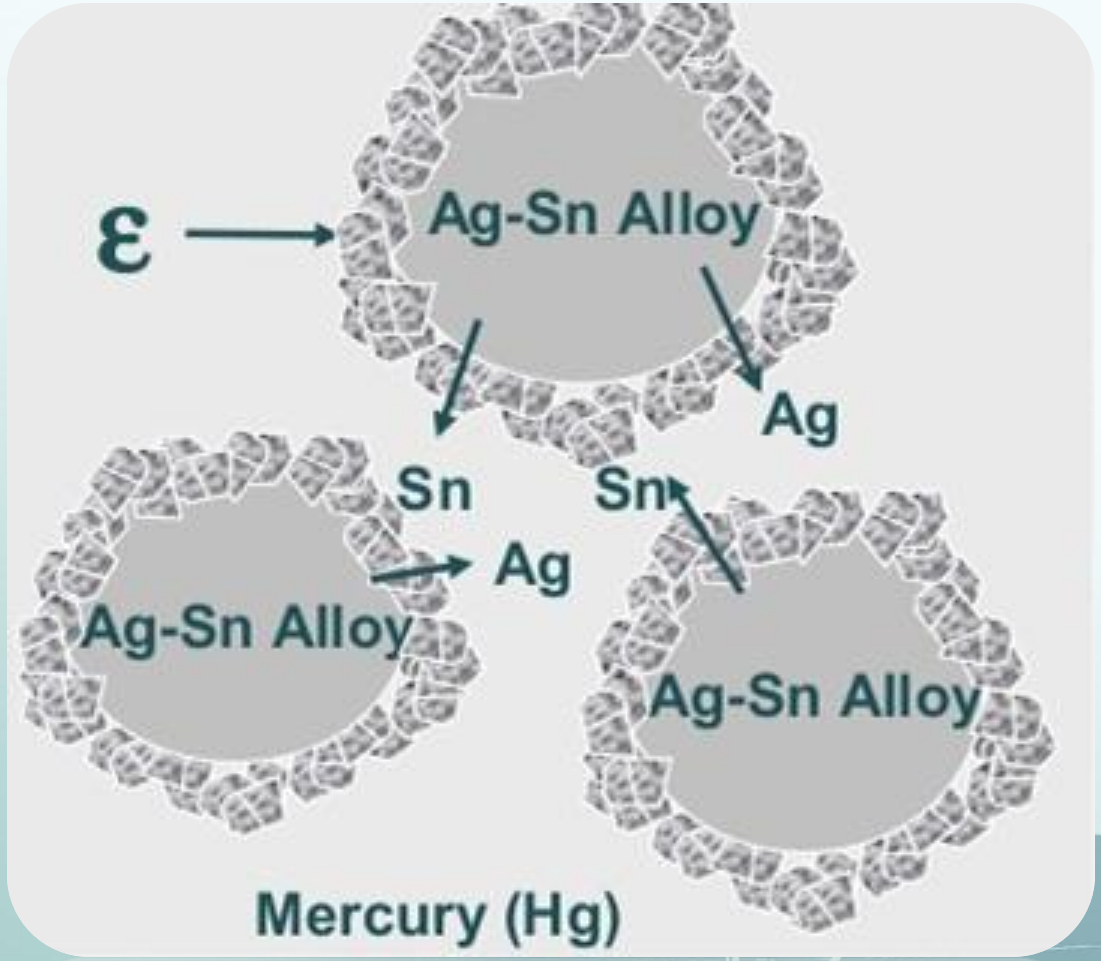
- **REACTION 2 :**
- **Ag-Cu** (unreacted Eutectic phase) + **$Sn_{-8}Hg$** (γ 2 Phase) → **Ag_2Hg_3** + **Cu_6Sn_5** (η phase)

