Confectionary processing

Level-II

Based on May 2011, Version 2 Occupational standards

Module Title: - Operating an Extrusion Process

LG Code: - IND COP2 M15 LO (1-3) LG (47-49)
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Table of Contents

LG #47	LO #1- Prepare the extrusion equipment and process for operation

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics:

- Confirming and made available services and materials
- Confirming and made available Materials/mixes
- Selecting and fitting machine components and related attachments
- Entering processing and operating parameters as required to meet safety
- Checking and adjusting extrusion equipment performance
- Carrying out pre-start checks

This guide will also assist you to attain the learning outcomes stated in the cover page.

Specifically, upon completion of this learning guide, you will be able to:

- Confirm and made available services and materials
- Confirm and made available Materials/mixes
- Select and fit machine components and related attachments
- Enter process and operate parameters as required to meet safety
- Check and adjusting extrusion equipment performance

Carrying out pre-start checks

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test

Information Sheet 1- Confirming and made available services and materials

1.1 Confirming and made available services and materials

The extrusion Process is the process of forcing food materials to flow under a variety of operations, including kneading, melting and/or shear, through an orifice (die).

1.1.1 Confirming and made available services

a) Lighting and power

Where lighting is needed, florescent tubes use less electricity than bulbs, but care is needed when using fluorescent lights above mills, dehullers and other equipment that has moving or rotating parts. This is because they can make machinery appear stationary at certain speeds, causing a hazard to operators.

The building interior should be equipped with adequate light and lighting facilities to permit employees to carry out their designated tasks in areas where:-

- processing
- handling
- storage
- testing
- Inspection and cleaning activities take place.

b) Water supply and sanitation

Water is used in bakeries to make dough and for washing equipment. An adequate supply of potable (safe for drinking) water should be available from taps in the processing room.

The drainage and sewage systems should be designed to prevent cross-connection of sewage with other wastes from the plant in order to avoid any potential for contamination.

c) Compressed Air

In chocolate production, compressed air is essential. Even the system of tubes for conveying the chocolate masses to the casting units is controlled by pneumatically activated valves.

Chocolate is a very sensitive foodstuff, and every effort must be made at the production and packaging stages to prevent contamination with even the faintest

1.1.2 Confirming and made available materials

- **Chocolate cookie Dough**

This chocolate cookie dough is the perfect way to satisfy your sweet tooth any time the chocolate craving strikes. It's delicious egg free edible chocolate cookie dough.

Just like our other cookie dough recipe is made egg free, so it's totally safe to eat.

Instead of adding chocolate chips you could also add a variety of other chips for yummy flavor combinations, which are:-

- Mint chips
- Peanut butter
- White chocolate
- Chopped up candy bars
- Nuts

Fig1 Chocolate cookie Dough

The possibilities are practically endless. Now, are you ready to see how to make the good stuff?

- **How to Make Chocolate Cookie Dough?**

First you'll cream together your butter, sugar and brown sugar. You'll want them nice and creamed for a couple minutes. Add in some vanilla extract and milk. You use milk to keep the

dough “wet” since there are no eggs to hold it all together. Add in some flour and a little salt too. Cut the salt in half or don’t use any if you are using salted butter.

Once it’s all mixed together and good dough like consistency you can fold in your chocolate chips.

- **Instructions**

1. Microwave your flour 1 minute till it reaches and internal temperature of 160 degrees, or use heat treated flour if you are worried about the risk of e.coli.
2. In small bowl, cream together the butter, sugar, and brown sugar for about 1 minute until smooth.
3. Add in the vanilla and milk and stir to combine.
4. Add in the salt, flour, and cocoa powder and mix until nice dough is formed.
5. Fold in the chocolate chips and enjoy

Fig2 Edible Chocolate Dough

Self-check 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: say true or false

1. Water is used in bakeries to make dough and for washing equipment….?(2pts)
2. You use milk to keep the dough “wet” since there are no eggs to hold it all together….?(2pts)

Test I: Choose the best Answer

1. **Which of the following is included in to services which are used in chocolate Extrusion?** (3pts)

A) Lighting C) water

B) power D) All

2. **Instead of adding chocolate chips you could also add a variety of other chips?** (3pts)

A) Mint chips C) White chocolate E) All

B) Peanut butter D) Chopped up candy bars

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating – ≥5 points** **Unsatisfactory - below 5 points**

Information Sheet 2- Confirming and made available Materials/mixes

2.1 Confirming and made available Materials/mixes

- **Chocolate Dough Preparation**

Ingredients

1 cup all-purpose flour
2 tablespoons cocoa powder
3 7 tablespoons confectioner's
4 ½ cup (1 stick)unsalted butter, cut into small pieces and chilled
5 1 large egg yolk, lightly beaten
6 1-2 tablespoons ice water

Directions

1. Place flour, cocoa powder, and confectioner's sugar in the bowl of a food processor; pulse to combine. And butter; pulse until mixture resembles coarse meal.
2. With motor running, add egg yolk, then 1 to 2 tablespoons ice water; process just until dough begins to come together.
3. Shape dough into disk; wrap in plastic, and chill at least 1 hour.

Fig1 chocolate chips

Notice: Refer Information Sheet-1 for more information

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best Answer

1. The first Direction in chocolate dough preparation is Place flour, cocoa powder, and confectioner's sugar in the bowl of a food processor to combine….?(4pts)

Test I: Choose the best Answer

1. **Which of the following ingredient is used in Preparation of Chocolate Dough…?(**3pts)

A) All-purpose flour

B) Cocoa powder

C) Unsalted butter

D) Sugar

E) All

2. Which of the following is one part of Directions used in preparation of Chocolate Dough…?(3pts)

A) Place flour, cocoa powder, and confectioner's sugar in the bowl of a food processor; pulse to combine. And butter; pulse until mixture resembles coarse meal.

B) With motor running, add egg yolk, then 1 to 2 tablespoons ice water; process just until dough begins to come together.

C) Shape dough into disk; wrap in plastic, and chill at least 1 hour

D) all

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 3- Selecting and fitting machine components and related attachments

3.1 Selecting and fitting machine components and related attachments

Different types of extruders are available for the production of pellets. Extruders not only differ in terms of size but also in terms of the extrusion principle. Extrusion process can utilize single screw extruder or twin-screw extruders.

a) **Single screw extruder** machines focus on pelletized materials or applications requiring less true mixing.

Fig 1 Single **screw extruder**

b) **Twin-screw extruders** are usually focused on powdered materials or where more intensive mixing is required.

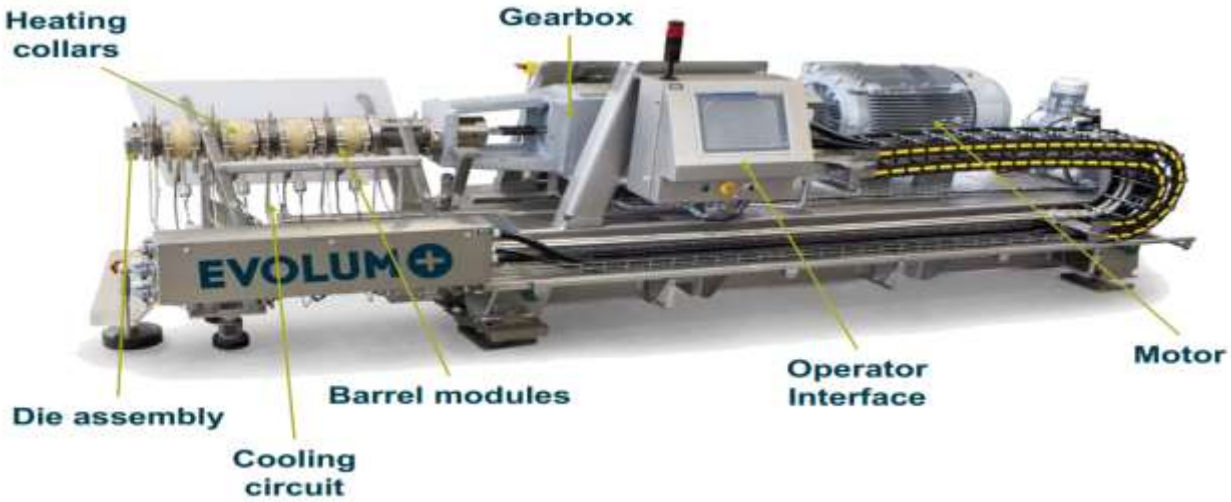

Fig2 twin screw extruder

❖ **Comparisons between Single screw and Twin-screw**

Table 1 Comparisons between Single screw and Twin-screw

Single screw extruder	Twin-screw extruders
Simple/economic	Expensive
Easy to operate	Difficult to operate
Suitable for foods with 4% fat,10% sugar and 30% Water	Better mixing capability, extended product range 20% fat, 40% sugar,65% moisture.

