SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

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Unit-II Bakery Machinery & Equipments

Bulk Handling of Ingredients

Laminating:

What is Dough Lamination?
Dough Lamination refers to the process of creating multiple, separate layers of dough and fat when making pastry. Under the lamination concept, the dough is wrapped around the fat, and then rolled out and folded over on itself many times to create layers of fat and dough.

The lamination step is critical for creating the unique flaky texture of laminated baked goods, including:

- Pastry
- Croissants
- Soda crackers

Origin
Perhaps the lamination of dough emerged when *Viennoiserie* baked goods were created in Europe. *Viennoiserie* is the meeting point between pastry and bread. Professional bakers and pastry chefs around the world have used this term to refer to yeast-leavened doughs that are rich in sugar, butter and eggs.

The two major classes of *Viennoiserie* are laminated and non-laminated dough. Examples of laminated *Viennoiserie* include croissant, puff pastry and Danish, while versions of non-laminated *Viennoiserie* include brioche, Pan d'Oro, and Gibassier.

How it works
As the name suggests, lamination is the process of creating alternating layers of dough and "roll-in-fat" (butter, hard fats, margarine, shortening) to create light, tender and flaky pastries. There is usually a 30-min rest period between folds. Refrigeration of dough between folds, or maintaining a bakery room temperature of 60°F (15°C), is usually the rule to prevent fat from melting.

In Danish pastry, fat is placed between two or three layers of fermented sweet dough and by repeated sheeting and folding methods, the fat layers are reduced to thin films separating dough layers. In these products, there are two principal leavening systems taking place, one from yeast and the other from expansion of the moisture and air entrapment in layers of dough and roll-in fat.

Lamination methods

1. **Three-fold (English) method:** Dough is sheeted to ½ in (12.7 mm) thickness. Then ⅔ of the dough sheet surface is covered with roll-in-fat and then folded in thirds. This process initially yields 2 layers of fat within 3 separate layers of dough. Repeating the English method produces more layers of fat.
2. **Four-fold (book fold) method, also known as double-turn method:** Here, the dough piece is sheeted slightly longer than the three-fold. Both ends are then folded over so that they meet slightly off-center. The folded dough piece is then again folded in half.
3. **Envelope method:** Dough is sheeted into a square about 1 inch (25.4 mm) thick. Roll-in-fat is then shaped into a square and placed in the center of the dough sheet. Next, the corners of the dough sheet are folded to the center like an envelope.

Number of layers for various categories of laminated products

- Croissants: 24–144 fat layers
- Danish: 24–54 fat layers
- Puff pastry: 81–729 fat layers

Fermentation & Brew Equipment's:

Fermenter

A vessel is needed to hold the wort as it ferments into beer. There are many types of fermenters, each with its own pros and cons.

Airlock & Bung

An airlock is inserted in the top of a fermenter and allows carbon dioxide, a byproduct of fermentation, to escape the fermenter without letting contaminants in. Depending on the fermenter, a bung is sometimes needed to secure the airlock. Without an airlock, pressure in the fermenter could cause the lid or bung to pop off, or worse, the fermenter to explode, leaving you with a sad mess.

Brew Pot (Kettle)

The entire boiling process, including extract, hops and/or other ingredients, takes place in the brew pot, or kettle. Depending on the batch size, a 1.5- to 5-gallon (6- to 20-liter) brew pot will be sufficient for partial-boil extract brew. As you start dealing with larger volumes of liquid, you'll want to look into larger brew pots and make sure you have plenty of headspace to avoid a boilover.

Heat Source

You'll need a heat source that's powerful enough to heat up your pre-boil volume in a timely manner (a watched pot never boils, right?). The stove in your kitchen should suffice for smaller amounts, while a turkey fryer or another powerful heat source works well for larger batches.

Siphon/Tubing

A siphon and tubing is a great way to streamline moving hot wort or finished beer around without the hassle and mess of lifting and pouring (and spilling!) large quantities by hand. Quick tip: an auto-siphon is a type of siphon that creates a vacuum to pump liquid from one vessel to another without introducing too much oxygen or other contaminants into the beer.

