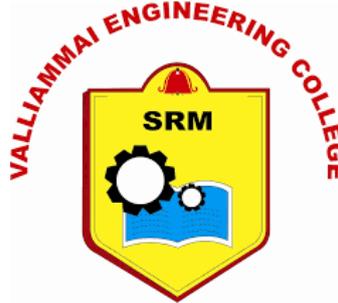# SRM VALLIAMMAI ENGINEERING COLLEGE
(An Autonomous Institution)
SRM Nagar, Kattankulathur – 603203.

Department of Agricultural Engineering

LABORATORY MANUAL

(2023 Regulation)

SEMESTER	**:**	**V**
SUBJECTCODE	**:**	**AG 3567**
SUBJECT	**:**	**POST HARVEST ENGINEERING LABORATORY**
ACADEMIC YEAR	**:**	**2025-26 ODD**

Prepared by,

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Assistant Professor

AG3567   **POST HARVEST ENGINEERING LABORATORY**   **L T P C**
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OBJECTIVES:

- To determine various engineering properties of grains.

- To understand   how   to   test   and   evaluate   different   post
  harvesting machineries.

- To get knowledge about evaluating the shelling efficiency of Agricultural materials.

- To visit industries working on post harvesting technologies.

- To evaluate the working efficiency of various agricultural machineries.

LIST OF EXPERIMENTS:

1. Determination of moisture content of grains by oven method and moisture meter.
2. Determination of porosity of grains.
3. Determination of coefficient of friction and angle of repose of grains.
4. Testing of paddy thresher & paddy winnower.
5. Determining the efficiency and testing of groundnut decorticator.
6. Determining the efficiency maize sheller.
7. Evaluation of thin layer drier.
8. Evaluation of L.S.U..drier.
9. Determining the efficiency of bucket elevator and screw conveyor.
10. Evaluation of shelling efficiency of rubber roll sheller.
11. Determining the oil content of oilseeds.
12. Visit to modern rice mill and pulse milling industry.

                                                        TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student should be able:

Students will be able to determine various engineering properties of grains and its
coefficients.

Students are able to done the testing for the various Agricultural machinery of paddy,
groundnut and maize.

Evaluation of various agriculture machineries can be done by the students.

Also getting the knowledge about the shelling efficiency and oil content of oilseed
crops.

Understanding the concepts of processing done in the various mills.

AG3567	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
CO1	2	2	1	3	-	1	2	-	-	2	1	3	2	1	3	1
CO2	2	1	1	2	3	1	1	-	1	2	1	2	1	2	1	3
CO3	3	2	2	3	3	-	-	2	2	3	3	2	2	2	3	1
CO4	2	2	2	1	-	-	-	2	2	3	3	2	2	1	2	3
CO5	1	3	2	1	1	-	-	-	-	2	1	2	1	1	2	2
Average	2.0	2.0	1.6	2.0	2.3	1.0	1.5	2.0	1.7	2.4	1.8	2.2	1.6	1.4	2.2	2.0

TEXT BOOKS:

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REFERENCE BOOKS:

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2. K.M Sahay and K.K Singh, 2020. Unit Operations of Agricultural Processing, Vikas Publication.
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4. Chadha, K.L. 2009. Handbook of Horticulture. IARI Publications, New Delhi.
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1. DETERMINATION OF MOISTURE CONTENT OF GRAINS BY OVEN METHOD AND MOISTURE METER

Aim:

To determine the moisture content of grains

Principle:

Removal of moisture from wet materials takes place by vapourization and it depends on the rate of heat and mass transfer, which is related with the two basic phenomenon namely vapourization of moisture from surface of material and movement of moisture from internal parts of materials to its surface. Movement of moisture takes place because of diffusion, cell contraction and vapour pressure gradient.

Apparatus Required:

- Electric balance,

- Brown-duel moisture meter,

- Satake moisture meter,

- Indo saw universal moisture meter,

- Oven,

- Desiccators,

- Moisture boxes.

Procedure:

a) **Oven drying method**

1) Take the sample box and weight it with lid over it

2) Put the sample in it (approximately 5- 10grams)

3) Keep the samplein an oven at 105 °C for 24hours

4) Take out the sample after 24 hours and weigh it along with the lid over it.