3.1.1 Typical components of An Extruder

This section describes the main machine components and their function within the production cycle

a) Feeding (delivery) System

The first basic component of the extruder is a delivery system. The purpose of this section is to deliver, uniformly, the food ingredients/recipe or raw material to the next components.

b) Preconditioner

Material from the delivery system is feed into the next section of the extruder, which is called the Preconditioner. It is not necessarily true that every kind of extruders will have a Preconditioner. Majority of the food and feed extruders will have a Preconditioner.

c) Extruder Barrel

The barrel is the heater of the extrusion system. Most of the is done in this section of the extrusion system. This component consists of screws, sleeves, barrel heads, and dies. This section makes the extruder either a single screw or twin screw extruder.

d) Knife assembly

This is the fourth and last component of extrusion system. The main function of this component is to cut the product to the desired length and shape. The knife assembly can be a different design depending on the manufacturer of the extrusion system.
The module which houses the screws, is comprised of several modular part

Different types available:

- AB1 (First feeding barrel)
- FER (closed barrel)
- VAP (vapors injection barrel)
- ABF (lateral feeding barrel)

Fig2 Screw modular parts

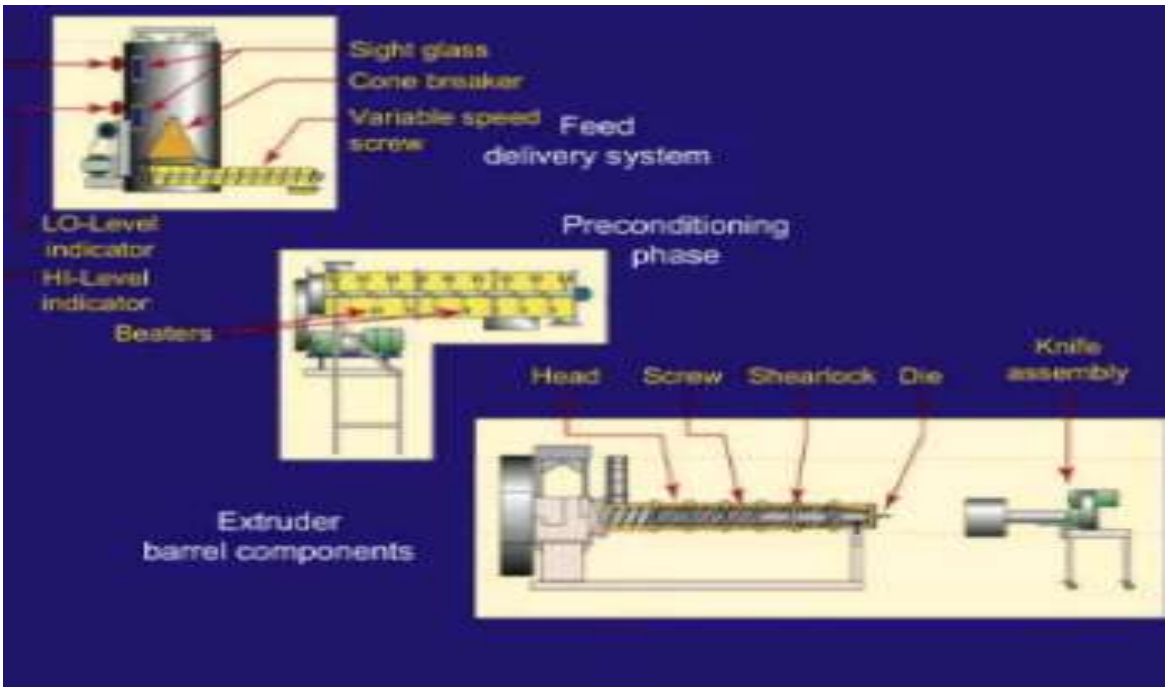

Fig3 Extruder components

Selecting machine component criteria:

a) Intended use: intended operations

The machine has been built and designed for cake and chocolate mixing to obtain shorter working times.

The working cycle can be manual or automatic with two speeds and a premixing cycle, all with timer.

b) Conditions of use intended

The machine has been designed and built to operate in a closed environment, protected from atmospheric agents.

c) Intended use of power

The machine is driver by electric energy, which is converted into mechanical energy for the intended operations.

d) Improper use

Improper use means any operation not expressly stated in the intended uses indicated at the beginning of the paragraph, in particular:

- Use of the machine in an explosive environment
- Use of the machine in a flammable environment
- Washing the machine control panel with jets of water.

Fig4 Pelletizing Extruder

e) **Safeguards**

Safeguards are all safety measures which involve the application of specific technical mechanisms (guards, safety devices) to protect people from dangers which cannot be made sufficiently harmless through design.

f) Fixed and Moveable Guards

- All power transmission components are shielded by screw fastened guards, in compliance with the EN 593 standard.
- Safety grille which prevents access to the bowl during the work process.
- Safety guard for the electrical system

Fig5 Twin screw extruder

Self-Check –3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. **Single screw extruder** machines focus on pelletized materials or applications requiring less true mixing….? (2pts)
2. **Twin-screw extruders** are usually focused on powdered materials or where more intensive mixing is required…..? (2pts)

Test II: Choose the best answer

1. **Which of the following are typical components of an Extruder..?** (2pts)

A) Knife assembly
B) Feeding System
C) Preconditioner
D) All

2. **Which of the following is selecting machine component criteria….?**(2pts)

A) Intended use of operations
B) Intended use of power
C) Intended use of conditions
D) All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - ≥ 4 points** **Unsatisfactory - below 4 points**

Information Sheet 4- Entering processing and operating parameters as required to meet safety

4.1 Entering processing and operating parameters as required meeting safety

g) Parameters of extrusion processing

a) Expansion

The expansion is characterized on cooled and dimensionally stable products. Expansion parameters are derived both from bubble growth up until maximum size and from the ensuing contraction. In a, the extrudate expansion, is a fundamentally important property during food extrusion cooking process. It is helpful in describing the product quality and also related to degree of cook. The product acceptability is based on its specific extrudate expansion.

b) Moisture

Analysis of variance indicated that the extrusion moisture content was significant to product temperature, die pressure, and percent torque while the cooking temperature was only significant to the product temperature ($p < 0.001$, data not shown). Response surfaces of product temperature die pressure and product temperature as functions of extrusion moisture content and cooking temperature. As the moisture content increased from 60 to 70% (wb), the percent torque, die pressure and product temperature significantly decreased. This was because water serves as a lubricant in the extruder.

c) Pressure

There are a number of different pressure transducers. The most common ones in extrusion are the strain gage transducer and the piezo-electric transducer. The strain gage transducer can be either a capillary or a pushrod transducer. In these transducers there are two diaphragms, one in contact with the plastic melt and one some distance away from the hot plastic melt.

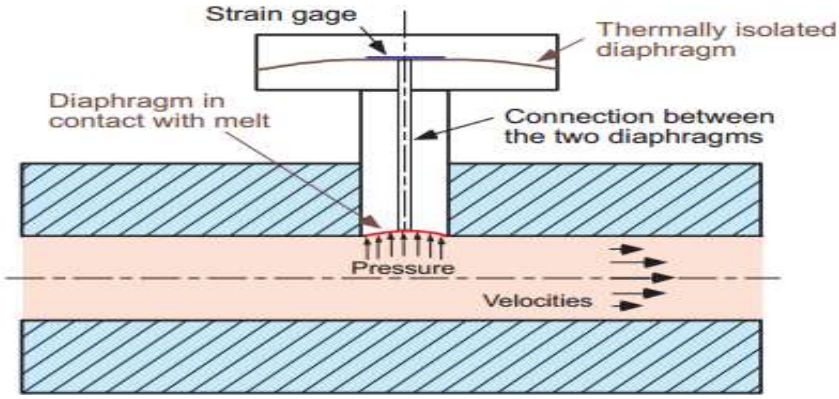

Fig 1 Pressure

d) Temperature

Increasing cooking temperature from 138 to 160^{0}C significantly increased product temperatures. Die pressure and percent torque, on the other hand, revealed little changes. This was contrary to the general expectation that a higher product temperature would have a lower viscosity resulting in a lower percent torque and die pressure.

e) viscosity

This was probably because of the increased protein denaturation and texturization as the product temperature was increased. While increasing product temperature reduced the viscosity, this was more or less counteracted by the simultaneous increase in protein denaturation and texturization, which increased viscosity.

f) Bulk Density

The extrudate density was mainly affected by feed moisture. Screw speed and temperature also have significant effects on the density of extrudate. Increased feed moisture also promotes a sharp increase in extrudate density. However, increased screw speed and barrel temperature caused a slight decrease in the density of extrudate.