Cleaner

There are homebrew-specific cleaners available that you can find at your local homebrew shop, but unscented dish cleaner also works. Avoid products with scents, which can stick around after cleaning and cause off-flavors and aromas in your beer.

Sanitizer

Different than cleaner, sanitizer ensures there are no microorganisms that could spoil the goods on your brewing equipment after you clean. There are homebrew-specific, no-rinse sanitizers available at your homebrew shop, but a proper dilution of 1 oz. bleach per gallon of water (8 mL/L) can be used followed by a thorough rinse.

Hydrometer

A hydrometer is used to measure the gravity, or sugar density in wort and beer. You technically don't need a hydrometer to brew beer, but measuring gravity lets you closely monitor fermentation and calculate specifications like alcohol content. You'll also need a vessel to hold the sample for measurement.

What is an Oven?

An oven is an enclosed cavity or tunnel where dough or batter is surrounded by a hot environment and becomes baked and transformed into bread, cookies, or other products.[1]

- In order to bake the products, ovens use energy generation sources, like the combustion of fuels such as gas or oil, or electricity.
- The released available energy from these sources is transferred to the products by means of radiation, conduction, and/or convection.
- The oven sets and maintains the proper conditions of heat flux, humidity, and temperature to carry out the baking process and the removal of moisture from the products.

1. Direct-fired oven (DFO)

DFOs place combusting gas (energy source) inside the baking chamber to heat the air and the products. The heat transfer in a direct gas-fired oven is primarily carried out by radiation from the flames (ribbon burners placed above and below the oven band), top, base and walls of the baking chamber. Direct-fired ovens are very efficient because they convert most of the fuel to heat and process the products, and this lowers fuel consumption and operating costs.

2. Indirect-fired oven (IFO)

IFOs indirectly heat the baking chamber by using exchangers. This oven is suitable for sensitive bakery products (e.g., cakes, pastries) since the byproducts of combustion remain inside the heat exchanger structure and do not come into direct contact with the dough pieces. This eliminates the risk of contamination and of impregnation of off-odors in the products.

This type of oven is less often used nowadays because of its limited power for heat transfer and energy efficiency (amount of fuel burned in a given time versus water loss (evaporated moisture) of the products during baking).

3. Electric oven

Electric ovens have construction features similar to those of DFOs, and operate similarly in terms of heat transfer mechanism to bake the products. This type of oven uses electrical resistances in place of the traditional gas burners of DFOs.

Electric-fired ovens have limited use in the baking industry due to their power consumption and costs per kWh. They also face scale-up challenges that require further research and industry application.

4. Peel brick oven

The peel brick oven was one of the first constructed baking units in human history. It consists of a massive brick material chamber. The chamber is connected to a refractory tile floor that holds the dough pieces. Coal and wood are used as fuel (combustion source).

Because of their construction features (insulation capacity of materials and thickness of the walls), these ovens are able to steadily transfer radiant heat to the products, and also maintain high temperatures inside the baking chamber for prolonged periods of time. The ovens are operated manually and require special skills from the baker.

5. Rack oven

A rack oven is a batch vertical oven into which racks full of sheet pans can be wheeled for baking. This unit can hold 8 to 20 sheet pans per baking cycle. Some units make use of electric or fuel sources, and place fans inside the baking chamber (generation of convection drying) to speed up baking times and to develop special features in the products.

This oven is suitable for retail operations due to its floor space economy, and medium to long baking cycle times. The products are baked upon customer order, and are often offered directly (unpackaged) for immediate consumption. These ovens usually have programmable (saved) recipes so that the operator can change baking time and temperature, intensity of air ventilation, and steam impingement frequency.

6. Reel oven (also known as revolving tray oven)

A reel oven is an oven in which trays or shelves are placed on platforms rotating on a central horizontal axis. A high baking chamber is required to accommodate the reel structure, thereby saving floor space. Reel ovens are normally directly fired with gas or electricity, with the heating source located centrally across the floor of the chamber. This type of oven is mostly designed for retail bakeries or baking plants with small-scale production.

Reel ovens often do not generate uniform distribution of heat transfer due to their revolving nature and interfering structure for radiant heat transfer. Products placed on sheet pans or trays continuously rotating may present uneven coloring or poor final moisture distribution.