Observations

SI. No	Item	Sample No.	Weight
1	Initial Weight of Sample	1 2 3	
2	Final Weight of Sample	1 2 3	
3	Container Weight Without Sample	1 2 3	

Calculations

Calculate the moisture content in percent with the following formula

b) Brown-Dual distillation method:

$$\text{Moisture content (Wet basis)} = \frac{\text{Initial weight of sample - Final weight of sample}}{\text{Initial weight of sample}}$$

$$\text{Moisture content (Dry basis)} = \frac{\text{Initial weight of sample - Final weight of sample}}{\text{Dry weight of sample}}$$

Procedure

l) Arrange the instrument and settings

2) Take 100 g of material by weighing on the balance

3) Take 150 ml mineral oil (high BP) using measuring jar

4) Take the grain and oil in a flask and keep it in the assembly

5) Supply the current and keep it for 30 minutes

6) Collect the condensed water in a graduated cylinder

7) Stop the supply when water collected in the cylinder is negligible

8) Take the cylinder and measure the reading which will give directly the wet basis moisture content.

Procedure (Universal moisture meter):

1) Arrange the instrument and set up

2) Take the sample and check the volume cup to be used from the meter

3) Fill the sample in the cup up to top

4) Read out the pressure to be applied

5) Provide the compaction by means of rachet handle

6) Press the button provided at the top such that the countdown starts from 10

7) After the end of countdown, moisture content is displayed on the screen which give the moisture content on wet basis

8) Repeat for three samples of same material

Results:

SI. No.	Moisture measurement method	Sample No. (wet basis)	Moisture content (dry basis)	Moisture content (wet basis)
1	Air oven method	1 2 3		
2	Universal moisture meter method	1 2 3		
3	Brown-dual fractional distillation method	1 2 3		

2. DETERMINATION OF POROSITY OF GRAINS

Aim:

To determine the true density, bulk density and porosity of the given seed sample.

Apparatus required:

- •Weighing balance,
- •Cubical/cuboidal container,
- •Measuring cylinder,
- •Graduated beaker,
- •Seed sample, Water

Description:

Density (r**):**

Bulk Density (Ⅱ): It is the density of material when stacked or packed in bulk. Bulk density of the material is determined by dividing the material volume inclusive of voids to weight of product. There are two kinds of voids, voids between particles and void within particles. The bulk density is an important in packaging requirement and is often 2-20% of true density

Tapped Bulk Density: Tap bulk density is measured for powdery samples. The volume is measured after tapping the powdery material so that the product is adjusted to intergranular spaces, but it cannot eliminate all the intergranular spaces.

Particle density / true density (rp): Density of solid material constituting the true volume of the occupied by the material, excluding any interior pores that are filled with air (blind and through pores). It can be calculated by dividing the sample weight by solid volume determined by the gas displacement method in which inert gas is capable of penetrating all open pores up to the diameter of the gas molecule.
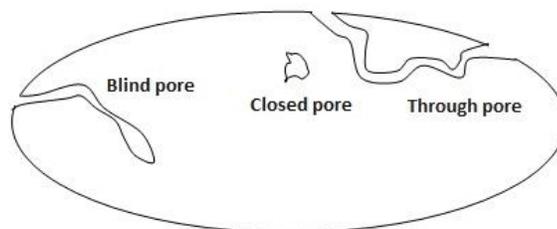
Gas displacement method is employed to find out the particle density. In gas displacement method, helium enters every nook and corner of material being lighter and inert gas.

Solid/substance density: is the density of a material measured when the material has been broken into pieces small enough to be sure that no closed pores remain.

Apparent Density: Apparent density (ρ_{app}) is the density of a substance including all pores within the material (internal pores). Apparent density of regular geometries can be determined from the volume calculated using the characteristic dimensions and mass measured. Apparent density of irregularly shaped samples may be determined by solid or liquid displacement methods.