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true false

1. The extrudate density was mainly affected by feed moisture….? (3pts)
2. Increased feed moisture also promotes a sharp increase in extrudate density..? (3pts)

Test II: Choose the best answer

1. **Which of the following parameters of chocolate extrusion process..?** (4pts)

A) Moisture C) Bulk density E) All
B) Pressure D) Temperature

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 5- Checking and adjusting extrusion equipment performance

5.1 Checking and adjusting extrusion equipment performance

h) Extrusion Equipment Basic Status checks:

In the case of e newly purchased extrusion Equipment, inspection of the machine assembly should be carried out:

1. After the equipment is installed according to the requirements of the manual, the entire unit should be calibrated, including the center position calibration of the extrusion blow machine head and the clamping device.
2. Install the mold water cooling tube and check that it is correct.
3. Operators and control devices (electrical control boxes, programmable controllers, operating keyboards) are convenient for operation
4. Whether the feeding, finished product placement, and waste recycling processes are smooth without affecting normal operation.
5. Whether the relevant auxiliary equipment is in the right position.
6. Inspection of the hydraulic and lubrication system check the hydraulic oil gauge of the extruder and each hydraulic unit so that oil level of thank is kept above the reference oil level.

Fig1 chocolate extruder

i) Calibration on the Extrusion Equipment

The quantity pushed inside the hot end depends upon mainly on drive gear diameter of the extruder. The gear diameter varies from one model to other.

The overall Extrusion procedure is as follow:

1. Extrude a certain length of filament, let's take 200m
2. Measure with a graduated ruler how much filament has been pushed.
3. Use a cross product to adjust the value of our machine.
4. Check that the new value is good by extruding again 200m and we measure again.
5. Adjust when needed and we repeat step 4 until we find the proper value.
6. Finally to ensure the measurement error is very small we extrude 400m or 600m of material (something you can measure with your rulers), we then slightly adjust the step/mm to get our final settings.
7. At this stage your extruder should be properly calibrated and the quality of your extrusion should increase.

5.1.1 Adjust/Maintain the Extrusion Machine Performance

- Lubricate each moving part once before turning it on.(manipulator, robot guide, opening and closing guide all).
- The swing arm can add lubricating oil once every 3-4 days. The heating machine has a large chain and a small chain to add lubricating oil once a month. Always check if the main unit reducer and warmer reducer are short of oil. The main bearing can be added once every 2-3 months. Check whether the moving parts are firm before the production, whether the screws are loose or not, especially in places with strong impact, whether the belt transmission parts are abnormal.
- Check if the high pressure gas source, low pressure gas source, power source and water source are normal.
- Check each emergency stop switch, safety door switch, and protection device to check if the switch is normal. Check the warming head to enter the embryo, and the part of embryo is working properly. If the nut of the insert is not in place, the nut of the preform can be adjusted.
- Check the lamp for damage and breakage. Replace it in time.
- Check if the pneumatic components are leaking and the action is sensitive.
- When the machine is being repaired, press the screen fault repair button to ensure safe maintenance.

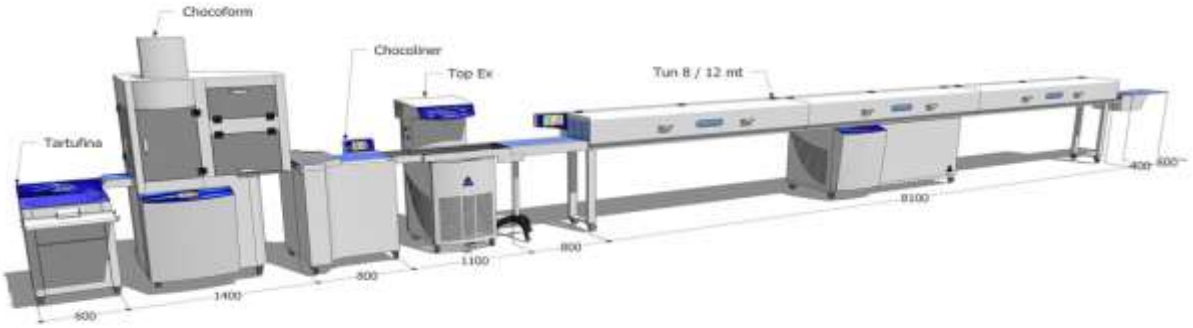

Fig1 Chocolate Extruder line

Self-Check –5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. After the equipment is installed according to the requirements of the manual, the entire unit should be calibrated…?(2pts)

Test I: Choose the best answer

1. Which of the following is used to adjust/maintain the extrusion machine performance…..?(4pts)

A) Lubricate each moving part once before turning it on.

B) Check the lamp for damage and breakage. Replace it in time.

C) Check if the pneumatic components are leaking and the action is sensitive.

D) When the machine is being repaired, press the screen fault repair button to ensure safe maintenance.

3. Which of the following is used to carrying out inspection of the machine assembly …?(4pts)

A) After the equipment is installed according to the requirements of the manual, the entire unit should be calibrated, including the center position calibration of the extrusion blow machine head and the clamping device.

B) Install the mold water cooling tube and check that it is correct.

C) Operators and control devices (electrical control boxes, programmable controllers, operating keyboards) are convenient for operation

D) Whether the feeding, finished product placement, and waste recycling processes are smooth without affecting normal operation.

E) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 6- Carrying out pre-start checks

6.1 Carrying out pre-start checks Extrusion Machine

This is where you find out how prepared you really are. Adequate space, light and administrative assistance may not always be available, but establishing the resources that are available will help ensure a successful completion of the process.

j) Keys to pre-start checks including:-

- **Mechanical:**

All workers must have adequate PPE (Personal Protection Equipment). Generally, this includes, as a minimum, safety shoes, safety glasses, a hard hat, and work gloves.

- **Electrical:**

Review the wire wiring specification with the electrical contractor to ensure it follows the provided cabling and conduit-run instructions. Make sure all power is “locked out/tagged out” while the electrical work is being done.

Think through which machines are fixed and which are movable. Do not apply power to the main panel or any other parts of the system until the appropriate technician is on-site and has inspected the installation.

- **Filling and checking fluids**

Confirm that gear box in the system is filled with the correct grade of oil.

- **Safety checks**

A safety team must evaluate the installation for potential hazards and confirm that issues that being addressed systematically by the site’s safety/health program. Categories concerns as they apply to the relevant regulations and suggest remedies as required. Categories may include:

- ✓ Walking and working surfaces
- ✓ Fire safety

- ✓ Hazardous-material storage/handling
- ✓ Confined-space entry (vessels and crawl spaces)
- ✓ Machine guards
- ✓ Lock out/tag out

- **Start-up phase**

Before any production, a preliminary evaluation of the equipment is conducted.

- **Installation qualification:**

The first thing the technician should do upon arriving on-site is to inspect the installation work.

- ✓ Visual inspection and identification of system components
- ✓ Verification of all utility connections
- ✓ Inspection of electrical devices and corresponding wirings
- ✓ Heat –zone check out
- ✓ Overview and demonstration of power-up procedure

The technicians should follow a start-up checklist. Beginning with the machine inter locks, the checklist will include:

- ✓ Verification of all safety devices and system interlocks
- ✓ Verification of temperatures, speeds and other indicated values
- ✓ Mechanical items related to machinery operation
- ✓ Complete system dry test
- ✓ Generation, recording, and completion of documentation

- **Operational Qualification:**

Training is the final step in starting up a new system. Once the system is working properly it's time to tackle operator training. Operator training is best handled independently after the system is up and running.

- **Review the startup procedure:**

- ✓ The main disconnect
- ✓ Temperature settings and heat soak times

- ✓ Turn on downstream equipment
- ✓ Fill the feeders
- ✓ Start the main drive at low rate
- ✓ Start the feeders at low rate
- ✓ Ramp up extruder and feeders to appropriate rate
- ✓ Increase the pelletizer speed to match rates.