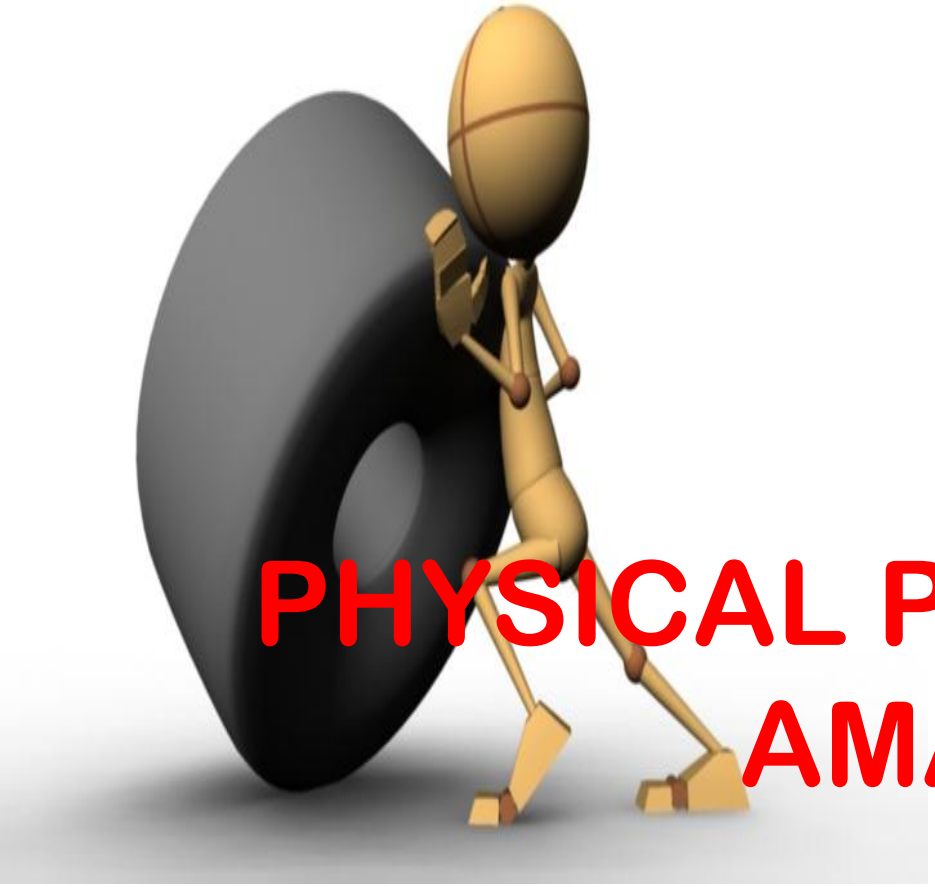
UNICOMPOSITIONAL ALLOY

- EACH PARTICLE OF THIS ALLOY HAS THE SAME CHEMICAL COMPOSITION

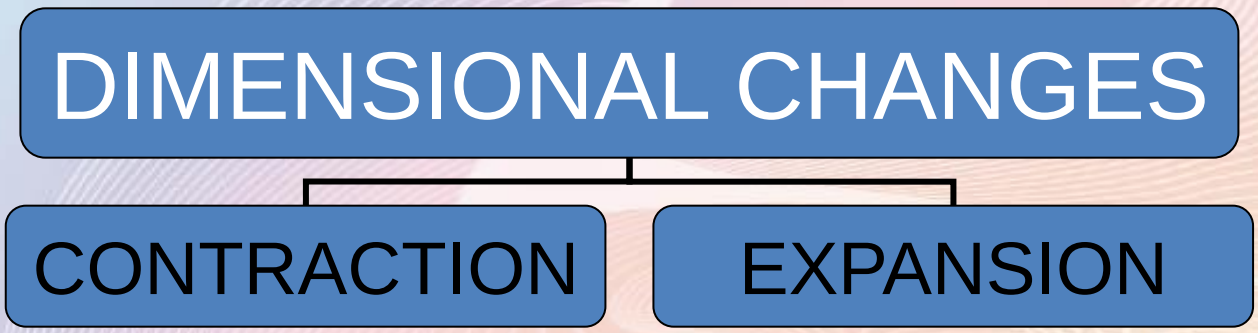
- SILVER -60%
  TIN -30%
  COPPER -13-30%

- REACTION:-AgSnCu + Hg ------- Cu6Sn5 + Ag2Hg3 + AgSnCu





PHYSICAL PROPERTIES OF AMALGAM



- **ANSI/ADA NO-1 requires that amalgam should neither contract nor expand more than 20 μm / cm, measured at 37˚C, between 5 mins and 24 hrs after the beginning of trituration.**

DELAYED EXPANSION

- Alloys containing Zn, if contaminated with moisture during trituration or condensation, a large expansion occurs.
- This is due to release of H_2 gas within the restoration creating an internal pressure