- **Solid displacement method:**
- **Liquid displacement method:**
- **Gas displacement method:**
- **Image vision system:**

Mercury displacement is used to find out as mercury cannot enter the small interparticles pores because of its high density and surface tension and does not wet the surface.

Porosity: (inter granular space)

It is the measure of void space between the materials. It is defined on the percentage of volume of inter seed space to the total volume of seed bulk. Porosity depends on

- Shape
- Dimension/Size
- Roughness of Seed surface

$$\text{Porosity, } \square = \ 1-[\{\square\}.\{r_p\}] \text{ x } 100$$

Quality of food materials can be assessed by measuring their densities. Density data is required in separation process, such as centrifugation, sedimentation, hydraulic transport, for liquid, pumping power calculation.

True density of seed was defined as the ratio of the seed sample weight to the true volume of the sample. The ground sample was placed in a sample container for weight measurement and volume determination using a pycnometer (gas displacement method).

Procedure:

Determination of Bulk Density:

- Measure an empty cuboid/cubical container (l, b, h). Fill it with the given sample (V).
- Now weigh the sample (W).
- Using the given formula, the bulk density is determined.

Bulk density, $\rho = \dfrac{W}{V}$

Sample	Volume of the cubical/cuboidal container (cm³)	Volume of the sample (cm³)	Weight of the sample (g)	Bulk Density (g/cm³)
A				
B				
C				

Determination of True Density:

- ✓ Weigh a known quantity of the given sample.
- ✓ Fill it in a measuring cylinder
- ✓ Fill with water in the same measuring cylinder with given sample and note the initial water level.
- ✓ Note the final water level after 10 min.

✓ Calculate the volume of water displaced, and it will give the volume of the sample.

✓ Now using the formula, the true density of the sample is determined.

True density, r_p = $\dfrac{W}{V}$

Tabulation:

Sample	Initial water level (mL)	Final water level (mL)	Volume of the sample (cm³)	Mass (g)	True Density (g/cm³)
A					
B					
C					

Calculation:

Bulk density, $\square = \dfrac{W}{V}$

True density, r_p = $\dfrac{W}{V}$

Porosity, $\square$ = 1-[{$\square$}.{r_p}] x 100

Result:

1. The bulk density of the given sample ($\square$) is   =

2. The true density of the given sample (r_p) is   =

3. Hence, the porosity of the given sample ($\square$) is   =

3. DETERMINATION OF COEFFICIENT OF FRICTION & ANGLE OF REPOSE OF GRAINS

Aim:

To determine the angle of repose of grains.

Apparatus required:

- Grain sample,
- Angle of repose apparatus – L type & Round type,
- Oil seed sample,
- Weighing balance

Formula used:

For Round type:

$$\text{Angle of repose, } \theta = \textbf{tan}^{-1}\left[\frac{2H}{D}\right],$$

Where,

H = height of the slope formed by the grain after sliding naturally, m.

D = Diameter of the grain heap at its base, m.

For L - type:

$$\text{Angle of repose, } \theta = \textbf{tan}^{-1}\left[\frac{2(Ha-Hb)}{D}\right],$$

Where,

H_a = height of the slope formed by the grain after sliding naturally, m.

H_b = height of the platform, m

D = Diagonal distance of the grain heap at its base, m.

Description:

The *Angle of repose is* the angle between the base and the slope of the cone formed on a free vertical fall of the granular material to a horizontal plane. The size, shape, moisture content and orientation of grains affect the angle of repose. There are two angles of repose namely,

1. Static angle of repose

2. Dynamic angle of repose

Static angle of repose: This is the angle of friction taken up by a granular material about to slide upon it.

Dynamic angle of repose: This is related to a situation where a bulk of the materials is in motion such as movement of solid discharging from a bin and hopper. It is more important than the static angle of repose.

Procedure:

For Round type:

- Initially measure the diameter (D), of the base plate provided.
- Take the sample given and allow it to flow freely through a hopper such that it forms a conical heap over the base circular plate.
- Now measure the height(H) formed by the cone using the scale & pointer arrangement
- Using the above mentioned formula, the angle of repose (θ) for the given sample is determined.