7. Conveyorized oven (also known as traveling tray oven)
Conveyorized ovens replace the reel ovens concept with two parallel endless conveying chains that carry trays of products through the length of the baking chamber, so the dough pieces continually enter and leave the oven.[5] Their main advantages are simplicity of design, and uniformity of baking as the products travel the same path through the baking chamber. A motor drive directly controls band speed, thereby determining baking cycle time.

Conveyorized ovens may be single-lap or double-lap. In single-lap ovens, the trays containing the products travel a single pass (back and forth). The trays in a double-lap oven travel through four heat zones instead of the two zones of the single-lap oven.

8. Tunnel oven
Tunnel ovens are continuous mode operation baking units, and are commonly used in large-scale bakeries. This unit typically has a long baking chamber (usually more than 80 meters in length), which goes from one side (loading point) to another (unloading point) in a straight conveying band. The conveyor band material may be built of wire mesh or carbon steel sheets.

Tunnel ovens are commonly powered by fuels such as natural gas (used for baking), and electricity (for powering air circulation and conveying system). The baking chamber may be divided into several baking zones. This makes the application of a temperature sequence possible, which provides the baker more flexibility in baking conditions and more complexity for controlling baking parameters.

9. Hybrid oven
Hybrid ovens combine the three modes of heat transfer and take advantage of their synergistic effect on products. This type of oven usually requires a high degree of automation since its construction, control systems, and energy sources are too complex to be manipulated manually.

SLICERS:

What is Bread Slicing?

Bread slicing involves cutting or slicing loaves into individual pieces for convenience and portion-controlled servings for consumers. The process takes place after baked loaves have passed through metal or X-ray detection and cooling.

An important aspect of bread slicing is setting the correct number of servings and size of slice as declared on the package label, critical for regulations compliance. The two main types of sixers are:

- Band slicers
- Reciprocating slicers

Origin

Slicing bread on a commercial scale was introduced in the 1920s in Missouri, US.[1] By 1933, 80% of all bread sold in the US was sliced.

How it works

There are two main types of bread slicers:

Band slicers: are most common in large-scale or high-speed production. They have two rotating metal drums, one at the upper and one at the lower section, that drive the slicing blades. Blades are set in guides known as a latticework. The blades move in a figure-8 motion. the width between them can be adjusted to create various slice thicknesses or serving sizes.

Reciprocating slicers: use fixed slicing blades in a frame that moves up and down. The blades cannot be adjusted for various thicknesses so reciprocating slicers are more common in retail bakeshops. Their throughput is less than that of band slicers.

Application

A few common problems with bread slicing include:

- Misaligned guides which make the slice size and count incorrect. An incorrect slicer guide setting may decrease or increase the number of slices per bag. Too thin slices cause a product collapse during its shelf life.
- Dull or missing blades can be an obvious issue. Blades need to be honed and replaced as conditions dictate. Some inclusions, such as prehydrated fruits, tend to create gumminess, so proper cleaning of blades during changeover time is critical.
- High product temperature after cooling. If product temperature is not within the target of 30–36°C (86–97°F), slicing problems can occur.

Product temperature impact on slicing operation

If loaves are too hot:

- The crumb will be too soft and small pieces of doughy crumb may cause gumming on the slicer blades
- Slice is ragged and may tear (rough surface)
- Sidewalls are weak and may collapse

If loaves are too cool:

- Excessive crumbs at the slicer will result in product loss
- Excessive moisture loss will make the bread drier and firmer
- The bread will not be soft as the consumer expects
- If this is a persistent problem, then higher doses of crumb softening amylase should be considered

Common adjustments to slicers

The slicer settings are different for every variety of bread produced at a bakery. As a result, bakers should use a set-up chart that details the settings for accurate results. Common adjustments include:

- Slice width
- Infeed hold down
- Side guides according to product size (especially loaves length)
- Push paddle timing

Regarding blades specifically, the oilers, honers, replacements, and tension can be adjusted or changed. Regular monitoring and maintenance of all of these factors are necessary to preserve good slicing quality.