  The gas is formed as follows:

  $$Zn + H_2O \rightarrow ZnO + H_2$$

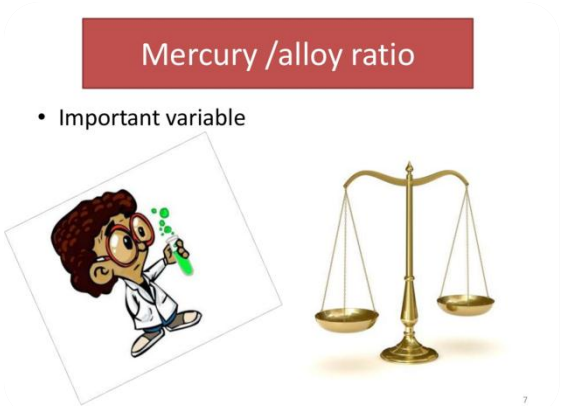
- Starts after 3-5 days , continue for months

STRENGTH

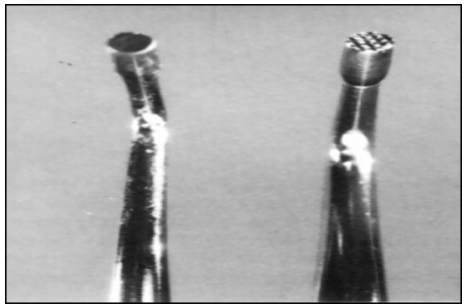
Hardened amalgam has good compressive strength but low tensile or bending strength. Therefore the cavity design should be such that the restoration will receive compression forces and minimize tension or shear forces in service.

Factors affecting strength:

- 1. Trituration affect:
- 2. Mercury content affect:



- 3. Condensation affect:



- **Porosity.**
- **Effect of amalgam hardening rate:** The ADA specification stipulates a minimum compressive strength of 80 Mpa at 1 hour.
- **Cavity design**

CREEP

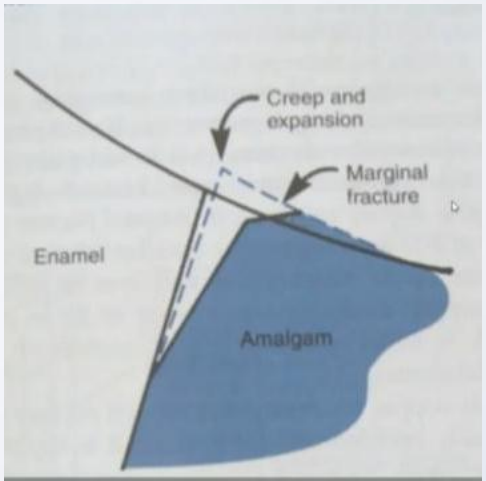
Defn:-Time dependent plastic deformation that is produced by a stress

TYPES : 1) STATIC 2) DYNAMIC

SIGNIFICANCE OF CREEP ON AMALGAM :

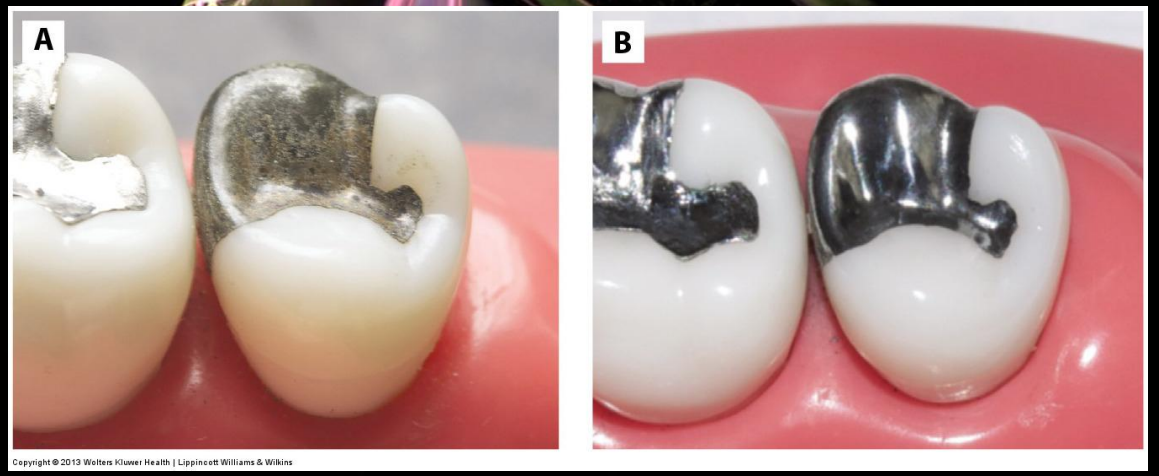
Creep rate has been found to correlate with marginal breakdown of traditional low-Cu amalgams.

- **Low copper amalgam creep= 0.8-8.0%.**
- **High copper amalgam creep= 0.4-0.1%.**



TARNISH & CORROSION

- Tarnish: means loss of luster from the surface of metal or alloy due to the formation of a surface coating.