For L type:

- The sides of the base of the platform are measured. Now the diagonal distance (D) can be derived from the equation $\mathbf{a^2 + b^2 = c^2}$.
- Now the box type compartment is filled with the given sample.
- The sliding door is opened by sliding upwards such that the sample is allowed to slide freely as well as naturally. Now the height (H_a) formed by the point at the top of the slope is measured with the help of a scale provided.
- The height (H_b) at the base of the platform is assumed to be 0.
- Using the above mentioned formula, the angle of repose (θ) for the given sample is determined.

Observation:

Round Type:

Sl. No.	Sample	H, (m)	D, (m)	Angle of repose, θ (°) = $\tan^{-1}\left[\dfrac{2H}{D}\right]$

L Type:

Sl. No.	Sample	H_a-H_b, (m)	D, (m)	Angle of repose, θ (°) = $\tan^{-1}\left[\dfrac{2(Ha-Hb)}{D}\right]$

Result:

1.	Angle of repose of the given sample A, by round type	=	
2.	Angle of repose of the given sample A, by L type	=	
3.	Angle of repose of the given sample B, by round type	=	
4.	Angle of repose of the given sample B, by L type	=	
5.	Angle of repose of the given sample C, by round type	=	
6.	Angle of repose of the given sample C, by L type	=	

4. TESTING OF PADDY THRESHER & PADDY WINNOWER

Aim: To study the performance evaluation of paddy thresher

Apparatus required:

- Paddy Panicle
- Weighing balance
- Paddy thresher

Formula Used

$$\text{Cleaning efficiency, \%} = \frac{\text{Clean grain}}{\text{Total grain collected from main outlet}} \times 100$$

$$\text{Threshing efficiency, \%} = \frac{\text{Threshed grain from all outlets}}{\text{Grain output in tank}} \times 100$$

Description: It is a machine operated by a prime mover such as electric motor, engine, tractor or power tiller, used for threshing.

Working principle

Types of threshing cylinder

(i) Peg tooth or spike tooth cylinder

(ii) Rasp bar cylinder

(iii) Angle bar cylinder

(iv) Loop type cylinder

(v) Hammer mill type cylinder
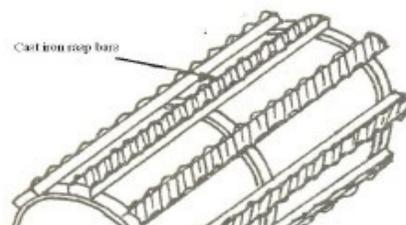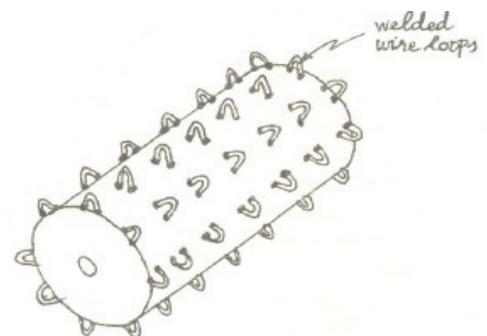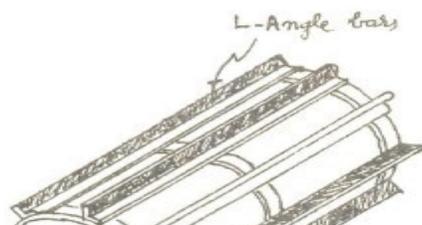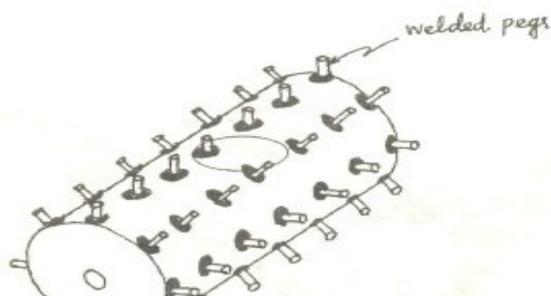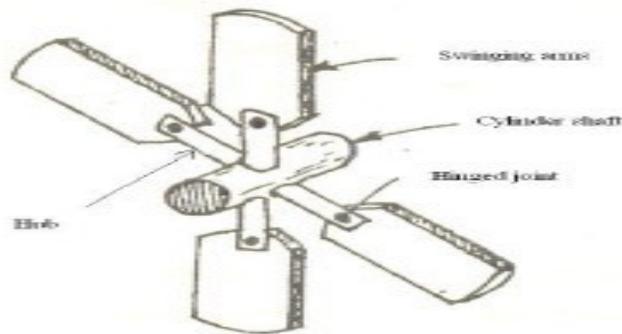
Rasp bar cylinder