Self-Check –6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer

1. All workers must have adequate PPE (Personal Protection Equipment)…?(2pts)
2. Training is the final step in starting up a new system (2pts)

Test II: Choose the best answer

1. Which of the following is one of Keys to pre-start checks…? (3pts)

A) Mechanical C) safety checks

B) Electrical D) All

2. Which of the following is first thing the technician should do upon arriving on-site…?(3pts)

A) Visual inspection and identification of system components

B) Verification of all utility connections

C) Inspection of electrical devices and corresponding wirings

D) Heat –zone check out

E) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Operation Sheet 1-Chocolate cookies making

Procedure:

1. Microwave your flour 1 minute till it reaches and internal temperature of 160 degrees, or use heat treated flour if you are worried about the risk of e.coli.
2. In small bowl, cream together the butter, sugar, and brown sugar for about 1 minute until smooth.
3. Add in the vanilla and milk and stir to combine.
4. Add in the salt, flour, and cocoa powder and mix until nice dough is formed.
5. Extrude the dough and fold in the chocolate chips and enjoy

Operation Sheet 2– Chocolate dough preparation

Procedure:

1. Place flour, cocoa powder, and confectioner's sugar in the bowl of a food processor; pulse to combine. And butter; pulse until mixture resembles coarse meal.
2. With motor running, add egg yolk, then 1 to 2 tablespoons ice water; process just until dough begins to come together.
3. Shape dough into disk (extrudate manually or mechanically);
4. Wrap in plastic
5. Chill at least 1 hour.

LAP TEST	Performance Test

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task-1 prepare chocolate dough
Task-2 Make Chocolate cookies

LG #48	LO #2- Operate and monitor the extrusion process

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Operating and monitoring the extrusion process
- Monitoring preparation of the mass to confirm specifications
- Operating the extrusion process
- Monitoring equipment to identify variation in operating conditions.
- Monitoring operation of equipment and processes
- Monitoring the extruded product
- Identifying, rectifying and/or reporting out-of-specification product/process outcomes
- Maintaining the work area
- Conducting the work
- Maintaining workplace records

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, upon completion of this learning guide, **you will be able to**:

- Operate and monitor the extrusion process
- Monitor preparation of the mass to confirm specifications
- Operate the extrusion process
- Monitor equipment to identify variation in operating conditions.
- Monitor operation of equipment and processes
- Monitor the extruded product
- Identify, rectify and/or report out-of-specification product/process outcomes
- Maintain the work area
- Conduct the work
- Maintain workplace records

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Information Sheet 1- Delivered Mixed/mass products to the extrusion process

1.1 Delivered Mixed/mass products to the extrusion process

k) Feeding Ingredients to the Extruder

Ingredient dosing to the extruder via feeders can be handled either by addition of a premix or by using separate feeders for each individual ingredient. The use of the individual ingredient feeders eliminates risk of segregation of blended product, eliminates added cost, and reduces the duration of the mixing step, and results in higher productivity in the case of fewer dry ingredients and additives. Regardless of the method chosen, feeding and proportioning of the preblends or the individual ingredients to the extrusion process are crucial to the product quality and process efficiency. At any stage of the production process undetected feed rate and proportioning errors waste ingredients and add to overall ingredient costs.

l) Transfer of Major Ingredients

Each of the confectionery types outlined usually requires the transfer of bulk ingredients such as corn syrup solids and sugar from the source to the process. These major ingredients (including starch) can arrive at the plant in a variety of forms, such as railcar, truck or bulk bag systems. The major ingredients are usually stored in specialized silos and then conveyed to the specific weigh batch stations as required for the blend.

Fig High Volume Production Extruder

m) Conveying Ingredients

What Method is best?

Regardless of the type of extrusion required, the transfer of raw materials from a variety of sources can be critical to overall production times and efficiencies. The arrival and transfer of major ingredients to a confectionery production line can include a number of different types of conveying systems.

The mode of transfer of ingredients is dependent upon a wide variety of process parameters, including material characteristics, distance to be transferred, required rate of transfer, and the type of container in which the ingredient is originally received.

n) Dilute Phase Transfer: Vacuum vs. Pressure?

Depending upon the volumes required, other possible sources of ingredient delivery include boxes, sacks, bulk bags or super sacks. In all of the ingredient transfer steps, pneumatic conveying systems can be used to transfer these ingredients. These systems can utilize either positive or negative pressure dilute phase conveying. Positive pressure conveying systems are typically used to transport product over long distances and at high throughputs.

o) Batching Ingredients to Cookers

In many confectionery processes where batch cookers are used, twin feeders are used to accurately dose the powder directly into the cooker. These gravimetric feeding devices can be either screw or vibratory feeders, mounted on weigh bridges, which deliver the product to the process by means of batching. In other processes the ingredients may be delivered to a batching station prior to the mixing step. This station can include volumetric metering devices, such as screw feeders or valves, which deliver the product to a hopper on load cells.

p) Loss-in-Weight Feeding Principle

Twin-screw feeders can be supplied in either volumetric or gravimetric designs. However, due to the high accuracy requirements of feeding in continuous extrusion or blending processes, the gravimetric feeding principle via loss-in weight feeding is mandatory. For example, when feeding materials with high variations in bulk density, volumetric feeders can have relatively high fluctuations in feed rate due to fluctuations in the filling of the screws.

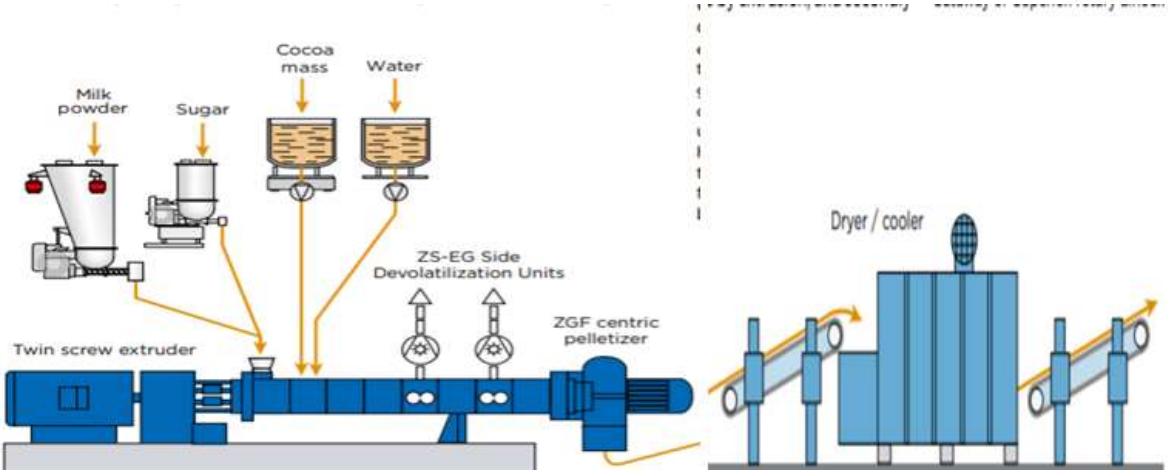


Fig1 Chocolate crunch Extrusion

- **Accurate Addition of Liquids to the Process**

In addition to the solid ingredient being fed via dry bulk feeding, additional liquid ingredients may also be introduced using a liquid feeder. These liquid feeders are often used not only for the metered high accuracy addition of liquids to the extrusion process, but also for the liquid addition of high value sweeteners or flavors, such as menthols, to the confectionery forming process.

Self-Check – 1	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. Ingredient dosing to the extruder via feeders can be handled either by addition of a premix or by using separate feeders for each individual ingredient**…(2pts)**
2. Twin-screw feeders can be supplied in either volumetric or gravimetric designs**…(2pts)**

Test II: Choose the best answer

1. **Which of is true about the use of the individual ingredient feeders…? (3pts)**
   A) Eliminates risk of segregation of blended product
   B) Eliminates added cost
   C) Reduces the duration of the mixing step
   D) All
2. Which of the following process parameters of transfer of ingredients including…? **(3pts)**
   A) material characteristics
   B) distance to be transferred
   C) required rate of transfer, and the type of container in which the ingredient is originally received
   D) All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 2- Monitoring preparation of the mass to confirm specifications

2.1 Monitoring preparation of the mass to confirm specifications

❖ **Product specification sheet**

- Product name

✓ Product: Chocolate Chip Cookie Dough
✓ Description: Chocolate Chip Cookie Dough with Semi-Sweet Chocolate,
✓ Individual Portioned, Ready to Bake

- **Ingredients:**

✓ Wheat flour (unbleached, unbromeated),
✓ semi-sweet chocolate chips (sugar, unsweetened chocolate, cocoa butter, dextrose, and soya lecithin, Natural vanilla extract)
✓ brown sugar and butter (sweet cream, salt)
✓ cane sugar and Whole eggs (pasteurized)
✓ natural vanilla extract, baking soda and salt

- **Shelf life:**

✓ Dough:
  - ➢ Frozen: 365 days from manufacturing.
  - ➢ Refrigerated dough 7 days. Once Baked 10 days ambient.