Downtime will be necessary when blades are replaced, and the blade tension is set. The blade tension is typically 60–70 pounds per square inch (psi) for a band slicer. If the blade tension is not set correctly, it will shorten the life of the blades, which is costly.

If one blade breaks in a reciprocating slicer, it can be changed/replaced very quickly. Changing out the latticework on band slicers requires a significant amount of time.

Since several settings must be adjusted for each variety of bread, a set-up chart should be created and maintained in the wrapping area. Having each setting correct is important to achieve the correct slice count and quality.

DOUGH EXTRUSION:

What is Dough Extrusion?
Dough extrusion is a forming operation in which bulk dough (usually sweet or rich) and/or highly viscous batters (relatively high in sugar and fat, and with very low hydration levels) are transformed into single pieces that can be immediately baked on a continuous biscuit oven.

Baked goods that are made using dough extrusion include:

- Pastry products (laminated prior to forming)
- Soft cookie doughs (wire-cut cookies, swirl-type cookies)
- Filled and two-dough cookies (co-extrusion of fillings using concentric dies)
- Whole grain bread from sprouted wheat “flourless” dough

How does dough extrusion work?
Dough extrusion is a process in which dough material in bulk is forced to flow, under pressure and shear, through a shaped die (orifice) and then cut to obtain a single piece of product of desired form or dimensions.

It is important to note the term “dough extrusion” in the bakery industry refers to a cold process. Cold extrusion is the forming of dough materials at temperatures below 40°C (more specifically below melting point of fat). This processing concept differs from “extrusion cooking” technology used in the snack industry and conducted at temperatures above the boiling point of water (212°F or 100°C) in which steam (water vapor from product) is formed.

Components of a dough extruder
1. Inlet hopper

A hopper is placed over the feeding or dough driving mechanism. The hopper holds the dough load coming from the mixer and becomes a balance tank. Hoppers have a special conical configuration, using gravity to convey the dough downwards.

2. Feeding or driving system

Two or three rollers force the dough into a “pressure chamber” that is located just before the die. The rollers run continuously (at low rotation speed that can be locally adjusted) or intermittently to force dough out of the pressure chamber at the die. In other systems, a single- or twin-screw feeder is used for handling different product rheology and consistency.

3. Die or nozzle

A die, nozzle or orifice, function as the final forming mechanism. Different diameters, shapes, configurations (e.g. concentric) and construction materials can be used, depending on the rheology and stickiness of the dough, product filling needs and desired form of the finished product.

4. Cutter and depositor

For production of wire-cut cookies, the dough is extruded, and a wire or blade mounted on a frame moves through the dough just below the die outlet. The cut dough pieces are then dropped onto a conveyor band for transport to the oven. The number of strokes ultimately determines the output (units per min) of this type of extrusion configuration.

Another cutting configuration is known as “bar- or rout-press.” Unlike the wire-cut system, a continuous ribbon of dough is extruded through the die, usually concentric and connected to a second hopper containing filling to be injected inside the product.

Then dough ribbon is cut into individual pieces by a vertically operating guillotine before the oven or after baking. If the product is to be baked as a continuous ribbon, the dough is extruded and deposited directly onto the oven band; otherwise, it is extruded, cut and deposited onto a conveyor belt connected to the oven.

Application
Relevant operational aspects:

- Dough extruders usually run at low speeds (hence generating low shear) to help the dough retain its integrity, prevent product distortion and to balance the speed of the oven (capacity).

- Dough extruders are rarely the production bottleneck of the line. The output of the extruder is usually limited by upstream equipment (mixer) and downstream equipment (oven).

- The formulation of the product is important when selecting the proper forming equipment. Dough extrusion is not suitable for doughs that are too soft or fluid so that they become pourable or have a cake batter-type rheology. The extruded product needs to hold on to its shape after passing through the die.

- Compared to other forming methods such as rotary moulding and sheeting, dough extrusion presents some challenges. Issues such as distortion of the extruded dough piece and inconsistent placement or drop (depositing) of the cut piece onto the conveyor can occur.

- Mechanisms to reduce product waste should be considered when selecting dough extrusion equipment. As some waste is generated due to process inconsistencies, the possibility to send incorrectly extruded dough back to the hopper should be considered.