Fig. 22. Hammer mill cylinder

The bundle of paddy straw with ear heads is delivered into the feeding chute. Removal of seeds from the grain heads is done by rotating cylinders, whose threshing action depends primarily upon impact, when slow moving material comes in contact with high speed cylinder, the heads or pods are shattered and grains are fed from the straw.

Removal of seeds from the grain heads is done by rotating cylinders, whose threshing action depends primarily upon impact, when a slow moving material comes in contact with the high speed cylinder, the heads or pods are shattered and grains are feed from the straw.

Procedure:

➢ The bundle of paddy straw with ear heads is delivered into the feeding chute.

➢ The straw is taken in the threshing drum and undergoes impact, rubbing and stripping through these operations, paddy grains separated from the straw.

➢ The empty straw is conveyed through the feeding drum towards the straw walker is delivered.

➢ The grain pass through the sieve box and partly cleaned.

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➤ The chaff and light weight impurities are blown off by the blast of air and the grains pass to the sieve.

➤ In the sieve, good grains pass through the sieve and larger impurities retain on the sieve.

➤ The cleaned paddy grains and larger impurities are collected separately.

➤ The air flow rate is adjusted by closing or opening the air inlet of the blower for effective cleaning.

Observation:

Calculation

Tabulation:

Threshing efficiency:

S.No.	Wt. of Paddy Panicle (kg)	% weight of Paddy grains	Wt. of Paddy husk (kg)	Threshing efficiency (%)

Result:

The threshing efficiency of paddy thresher is

The percentage of broken using the paddy thresher is

5. DETERMINING THE EFFICIENCY AND TESTING OF GROUNDNUT DECORTICATOR

Aim:

 To determine the shelling efficiency of groundnut decorticator

Apparatus required:

- Groundnut decorticator
- Sample,
- Weighing balance,
- Trays

Description:

Groundnut Decorticator

Groundnut decorticators are used for removing kernels from groundnut pods. Groundnut decorticators are classified as manually operated and power operated shellers. Based on the shelling action they can be divided into reciprocating type or rotary type. A hand operated groundnut decorticator was evaluated and the shelling efficiency was found. The hand operated groundnut decorticator will be of reciprocating type usually. But the hand operated groundnut decorticator was designed as rotary type and the shelling efficiency as well as the performance of the hand operated groundnut decorticator was studied.

Procedure:

- Take completely dried, unshelled groundnut sample. Weigh it in a weighing balance.
- Drop at the inlet of groundnut decorticator, while the lever is rotated.
- The kernels get separated out of the shells and collected at the bottom.
- Now using a separator the kernels are separated from the shells (trash).
- Weigh the kernels and shells (trash) separately.
- Using a sieve, the mechanically broken kernels are separated from the good kernels and are weighed separately.

- Using the formula, the shelling efficiency and the percentage of brokens are calculated.

Description:

Maize sheller

} The cylinder-type sheller consists of a cylinder with lugs, concave assembly and a blower unit.

} Spiral ribs are provided in the cylinder for smooth movement of cobs.

} Cobs are fed in between cylinder and concave and kernels are removed by the action of lugs.

} Blower cleans the lighter materials and small pieces of cobs and clean grain is collected.

} The 5-10 hp electric motor or tractor can operate the machine.

} It can give output of 5-15 q/h depending upon the size of power sources and machine.