- **Storage**:

✓ Maintain Frozen

- **Julian lot code**:XXXXXXXXXXXXXXXXXXXXXXXXXXX

Fig 1 Chocolate dough mass

- **Processing specifications:**

Dough: Thaw dough (approx. 60 minutes). Place on a parchment lined baking sheet, bake at 330° in a preheated convection oven: approx. time: M2 = 18 mins.

- **Allergen:**

✓ Wheat, Dairy, Eggs, Soy.
✓ Processed in a facility and on equipment that also processes
✓ Peanuts and tree nuts.

- **Nutrition Facts**

Amount Per Serving:

✓ **Calories** 130,
✓ total Fat 20g (26%), sat Fat 4g (20%), Trans Fat 0g,
✓ **Cholest,** 20mg (7%), **Sodium** 115mg (5%), Total Carb. 18g (7%),
✓ Total sugars 12g added sugars, 24%,
✓ Protein 1g (0%), calcium (0%)
✓ Potassium (0%).

Snacks contribute an important part of daily nutrient and calorie intake for many consumers. Extruded snack foods have been increasingly gained popularity for providing:-

- Safe, nutritious
- Food for poor and undernourished populations for the developing world.

Reasonably low protein content (2.44 to 11.06%) in market snacks has been reported by several workers. Thus, high consumption of such snacks could lead to malnutrition in children and obesity, which leads to several diseases in adults. Consumption of snacks as a meal could be applicable if it could either provides protein of 2.5–3.0 g per 100Kcal; or if 10–12% of total calories are obtained from protein; or if the calories gained carbohydrate (55–65%), fat (20–30%) and protein10–15%).

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I

1. **Which of the following is included in Product specification sheet….? (3pts)**

A) Product name
B) Ingredients
C) Nutritional Facts
D) All

2. **Which of the following is included in chocolate dough Ingredients…? (3pts)**

A) Wheat flour
B) Semi-sweet chocolate chips
C) Brown sugar and butter (sweet cream, salt)
D) Cane sugar and Whole eggs (pasteurized
E) All

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

You can ask you teacher for the copy of the correct answers.

Information Sheet 3- Operating the extrusion process

1.1 Operating the extrusion process

Extrusion is defined as a process in which material is pushed through an orifice or a die of given shape. The pushing force is applied using a piston or a screw. In food applications, screw extrusion is predominant.

Extrusion processing of food materials has become an increasingly important manufacturing method, and its applications have broadened substantially in the last two decades. From the point of view of transport phenomena, extrusion processing can be thought of as a combination of several processes, including fluid flow, heat and mass transfer, mixing, shearing, particle size reduction, melting, texturizing, caramelizing, plasticizing, shaping, and forming. Depending upon the product, one or many of these processes will take place in an extruder.

Notice Extrusion process video

For example, in pasta manufacturing, the main objective of the extrusion process is to partially gelatinize starch, compact the dough, and give it the desired shape. In the case of chocolate manufacturing, the extruder is used as a reactor to generate key flavor attributes. In the case of corn puffs, the extruder is used to develop the desired expanded, porous structure. Today, a variety of products such as breakfast cereals, pasta, snacks, candy, confectionery products, and pet foods are made using screw extrusion processes.

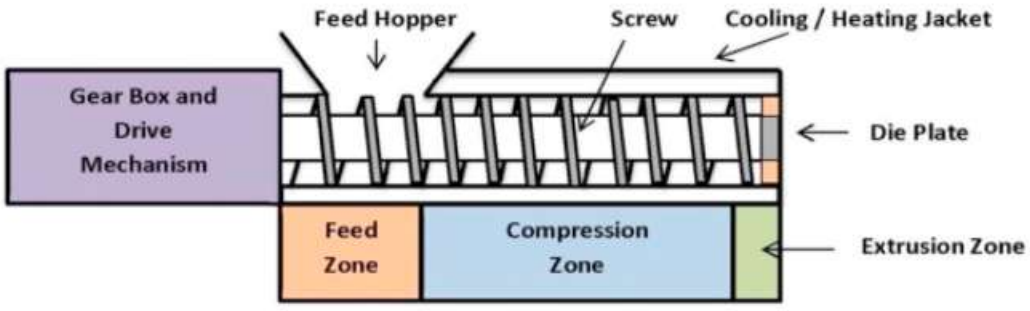


Fig Extruder Equipment Sections

q) Advantages of an Extrusion

There are many advantages of extrusion processing over other conventional cooking processes. Extrusion is a continuous process. It is flexible because on-line process adjustments can be made to achieve desired product characteristics. In addition, the same extruder can be used to manufacture different types of products. The process has no effluents and is energy-efficient. It can be used to process relatively dry, highly viscous materials as well as moist or wet materials. Recent advances in the basic research and development of better process control strategies have made it possible, to a large extent, to control the thermo-mechanical changes during extrusion to achieve desired product properties. Food extrusion is a high-temperature–short-time (HTST) process.

Notice: Extrusion Video

Fig Food Extruder/ Pet Extruder

Self-Check – 3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. Extrusion is defined as a process in which material is pushed through an orifice or a die of given shape…? (2pts)
2. Extrusion is a continuous process….?(2pts)

Test II: Choose the best answer

1. Which of the following statement is true about Extrusion process..? (3pts)
   A) Extrusion is a continuous process.
   B) Extrusion is flexible because on-line process adjustments can be made to achieve desired product characteristics.
   A) In Extrusion, the same extruder can be used to manufacture different types of products
   B) All

2. Which of the following included of extrusion several processes **(3pts)**
   A) Fluid flow, heat and mass transfer,
   B) Mixing, shearing, particle size reduction,
   C) Melting, texturizing, caramelizing,
   D) Plasticizing, shaping, and forming.
   E) All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 4- Monitoring equipment to identify variation in operating conditions

4.1 Monitoring equipment to identify variation in operating conditions

❖ **Monitoring the Variation when operating an Extrusion Equipment**

In order to prevent personal accidental injury:-

- Safety shields shall be installed on the transmission parts of all machines
- Safety doors shall be provided when the products are removed from the extruder
- The heating zone of the machine shall have safety and thermal insulation cover
- The crusher shall prevent the steel from falling in and prevent the operators hand is extended into the internal protection device
- Emergency brake buttons and alarms shall be installed at key parts of the equipment
- Hydraulic pressure tests shall be carried out regularly for all pressure vessels.

In the extrusion operation, if there is two or more operation, the division of labor must be clearly defined; when the equipment or extruder is unloaded, the power supply and air source should be cut off and the “maintenance” mark should be hung at the repair place; when the large container is produced, due to the extruder cavity in order to prevent the human body from entering the extruder cavity.