CORROSION

- ***Corrosion***

➢ Corrosion is the progressive destruction of a metal by chemical or electrochemical reaction with its enviorment.

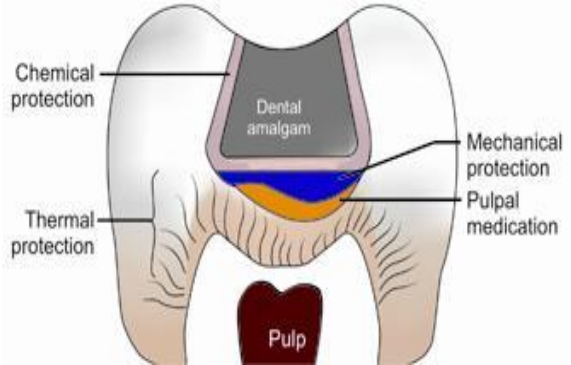
- Excessive corrosion can lead to increased porosity, reduced marginai integrity, loss of strength, and the release of metallic product

Factors related to excess corrosion

- Contact of dissimilar metals, e.g gold, and amalgam increase **galvanic** corrosion.
- High copper amalgam is cathodic in respect to a low copper amalgam so mixed high copper and low copper restoration increase **galvanic** corrosion (should be avoided).
- High residual mercury increase corrosion.

Thermal properties:

- Amalgam has a relatively high value of *thermal diffusivity*.
- The *coefficient of thermal expansion* value for amalgam is about three times greater than that for dentine.