Procedure:

- Take completely dried, unshelled maize cob sample. Weigh it in a weighing balance.
- Drop at the inlet of maize sheller, while the lever is rotated.
- The kernels get separated out of the cobs and collected at the bottom.
- Now using a separator the kernels are separated from the cob (trash).
- Weigh the kernels and cob (trash) separately.
- Using a sieve, the mechanically broken kernels are separated from the good kernels and are weighed separately.
- Using the formula, the shelling efficiency and the percentage of brokens are calculated.

Formula:

$$\text{Shelling efficiency} \quad = \frac{\text{Wt.of kernels} - \text{Wt.of unshelled kernels}}{\%\ \text{Wt.of kernels}} \times 100$$

$$\text{Percentage of broken} = \frac{\text{Wt.of broken kernels}}{\text{Total weight of kernels}} \times 100$$

Calculation

Tabulation:

Shelling efficiency:

S.No.	Wt. of kernels (kg)	% weight of kernels	Wt. of unshelled kernels (kg)	Shelling efficiency (%)

Percentage of broken:

S. No.	Wt. of broken kernels (kg)	Total weight of kernels (kg)	% of brokens (%)

Result:

1. The shelling efficiency of groundnut decorticator is   =

2. The percentage of broken using the groundnut decorticator is   =

6. DETERMINING THE EFFICIENCY OF MAIZE SHELLER

Aim:

To determine the shelling efficiency of maize sheller

Apparatus required:

- Maize sheller
- Sample,
- Weighing balance,
- Trays

Description:

Maize sheller

} The cylinder-type sheller consists of a cylinder with lugs, concave assembly and a blower unit.

} Spiral ribs are provided in the cylinder for smooth movement of cobs.

} Cobs are fed in between cylinder and concave and kernels are removed by the action of lugs.

} Blower cleans the lighter materials and small pieces of cobs and clean grain is collected.

} The 5-10 hp electric motor or tractor can operate the machine.

} It can give output of 5-15 q/h depending upon the size of power sources and machine.

Procedure:

- Take completely dried, unshelled maize cob sample. Weigh it in a weighing balance.
- Drop at the inlet of maize sheller, while the lever is rotated.
- The kernels get separated out of the cobs and collected at the bottom.
- Now using a separator the kernels are separated from the cob (trash).
- Weigh the kernels and cob (trash) separately.
- Using a sieve, the mechanically broken kernels are separated from the good kernels and are weighed separately.

- Using the formula, the shelling efficiency and the percentage of brokens are calculated.

Formula:

$$\text{Shelling efficiency} \quad = \frac{\text{Wt.of kernels} - \text{Wt.of unshelled kernels}}{\% \text{ Wt.of kernels}} \text{x } 100$$

$$\text{Percentage of broken} \ = \frac{\text{Wt.of broken kernels}}{\text{Total weight of kernels}} \text{x } 100$$

Calculation

Tabulation:

Shelling efficiency:

S.No.	Wt. of kernels (kg)	% weight of kernels	Wt. of unshelled kernels (kg)	Shelling efficiency (%)

Percentage of broken:

S. No.	Wt. of broken kernels (kg)	Total weight of kernels (kg)	% of brokens (%)

Result:

1. The shelling efficiency of maize sheller is

2. The percentage of broken using the maize sheller is

7. EVALUATION OF THIN LAYER DRYER

Aim:

To study the drying characteristics of seed.

Apparatus required:

- Drying trays,

- Hot air oven,

- Thin layer dryer,

- Sample to be dried,

- Fan,

- Diffuser,

- Heater,

- Bucket,

- Drying chamber,

- Humidity control unit,

- Temperature control unit,

- Variator

Principle of Thin layer drying

- Process in which all grains are fully exposed to the drying air under constant drying conditions i.e. at constant air temperature & humidity.

