Identifying principles of amalgamator etc.

○ Amalgamator and amalgam separator
  ○ Principles of operation
    ▪ function, use
    ▪ scientific principles
○ Polymerisation unit
  ○ Principles of operation
    ▪ function, use
    ▪ scientific principles
○ Dental drill
  ○ Principles of operation
    ▪ function, use
    ▪ scientific principles
○ Dental furnace
  ○ Principles of operation
    ▪ function, use
    ▪ scientific principles

13.5.5 Principles of amalgamator, amalgam separator, etc.
Unit B 13.5 Maintaining dental and dental laboratory equipment
Module 279 18 B Medical Instrumentation I
Amalgam

Amalgam has many desirable properties as a dental material. Although its use is decreasing, amalgam remains one of the most widely used restorative materials in dentistry (since 150 years). Amalgam is composed of an alloy and mercury. These are combined and mixed in the dental lab and inserted into the tooth cavity before hardening out.

Mercury is used in amalgam because it helps make the filling materia pliable. When it is mixed with an alloy powder, it creates a compound that is soft enough to mix and press into the tooth. But it also hardens quickly and can withstand the forces of biting and chewing.

Mixing can be either done by hand using a mortar and pestle or by a mechanical amalgamator.

While the safety of dental amalgam in patient care is well established, amalgam entering the sewage system by way of dental vacuum systems may be exposed to conditions that do not occur in the mouth such as incineration of wastewater treatment plant sludge. This can result in release of mercury to the environment. The amalgam separator is designed to prevent this.
Amalgamators are used to form amalgam fillings to fill cavities in teeth. They are present in every dentist's office.

The dental amalgamator is used to mix silver-coloured amalgam capsules from a dental alloy (combination of different materials, including at least one metal such as silver, tin or copper) and mercury.

All materials must be weighed before mixing starts, according to manufacturers instruction. The amalgamator mixes the amalgam in a capsule by rapid shaking or vibration during a set period of time (seconds only). This produces a uniform mix.

The amalgam is taken from the capsule and placed in an amalgam cup. The amalgam is then carried to the mouth and deposited in the cavity preparation, before the material starts hardening out and crystals are formed.
Amalgamator

An electromotor (3) drives the fork (17) in which the capsules are locked. Its operation is controlled by a microprocessor (24), which ensures that a precise mix is achieved.
Amalgamator

Digital dental amalgamators are noiseless, reliable and precise. LEDs are used to show the status of the amalgamator operations. The device needs to be set depending on the alloys being used. Amalgamators are basic and simple, which makes their servicing easy.

When handling dental amalgamators one needs to maintain high standards of cleanliness to ensure that there is no contamination. Contaminated devices should be disposed of immediately as they become environmentally hazardous when they start to emit any amount of mercury vapour. Such disposal reduces the risk of exposing patients to hazardous mercury residues which can lead to infections.
Amalgam separator

Most dental offices currently use some type of basic filtration system to reduce the amount of mercury solids passing into the sewer system. The installation of a good amalgam separators system reduces amalgam waste entering the sanitary system with up to 99.9%.

An amalgam separator typically consists of a canister that is located either in the dental treatment room or in the mechanical room adjacent to the vacuum pump.

Different amalgam separators have been designed to remove amalgam particles from dental office wastewater through sedimentation, filtration, centrifugation and chemical means; or a combination of these.
Amalgam separators require regular monitoring and maintenance to ensure they are functioning properly. This varies depending on the amalgam separator you chose and your practice volume. For example, the collected amalgam may have to be removed daily with some units or in high-volume practices, while other units may only have to be serviced periodically (e.g., every 3 to 18 months).

It is important to plan how to dispose of the amalgam waste and used parts of the amalgam separator (e.g., used cartridges and filters). Some amalgam separator companies offer disposal/recycling of the amalgam waste as part of a package when you purchase their product, while others leave it to the user to obtain disposal/recycling services.
**Polymerisation unit**

**Polymerisation** a chemical reaction of molecules to form polymer chains or three-dimensional networks of molecules.

A dental Polymerisation unit or *Curing light* is used for polymerisation (hardening) of light-cure-resin-based composites, used for filling cavities in a tooth.

Composites are placed in the cavity while still in a soft, dough-like state. When exposed to light of a certain blue wavelength (typically 470 nm), they polymerize and harden into a solid filling. The two main dental curing lights use *halogen* or *LEDs*.

