Dental Material

Physical properties of dental material (adhesion and cohesion)

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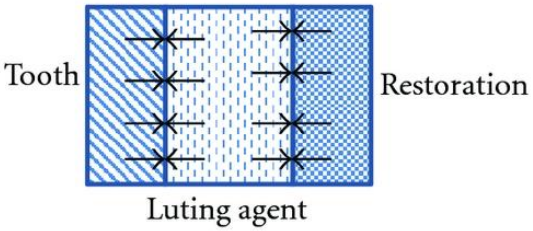
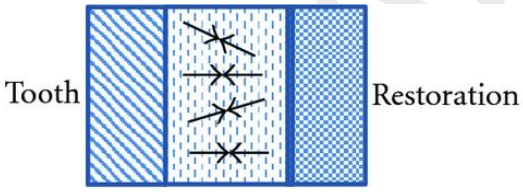
Lec. 7

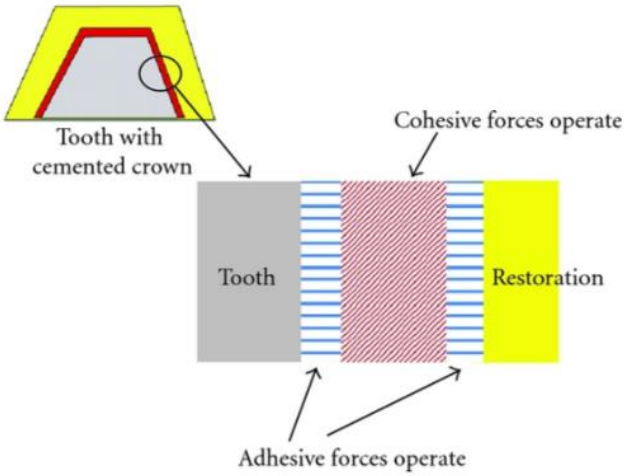
Adhesion and cohesion

Adhesion is the force which causes two or more different substances to attach when they are brought in contact with one another.



Cohesion forces make molecules of the same substances hold together.





Mechanisms of Adhesion

The strength of the adhesion between two materials depends on the interactions between the two materials, and the surface area over which the two materials are in contact. As a result, a number of factors enter into the overall adhesion system.

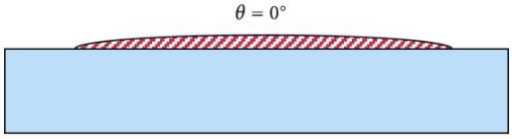
1. Contact Angle and Surface Tension

Materials that wet against each other tend to have a larger contact area than those that do not, however, wetting depends on the relative surface energies of the adhesive and substrate materials.

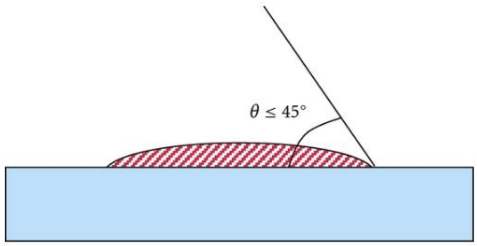
Wetting is the ability of a liquid to form an interface with a solid surface and the degree of wetting is evaluated as the contact angle θ formed between the liquid and the solid substrate surface.

The smaller the contact angle and the lower the surface tension of the liquid, the greater the degree of wetting

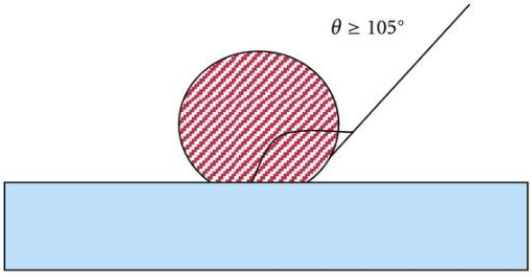
- clean surface allows good wetting (contact angle θ is close to 0°)



- a slightly contaminated surface (contact angle θ is greater than 0° but less than 90°)



- a contaminated surface (contact angle exceed 90°)



- A small contact angle indicates more adhesion is present **because** there is a large contact area between the adhesive and the substrate, resulting in a greater overall substrate surface energy and a high interactive force between the liquid and the substrate.

2. Chemical Adhesion

If the adhesive and substrate can form a compound at their interface or union, the ionic or covalent bonds that are formed result in a strong bond between the two materials.

- To achieve chemical bonding the surfaces brought very close together and remain in this proximity for the bond to be stable.

3. Dispersive Adhesion

In dispersive adhesion, the surfaces of two materials are held together by van der Waals forces (they are the attractive forces between two molecules)

4. Diffusive Adhesion

Diffusive bonding occurs when atoms from one surface penetrate into an adjacent surface while still being bound to their surface of origin. Like polymer chains where one end of a molecule can diffuse into the other material.

Example:

- when a fractured denture is repaired with acrylic resin.
- when metal or ceramic powders are compressed and heated so that atoms diffuse from one particle to the next to produce a solid mass.

5. Mechanical Adhesion

When adhesives flow over the substrate, filling the voids and pores of the surface and attach or "bond" to that surface by mechanical interlocking. This is often referred to as micromechanical adhesion.