- Up to 20 cm thickness of grain bed is taken as thin layer

- All commercial dryers are designed based on thin layer drying principles

- Represented by Newton's law by replacing moisture content in place of temperature
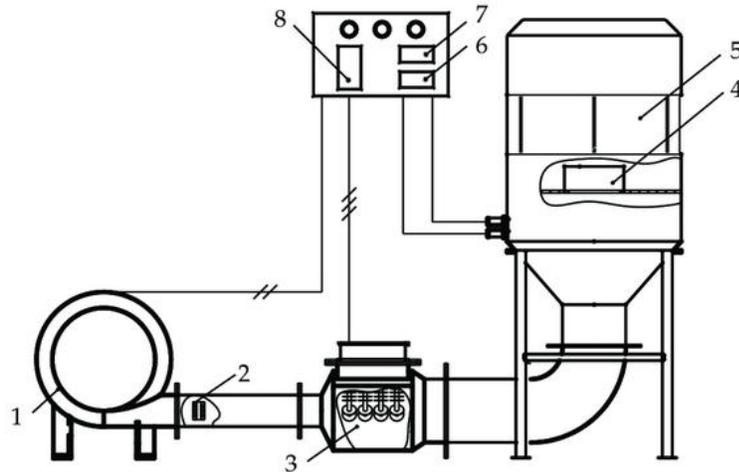
$$M\text{-}Me/Mo\text{-}Me = e^{-Kq}$$

M – Moisture content at any time q, % db

Me- EMC, %db

Mo – Initial moisture content, %db

K – drying constant

q - time, hour

Schematic view of Thin Layer Dryer

Procedure:

- Take the sample to be dried and weigh it.
- Spread it as a thin layer, over the drying tray provided.
- Keep it in the hot air oven for 1hour at a temperature of $105\pm2^{\circ}C$
- Weigh the sample. Repeat the process until the weight remains unchanged.
- Determine the velocity of air in the hot air oven.
- In a graph, plot the changes in moisture ratios with time for different drying air temperatures
- In a graph, plot the experimental drying rate at different drying temperatures under each air velocity.
- In a graph, plot the experimental drying rate at different air velocities under each drying temperature.

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Observation:

Sample	Trial	Drying Time (t)	Average ambient temperature (T) ^0C,	Average relative humidity (H) %,	Weight of the sample (g)
	1				
	2				
	3				

Result:

Hence the thin layer dryer is evaluated.

8. EVALUATION OF L.S.U. DRIER

Aim:

To evaluate the Louisiana State University drier by parboiled paddy.

Apparatus Required:

- Boiler
- Blower and Heat exchanger
- Paddy samples
- L.S.U. Dryer

Procedure:

- The parboiled paddy with initial moisture content of 33 % (w_b) is fed to the dryer chamber.
- The forced air at normal temperature is passed through the drying chamber to evaporate the water content (if any) for about half an hour.
- The steam supplied by boiler is passed through heat exchanger and forced air is flown across the heat exchanger to get heated.
- The hot air is supplied to the dryer through duct at 800^0C (constant). The temperature of the hot air is maintained by changing the opening of steam outlet valve manually.
- The heated air is blown through drying chamber continuously, to evaporate the moisture content of the paddy. Since the moisture removal is the very slow process, the recirculation of paddy is done for maintaining the uniform moisture content in the bulk paddy.
- The moisture content measured in the interval of every half an hour in the initial stage and after every 15 minutes in the later stages.
- This process is continued till the paddy attends the desired moisture level (13- 13.5 %).

Observation

Sample	Trial	Average ambient temperature (T) ^0C,	Average relative humidity (H) %,	Drying time min.
Thick size paddy	1			
	2			
	3			
Medium size paddy	1			
	2			
	3			

Result:

The drying time for different samples = _____ minute

9. DETERMINING THE EFFICIENCY OF BUCKET ELEVATOR & SCREW CONVEYOR

Aim:

To determine the efficiency of bucket elevator and screw conveyor.

Apparatus required:

- Sample
- Weighing balance
- Bucket elevator,
- Screw Conveyor,
- Stop watch,
- Tachometer

Description:

Bucket Elevator:

A bucket elevator, also called a Seed leg, is a mechanism for hauling flow able bulk materials (most often Seed or fertilizer) vertically. The positive discharge bucket elevator is a type of centrifugal bucket elevator. Positive discharge elevators are used for materials that tend to stick to buckets, which prevent the material from being discharged by a centrifugal bucket elevator. These elevators rotate slowly, approx. In Seed trade, the term Seed elevator also describes a tower containing a bucket elevator or a pneumatic conveyor, which scoops up Seed from a lower level and deposits it in a silo or other storage facility. It may also mean organizations that operate or control several individual elevators, in different locations.