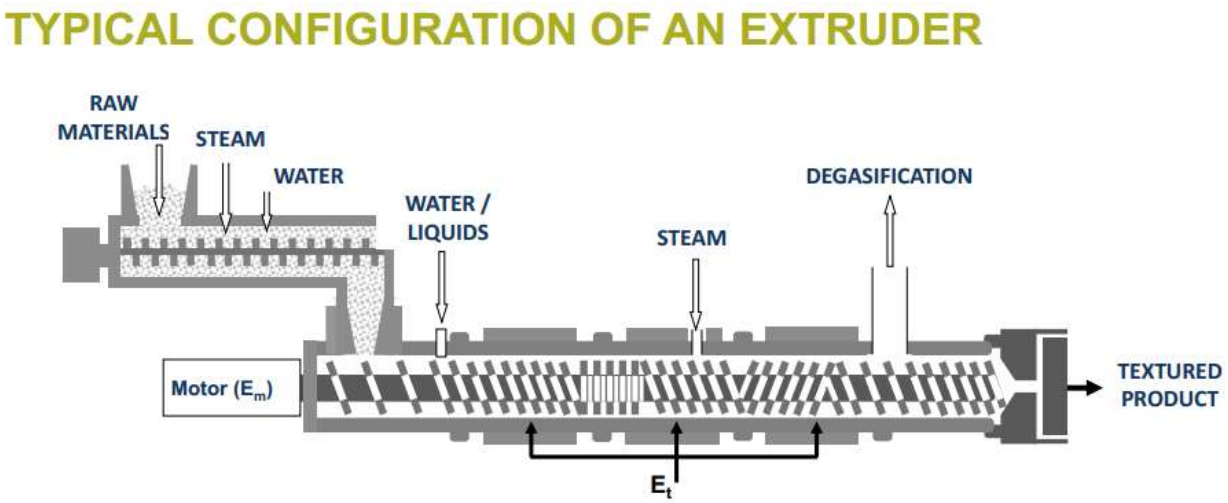


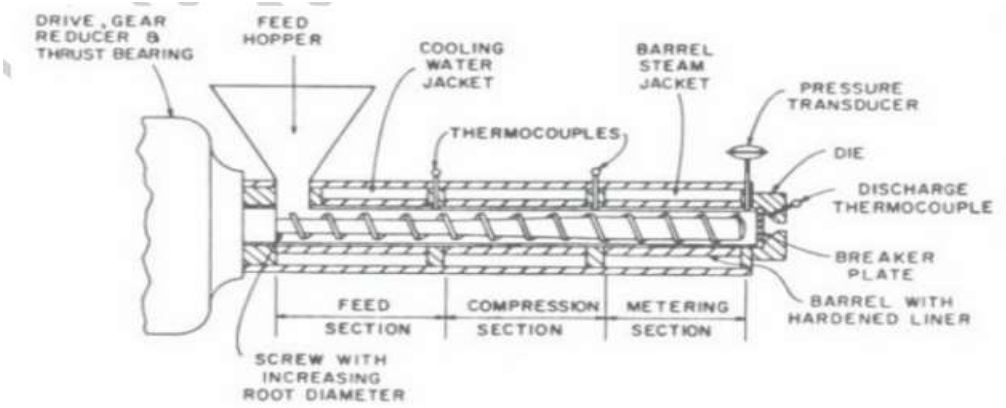
Fig Configuration of an Extrusion

a) Single-Screw Extruders

Single-screw extruders contain a single rotating screw in a metal barrel, and come in varying patterns. The most commonly used single-screws have a constant pitch. Single-screws usually consist of three sections:-

1) Feed
2) Transition or compression
3) Metering

The raw materials are fed in a granular form at the hopper located in the feed section. The rotating action of the screw conveys the material to the transition section. In the transition section, the screw channel becomes shallower and the material is compacted. A major portion of mechanical energy is dissipated in this section, which results in a rise in temperature of the material. Starch becomes gelatinized, and the material becomes more cohesive. It is transported further by the metering section and pushed through the die opening. The barrels of single-screw extruders usually have helical or axial grooves on the inner surfaces. This helps to convey and mix the material more effectively



b) **Twin-screw extruders** are usually focused on powdered materials or where more intensive mixing is required.

Note: Refer LO-1, Information Sheet 3 for more information

Self-Check – 4	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say True or False

1. The raw materials are fed in a granular form at the hopper located in the feed section…?(2pts)
2. The rotating action of the screw conveys the material to the transition section?(2pts)

Test I: Choose the best answer

1. Which of the following is done In order to prevent personal accidental injury…?(3pts)
   A) Safety shields shall be installed on the transmission parts of all machines
   B) Safety doors shall be provided when the products are removed from the extruder
   C) The heating zone of the machine shall have safety and thermal insulation cover
   D) All
2. Which of the following is one a section for Single-screws extruder…?(3pts)
   A) Feed
   B) Transition or compression
   C) Metering
   D) All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 5- Monitoring operation of equipment and processes

5.1 Monitoring operation of equipment and processes

5.1.1 Monitoring the extrusion process

During extrusion both process-based monitoring and product-based monitoring are used to achieve product improvements. Process Based monitoring watches production process conditions such as melt temperature and pressure. Product-Based monitoring follows properties of the product, such as, clarity and thickness.

1. Process Based monitoring

a) Pressure Measurement

Pressure Measurement is now most commonly done with a pressure transducer, or sensor, which sense pressure or pressure changes. Several types of electrical pressure transducer are used; however, the most common type is the strain gauge pressure transducer.

Fig Pressure Transducer

b) Pressure Measurement Locations

There are several locations on the extruder where pressure measurements should be made. Along the barrel, measurements help determine screw performance and design; before and

after the screen pack, measurements warn of potential high pressure situations and avoid flow restrictions between the screw and the die; at the inlet and outlet of the gear pump, pressure measurement ensures a constant melt flow to optimize pump performance and safety; and pressure measurement at the die maintains stable output and reduces scrap and material waste.

c) Temperature Measurement

Thermocouple (TC) is the most common temperature Measuring element. If the thermocouple calibrated, so a simple and accurate measurement of temperature can be made. The measurement can be displayed as ^{o}C or ^{o}F in analog or digital.

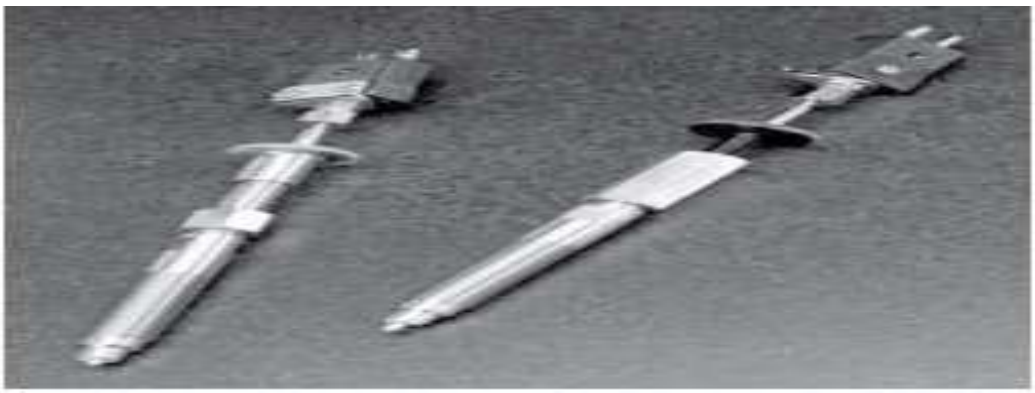


Fig Thermocouple

2. Product-Based monitoring

a) Thickness measurement

The thickness of sheet is often measured using a beta radiation gauge. If the extrudate composition is fixed, then the sensor output can be set to continuously read product thickness. The amount of beta particle transmission varies with the thickness and composition of material through which it passes. Gravimetric thickness is obtained from the weight a sample of the known area its density by dividing the weight by the area and the density.

b) Speed measurement

In extrusion, the screw speed is the screw rotational speed that is usually measured by revolution per minute (RPM). However, it should remembered that is the screw surface speed that is important. Speed must be measured and displayed very accurately as, screw speed controls how much materials is pumped, well it is mixed, shear history, melt temperature and melt temperature variations. As each tooth passes the sensor, this creates a change in the magnetic field (a pulse) which is sensed by the transducer. When the number of pulses is counted per unit of time, the screw speed is obtained.

Self-Check –5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. During extrusion both process-based monitoring and product-based monitoring are used to achieve product improvements….? (2pts)
2. Pressure Measurement is now most commonly done with a pressure transducer, or sensor, which sense pressure or pressure changes..? (2pts)

Test II: Choose the best answer

1. Which of the following is measurement included in Process Based monitoring…? (3pts)

A) Pressure measurement
B) Temperature measurement
C) Viscosity/thickness
D) Except C All are answer

2. Which of the following is used to measure Temperature…..?(3pts)

A) Thermocouple
B) Transducer
C) Revolution per minute (RPM)
D) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 6- Monitoring the extruded product

6.1 Monitoring the extruded product

6.1.1 Extruded product

Extrusion is a mechanical process in which certain materials are forced, under pressure, through a die opening to create products of a desired shape, size, and/or texture.

Extruded Products today, extruders are used in a variety of applications, such as the manufacture of breakfast cereals, pasta, meat analogs, filled snack products, and confections industries.

d) Products for Human Consumption

Table 1 some examples of extruded products for human consumption are listed

Type	Example
Directly expanded	Breakfast cereals, corn curls
Unexpanded	Pasta
Half-products	Potato pellets
Co-extruded	Fruit-based cereal, jelly-filled cores
Modified	Starches, fat mimics
Texturized	Meat analogs
Candy	Licorice, chewing gum

Fig1 Extruded Products (snacks, cereals, pet foods)

The dough is mixed with water and other ingredients to achieve a level of dough consistency that is suitable for extruding.

Fig2 Extruded Products

6.1.2 Monitoring the extruded product

The machine operators may make checks on product quality or a control system or a separate system such as a robot-type device can make them. Verification of product quality at the point of manufacture can be documented in statistical quality control (SQC) records. It is possible to produce puffed snacks from 100% pulse flour.

e) Parameters to be monitored when processing pulse based extruded snacks are listed as follows:

- Starch, dietary fiber and protein content of raw materials
- Amylose/amylopectin ratio of starch/starch blend
- Type of extruder (single or Twin screw)
- Shapes of the extruded Product.

Machine operators are alerted to issues before they happen, reducing unplanned downtime while also collecting valuable data. Users receive notifications via-text, and continuous monitoring of production machine status is available on smart devices and remote. Key parameters monitored include extruder reducer, lubrication system, and monitor characteristics, the drive power unit, barrel heating and cooling.

Vibration sensors on extruder reducer provide data regarding the condition of the gears, bearings and lubrication system.