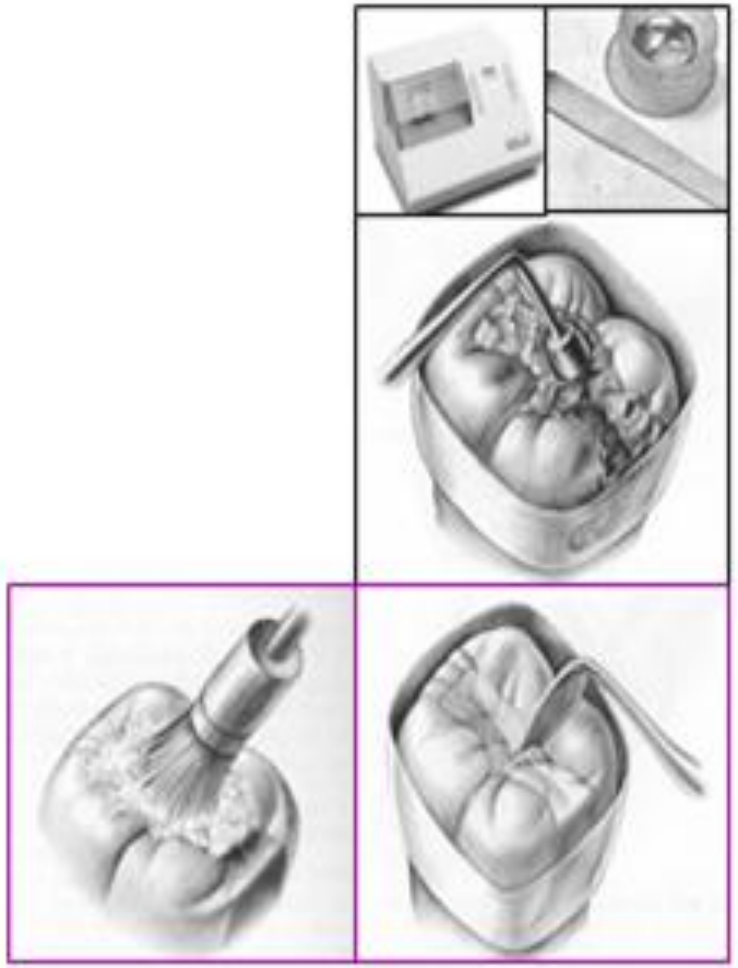
Biological properties


MANIPULATION TECHNIQUES

The manipulation of amalgam

(1) Proportioning and dispensing

(2) Trituration



- ***Proportioning***

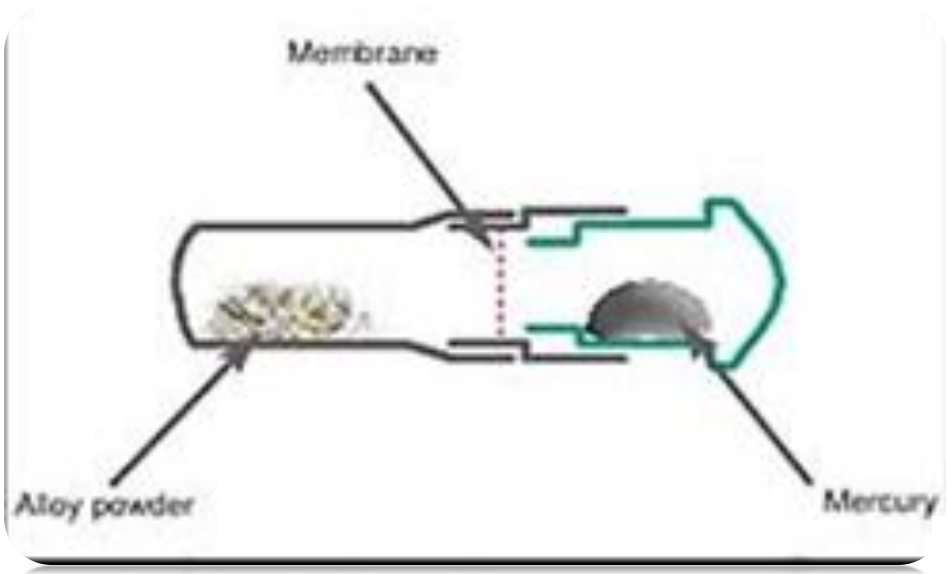
- For any given alloy/mercury ratio, the nature of the mix may vary depending upon the size and shape of the alloy particles. Spherical particle alloys, for example, require less mercury to produce a workable mix.
- Some alloy require Hg/alloy ratio in excess of 1:1, whereas other use ratio of less than 1:1, the percentage of Hg varies from 43%-54%.

Dispensing

- The simplest type volume dispenser releases a known volume of either mercury or alloy.

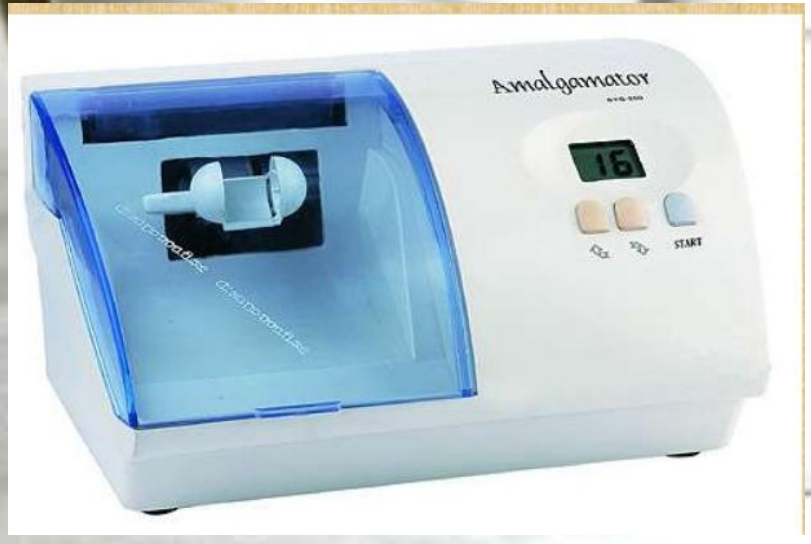
- Tablets:

➢ preproptional capsule



Trituration

- **The mixing or trituration of amalgam may be carried out by hand; using a mortar and pestle, or in an electrically powered machine (mechanical mixing device called amalgamator**
- **Methods:**
- **mortar and pestle (hand)**
- **mechanical amalgamator**



MORTAR AND PESTLE

2. Mechanical mixing: using electrically powered machine (amalgamator) which vibrates a capsule containing alloy and mercury
   - Advantages:
   1. More uniform and reproducible mix is produced
   2. Shorter trituration time
   3. Lower Hg/alloy ratio can be used

There is no exact recommendation for mixing time, since amalgamators differ in speed, oscillating pattern and capsule designs.

--spherical alloys usually require less amalgamation time than lathe cut alloys

--a large mix requires slightly longer mixing time than a smaller one

appears rounded with a smooth shiny surface(normal mix)

Under mix is rough & grainy,may crumble,mix hardens too rapidly

Over mix. Soupy mix ,difficult to remove from the capsule,too plastic to manipulate

decreased working time


DENTAL AMALGAM WILL NOT GO AWAY
EVEN IF IT WERE TO BE IMMEDIATELY DISCONTINUED
AS A RESTORATIVE MATERIAL.
IT WILL KEEP GOING , GOING & GOING
Thank you