Composite fillings are an alternative for amalgam fillings.
(Tungsten) halogen curing light, is the most frequent polymerization source used in dental offices. In order for the light to be produced, an electric current flows through a thin tungsten filament, which functions as a resistor. This resistor is then heated to a temperature of about 3,000 °Kelvin at which point it emits infrared and electromagnetic radiation in the form of visible light. It provides a blue light of about 400 to 500 nm, with an intensity of 400-600 mWcm².

Drawbacks:

• the high temperatures requires a ventilating fan for cooling. This makes the curing light larger. The wattage of the bulb (e.g. 80W) requires that these curing lights must be plugged into a power source, that is, they are not cordless.
• the light requires frequent regular replacement of the light bulb because of the high temperatures that are reached.
• the time needed to fully cure the material is much more than with the LED curing light.

Tungsten, also known as wolfram, is a chemical element with symbol W and atomic number 74.
LED curing lights use one or more light-emitting diodes [LEDs] and produce blue light that cures the dental material. LEDs as light-curing sources are relatively young (1995).

The dental LED curing lights use LED’s that produce a narrow spectrum of blue light in the 400- to 500-nm range.

These curing lights are very different from halogen curing lights. They are more lightweight, portable and effective. The heat generated from LED curing lights is much less which means it does not require a fan to cool it. Its portability comes from the low consumption of power. The LED is powered by rechargeable batteries, making it more comfortable and easier to use.
Dental drills (or “Handpieces”) are air-powered or electrically powered rotary instruments that are used to cut or polish teeth. A clinic needs both high-speed handpieces and low-speed handpieces for general dentistry.

Hand pieces are equipped with a wide range of attachments that are purchased separately. Handpieces and/or their attachments must be sterilized after being used.

Traditionally, dentists used air-driven drills; nowadays more and more drills are electric. Air-driven drills are cheaper and lighter than electric drills, but have a more variable energy output: the drilling speed slows down under load.
Dental drill (or ‘dental handpiece’)

Handpieces come with different gear ratings. At 1:1 (default) the handpiece will rotate at the speed of the motor.

The gear can speed up or slow down and is colour coded on the handpiece:
- red is for high speed work (e.g. 1:5),
- blue for 1:1 transmission work
- green for speed reducing work (e.g. 4:1)
Dental drill: Low-speed handpiece

Design:
- Straight in appearance
- Standard length and “shorty”
- Speed ranges from 10,000 to 40,000 rotations per minute (rpm).
- Operates the rotary instrument in either a forward or backward movement.

Uses:
- In case a high torque is required
- Removal of soft decay
- Fine finishing of a cavity preparation
- Finishing and polishing of restorations.

There are 2 basic types of attachments used with slow-speed motors: nose cones (‘straight attachments’) and contra angles.
Dental drill: High-speed handpiece

Design:
- Single-piece unit with a slight curve in appearance.
- Operates from air pressure.
- Operates at speeds up to 800,000 rpm.
- Maintains a water-coolant system.
- Friction-grip locking system for rotary instruments.
- Fiber-optic lighting to bring light to the drill head.

Uses:
- Removes decay
- removes old or faulty restorations
- Reduces the crown portion of the tooth for the preparation of a crown or bridge.
- etc.

Modern dental drills generally use hard metal alloy bits known as burrs (cutters). Dental burrs come in a great variety of shapes designed for specific applications. They are often made of steel with a tungsten carbide coating, or of tungsten carbide entirely. The burr may also have a diamond coating.
Dental drill: construction

Micro motors are maintenance free.

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Dental furnace

Used during the production of ceramic dental restorations such as crowns, bridges and inlays, dental ceramic ovens employ **high temperatures and pressures** to process ceramic materials into a hardened, final state.

A Dental oven is an oven that can function with or without vacuum. It can heat rapidly (200°C/min) up to more than 1000°C.

Dental furnaces can fall into several categories:

- **firing** furnaces and **pressing** furnaces are often combined into a single unit. These are used to process conventional and glass ceramics whether those materials have been milled, layered or waxed-up.
- **Sintering** furnaces are capable of reaching the extreme temperatures required to process **zirconia** following milling.
- **Glazing** furnaces are used for setting certain stains and glazes that add the final shade details to a restoration.
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