Fig3 Extruder Equipment

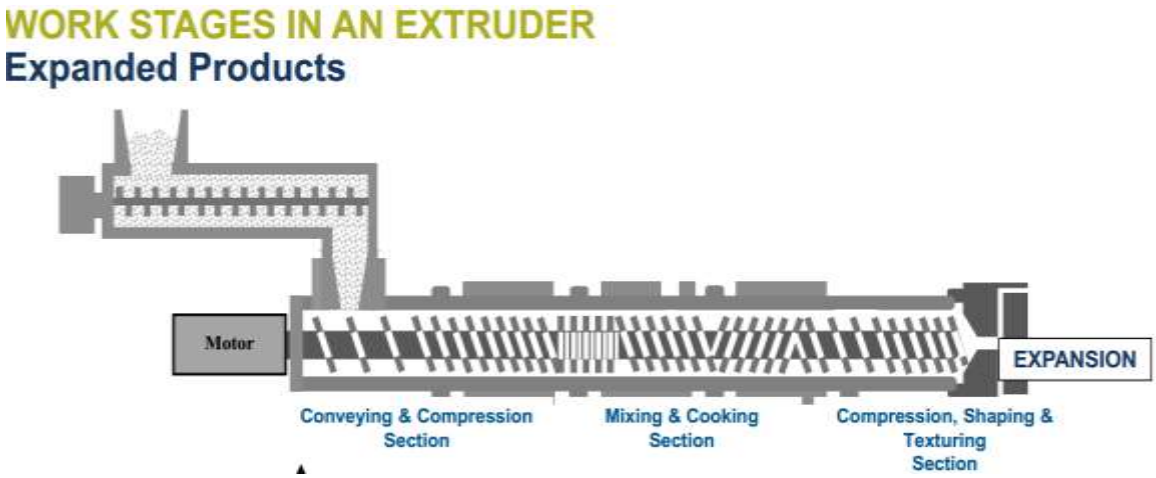


Fig4 Work stages in an Extruder

Self-Check –6	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. Machine operators are alerted to issues before they happen, reducing unplanned downtime while also collecting valuable data…? (2pts)
2. Vibration sensors on extruder reducer provide data regarding the condition of the gears, bearings and lubrication system…? (2pts)

Test I: choose the best answer

1. Which of the following is one of variety applications of the extruders…? (3pts)
   A) Breakfast cereals
   B) Pasta, meat analogs
   C) Filled snack products
   D) Confections industries
   E) All

2. Which of the following are key parameters to be monitored during extrusion..? (3pts)
   A) Extruder reducer lubrication system
   B) Monitor characteristics, the drive power unit
   C) barrel heating and cooling
   D) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 7- Identifying, rectifying and/or reporting out-of-specification product/process outcomes

7.1 Identifying, rectifying and/or reporting out-of-specification product/process outcomes

7.1.1 Identifying and rectifying out-of-specification outcomes

Proteins are a group of highly complex organic compounds that are made up of a sequence of amino acids. Protein nutritional value is dependent on the quantity, digestibility and availability of essential amino acids. Several changes occur during extrusion of which denaturation is undoubtedly the most Important. Extrusion may improve protein digestibility by denaturation proteins and exposing enzyme-accessible sites. Enzymes and enzyme inhibitors generally lose activity due to denaturation

The extrusion operations have very little effect on the protein denaturation Maillard reactions occur during extrusion particularly at high barrel temperature, low moisture, and high shear. All processing variables have different effects on protein digestibility.

High shear extrusion conditions in particular promote denaturation, although mass temperature and moisture are also important factors. In a model system of wheat starch, glucose and lysine, low pH favors Millard reactions, as measured by increased colour.

7.3 Reporting product/process out-of-specification outcomes

- **Sharing the Experience**

The final component of reporting the defect is sharing the experience. This involves

- discussing the problem and solution with other members of the operations and quality control staffs through one-on-one discussions
- group discussions
- written communications, or
- formal training sessions so that each team member gains the experience of defect recognition
- solution determination
- Implementation for as many situations as possible.

Self-Check –7	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer

1. Which of the following is final component of reporting the defect is involves? (10pts)
   A) discussing the problem and solution with other members of the operations and quality control staffs through one-on-one discussions
   B) group discussions
   C) written communications, or
   D) formal training sessions so that each team member gains the experience of defect recognition
   E) solution determination
   F) all

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 8- Maintaining the work area according to housekeeping standards

1.1 Maintaining the work area according to housekeeping standards

f) **Housekeeping**

Mess can cause slips, trips and falls. Avoid injuries by:

- Keeping work areas, walkways and other paths clear and clean
- Clearly marking walkways and no-go areas
- Preventing spills, which can cause slips

g) To Maintain work area apply the following

- Design machinery and work process to minimize oil loss or spillage.
- Clean up spills as soon as possible and avoid any oily residues on the floor.
- Provide a rough anti slip floor where this is not practical.

Self-Check –8	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best Answer

1. Which of the following is applied to Maintain work area? (5pts)

A) Design machinery and work process to minimize oil loss or spillage.

B) Clean up spills as soon as possible and avoid any oily residues on the floor.

C) Provide a rough anti slip floor where this is not practical.

D) All

2. **Which of the following is used to** avoid injuries during extrusion process? **(5pts)**

A) Keeping work areas, walkways and other paths clear and clean

B) Clearly marking walkways and no-go areas

C) Preventing spills, which can cause slips

D) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 9- Conducting the work according to Environmental Guidelines

9.1 Conducting the work according to Environmental Guidelines

9.1.1 Environmental and occupational health hazards

When reviewing machinery for non-mechanical hazards, consider how machinery can affect the area around it. A through hazard identification process needs to consider the effect of environmental factors such as:

- Lighting
- Heat
- Cold have on workers when using machinery.

Environmental factors which affect a work are:

a) Working Height

People need a suitable work platform to reduce the fallings from machinery.
Working safely at height may need:

- Fixed or permanent access platform

b) Lightings

Make sure the work area is well. Poor lighting can be a hazard. Sometimes the machine or guards can block normal lighting so extra local light is needed. Also put local lighting in regular maintenance areas that are poorly light, such as inside some electrical components where electrical isolation is needed for access.

c) Noise

Employers must take all practicable steps to reduce any risk of harm to people from machinery noise. Machinery noise should be eliminated, or through isolation kept to a level that does not damage hearing.

d) Machinery stability and security

All machines must be secured to the floor or other structure so that it cannot tip, become unstable or create any other hazards, unless it is designed to be portable.

Self-Check –9	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. Poor lighting can be a hazard…? (2pts)
2. People need a suitable work platform to reduce the fallings from machinery..? (2pts)

Test I: Choose the best answer

1. Which of the following is one of environmental factors in extrusion process..? (3pts)
   A) Lighting
   B) Heat
   C) Cold have on workers when using machinery
   D) All
2. Which of the following is need of Working safely at machinery falling environments…?(3pts)
   A) Fixed access platform
   B) Permanent access platform
   C) A & B
   D) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 10- **Maintaining workplace records** according to workplace Information

10.1 Maintaining workplace records

Regarding to the material, the die and the machine settings used to produce an extrudate, which are recorded on the process settings sheet. This is a sheet used for keeping a record of data regarding each run. Not only is it useful to have a full and accurate recording of process settings, but such records are useful for liability reasons and for compliance with ISO 9000 requirements.

11 Machinery Information

A wide range of information sources can be used to identify hazards, including:

- Manufacturer's instructions and advice
- Maintenance logs of machinery
- Documents of safe work practices and the effectiveness
- Injury or incident information and hazard alert
- Relevant reports from occupational health and safety agencies, unions, and employer and professional bodies.

12 Keeping documents and records

Documenting your chosen control measures helps show you have to meet your legal obligations. Keep records to track what has been done and what is planned; effective record-keeping can save time and money.

The level of documentation should be appropriate for the level of risk and control measures.

13 Spare parts stock records

Spare parts stock control systems help managers dispatch repair technicians with the right spare parts and help them reorder these parts in the right quantity, when needed.

Spare parts record-keeping procedures should include the following data:

- Part description (name)
- Stock (inventory) number
- Manufacturer's name, serial and part number

- Link to equipment models
- Minimum stock level
- Current stock level
- Part storage location
- Price and date purchased.

A number of factors will affect how often to order spare parts, including:

- Rate of use of each part (estimated from past experience and records);
- Level of criticality to operation
- Procurement lead time for each item
- Frequency of ordering
- Dry storage capacity
- Cost of each part.

Managers should analyses spare part stock records to identify which spare parts are most quickly consumed.

Forward planning will ensure that these parts are available when and where needed.

Self-Check –5	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Say true or false

1. Die and the machine settings used to produce an extrudate, which are recorded on the process settings sheet..?(2pts)
2. Forward planning will ensure that these parts are available when and where needed..?(2pts)

Test II: Choose the best Answer

1. Which of the following information sources can be used to identify hazards? (3pts)

A) Manufacturer's instructions and advice
B) Maintenance logs of machinery
C) Documents of safe work practices and the effectiveness
D) Injury or incident information and hazard alert

3. Which of the following factors will affect how often to order spare parts?(3pts)

A) Rate of use of each part (estimated from past experience and records);
B) Level of criticality to operation
C) Procurement lead time for each item
D) Frequency of ordering
E) All

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

LAP TEST	**Performance Test**

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

Task-1 Operate grinding machines

LG #49	LO #3- Shut down the Extrusion process

Instruction sheet

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Starting and operating the refining process
- Monitoring the operation of equipment and processes to identify variation
- Identifying , maintaining and reporting variation in equipment operation
- Monitoring the refining process
- Identifying, rectifying and/or reporting out-of-specification product/process outcomes
- Maintaining the work area.
- Conducting the work in accordance with legislative requirement /guidelines
- Maintaining workplace records

This guide will also assist you to attain the learning outcomes stated in the cover page. Specifically, **upon completion of this learning guide, you will be able to**:

- Start and operate the refining process
- Monitor the operation of equipment and processes to identify variation
- Identify , maintain and report variation in equipment operation
- Monitoring the refining process
- Identify rectify and/or report out-of-specification product/process outcomes
- Maintain the work area.
- Conduct the work in accordance with legislative requirement /guidelines
- Maintain workplace records
-

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below.
3. Read the information written in the information Sheets
4. Accomplish the Self-checks
5. Perform Operation Sheets
6. Do the “LAP test

Information Sheet 1- Identifying the appropriate shutdown procedure

1.1 Identifying the appropriate shutdown procedure

It is most important to adopt a sensible shutdown procedure as it can save a great deal of time and money. If, for example, the product is prevented from burning then there will not be so much urging required on re-heating and the cost of a complete shutdown and machine clean out may be saved.

Most thermoplastic resins, when left in the barrel- even for short time-are likely to degrade and cause product contamination.

To prevent contamination or deposit formation in your machine s, use purging compound to clean the barrel and screw and displace resins from the machine completely

Normal safety precautions for working around any moving machinery are to be observed.

a. Avoid loose clothing such as unbuttoned shirtsleeves, lab coats, or dangling ties.
b. Jewelry, such as bracelets and rings, should be removed.
c. Inspect tools and electrical equipment such as heater bands, etc. for defects.
d. Use “hot mill” gloves and sleeves when making die adjustments and changes.
e. Never place fingers or metal probes in the feed throat. If necessary, use a plastic probe for clearing the throat.
f. Because of possible overpressure, clamp or bolt failure, never stand directly in front of any extruder during start up, operation, or shutdown.
g. Use a vacuum for cleaning and an air hose with low-pressure nozzle for cleaning inaccessible areas.
h. Keep the floor area around the extruder clean of compound and water, which could cause a slipping or electrical shock hazard.

i. Check the pressure gauge in the head of the extruder to be sure it is indicating pressure correctly.

Self-Check – 1	**Written test**

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Choose the best answer

1. Which one types of testing or testing for conformance of the machined component?
   A. Performance B. Surface finishC. Shapes and dimensions D. None
2. Which is one must be included in a non-conformance report?
   A. Main reason error B. The solution to prevent the problem
   C. Explanation of corrective action to be takenD. All

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Information Sheet 2- Shut down the process of Extrusion

2.1 Shut down the process

Shutdown procedure

Step1 Use “hot mill” gloves and sleeves during shutdown procedure.
Step2 Empty the fed hopper and lower the heats on the barrel to about 300 0 F. Turn off all the power to the heater bands while running the remaining material out of the barrel. Turn off the water on the feed throat.
Step3 Run all of the remaining material out of the barrel. Some material might adhere to the barrel or screw requiring you to run a flush or purge compound to clear out the barrel. In this case the die heat may be turned back on.
Step4 After the barrel is purged, turn the power off to the heater bands and unplug them.
Step5 Turn off the barrel heaters and hit the “OFF “button to turn off the screw drive motor.
Step6 Disconnect thermo wells, pressure transducers and wires. Remove the heater bands from the die.
Step7 Blow air on the die face to harden the extrudate enough to pull it out of the die land with pliers.
Step8 Take bolts out of the face of the die and remove the die.
Step9 Turn the extruder on and push out any core if applicable and shave any extrudate plug from the breaker plate.
Step10 Turn the extruder off and unbolt the die clamp and remove it from the extruder.
Step11 Turn the extruder back on and push out the breaker plate. Apply air to the face of the breaker plate and slowly pry the plug out.
Step12 Turn the extruder speed up and run out any material remaining by blowing air into the feed hopper. Be sure no one is standing in front of the extruder.
Step13 Clean the die parts with a brass scouring pad and spray with neutralizer.
Step14 After the screw is empty, turn off the main power switches. Push the screw out of the extruder from the back using a long steel rod or use a hydraulic “pusher”. Tap the screw out with a hammer.
Step15 Clean the screw with a brass scouring pad and blow out the barrel with air. In extreme cases, a motor driven wire brush may be used to scrub material out of the barrel.
Step16 Take out the pressure transducers, if necessary, to clean plastic out of the thread wells

Self-Check – 2	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: Short answer

1. List down the appropriate Extrusion shutdown process…(10)pts

You can ask you teacher for the copy of the correct answers.

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Information Sheet 3 Identifying and reporting maintenance requirements

3.1 Identifying and reporting maintenance requirements

Typically rigid compounds are thermally stable at the recommended melt temperatures (measured at the die exit with a hand held pyrometer) of 360-380° F. In general they will remain stable up to 390 to 395° F as long as the material is not allowed to sit, or stagnate in the equipment. I.e. as long as the screw is turning and material is exiting the die. If the material is allowed to sit idle in the extruder or die at the recommended processing temperatures (barrel and die heats @ 280 to 320° F) it should remain stable for approximately 20 to 30 minutes.

If degradation begins to occur due to an errant temperature controller or similar Problem during production:

1. Close the feed hopper gate.
2. Shut off all barrel and die heaters.
3. Run at normal screw RPM until barrel and screw are empty.
4. Remove the die and adapter assembly.
5. Push the screw out of the barrel; inspect and clean.
6. Locate and replace the faulty controller, or component.
7. Resume using normal start-up procedures

Self-Check –3	Written test

Name…… ID…… Date…….

Directions: Answer all the questions listed below. Examples may be necessary to aid some explanations/answers.

Test I: short answer

1. What are the steps, If degradation begins to occur due to an errant temperature…(8pts)

You can ask you teacher for the copy of the correct answers

Note: **Satisfactory rating - ≥ 5 points** **Unsatisfactory - below 5 points**

Operation sheet 1– Extrusion Shutdown procedure

Shutdown procedure

Step1 Use “hot mill” gloves and sleeves during shutdown procedure.
Step2 Empty the fed hopper and lower the heats on the barrel to about 300 0 F. Turn off all the power to the heater bands while running the remaining material out of the barrel. Turn off the water on the feed throat.
Step3 Run all of the remaining material out of the barrel. Some material might adhere to the barrel or screw requiring you to run a flush or purge compound to clear out the barrel. In this case the die heat may be turned back on.
Step4 After the barrel is purged, turn the power off to the heater bands and unplug them.
Step5 Turn off the barrel heaters and hit the “OFF “button to turn off the screw drive motor.
Step6 Disconnect thermo wells, pressure transducers and wires. Remove the heater bands from the die.
Step7 Blow air on the die face to harden the extrudate enough to pull it out of the die land with pliers.
Step8 Take bolts out of the face of the die and remove the die.
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Step13 Clean the die parts with a brass scouring pad and spray with neutralizer.
Step14 After the screw is empty, turn off the main power switches. Push the screw out of the extruder from the back using a long steel rod or use a hydraulic “pusher”. Tap the screw out with a hammer.
Step15 Clean the screw with a brass scouring pad and blow out the barrel with air. In extreme cases, a motor driven wire brush may be used to scrub material out of the barrel.
Step16 Take out the pressure transducers, if necessary, to clean plastic out of the thread wells

Lap Test	Demonstration

Name……. ID……..
Date…….

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within **1** hour. The project is expected from each student to do it.

During your work: You can ask all the necessary tools and equipment
Lap Test Title: Produce Tool Shanks for Milling Machines

Task 1 Shutdown an Extrusion process

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