Screw conveyor:

A screw conveyor or auger conveyor is a mechanism that uses a rotating helical screw blade, called a "flighting", usually within a tube, to move liquid or granular materials. They are used in many bulk handling industries. The rate of volume transferred is proportional to the rotation rate of the shaft. Horizontal screw conveyors are the most widely used type of screw conveyor. Used to convey bulk materials from one part of a process to another, horizontal screw conveyors are available in a wide range of sizes, lengths, configurations and materials of construction.

Screw conveyors are typically designed to convey bulk materials at 15, 30 or 45-percent trough loading, depending upon material characteristics of the specific bulk material. As a general rule, trough loading of 45-percent can be used for light, free-flowing and non-abrasive bulk materials. Trough loadings of 15 and 30-percent are typically used for denser, sluggish and more abrasive bulk materials. Loss in efficiency can also be overcome by increasing the speed or the diameter of the screw conveyor. Additional horsepower is required to overcome gravity and bulk material fall back. Incline between 30 and 45 Degrees – Loss in conveying efficiency is typically between 30 and 90 percent on inclines up to 45 degrees.

Formula used:

Efficiency, $\eta = \dfrac{\text{Output}}{\text{Input}} \times 100 \%$

Procedure:

- Take a known sample to be conveyed / handled and weigh it.
- Switch the power on for the bucket elevator/ screw conveyor, the sample to be conveyed passes through the conveyor and it is collected at the outlet.
- The speed of the conveyor is measured using tachometer by placing it at the end of the shaft.
- Now the sample collected at the outlet is weighed and the efficiency is calculated.
- If the efficiency is below par, the speed can be either increased or decreased, to get a better efficiency.

Calculation:

Result:

The Efficiency of

1) Bucket Elevator is   =   %

2) Screw Conveyor is   =   %

10. EVALUATION OF SHELLING EFFICIENCY OF RUBBER ROLL SHELLER

Aim:

To determine the shelling efficiency of a rubber roll sheller

Apparatus required:

- Paddy sample,
- Rubber roll sheller,
- Weighing balance.

Description:

Working Principle of Rubber Roll Sheller:

The rubber roller sheller is the most efficient shelling machine. As the name suggest two Rubber Rollers of the same diameter are operated at different speeds to remove the husk from the paddy. One roller has a fixed position and the other is adjustable to meet the desired clearance. The adjustable roller rotates slightly slower than the fixed roller. Rubber-roll shellers have an aspirator in the base of the machine to separate the hulls from the brown rice.

General guidelines to get optimum life and performance of Rubber Rollers

- Paddy should be at 14% moisture content.
- Before starting the husker, check the alignment of the rubber rolls. Remove any grain present between the roll.
- Adjust the clearance to nearly 0.5 mm (or) the rolls should be just touching each other.
- Immediately after starting the machine check the hulling efficiency checked. If the hulling efficiency is less than 90% decrease the clearance until the hulling efficiency is about 90-95%. The rolls are not locked in this position.
- In operation the feed gate above the rollers must be fully opened so that the rollers will wear out uniformly.
- Check hulling efficiency at regular intervals as the rubber rolls wear.
- Before stopping the machine, close the feed gate completely and clear the rolls of paddy.

- The roller's axis must be in perfect line with then of hub and shaft.
- The roller surfaces must be aligned and must be keep equal distance whilst rotating. While changing the rolls, the bigger roll should always be mounted to the fast moving shaft.
- Spare rolls must be kept in dark room and if possible should be packed well to protect them from light and sudden changes in temperature.
- Unevenly worn rolls must be carefully lathed on a lathe machine and the surfaces made uniform and smooth.
- The huller should be cleaned after every day of operation.
- The side baffle plates on each side of the rubber rolls should be checked each day to see that there is no leakage of paddy between the plate and the rubber roll surfaces.
- Whenever rubber rolls are replaced, it should be ensured that their end faces are in line.
- The cover plates of the cooling chamber inside the rubber roll housing should be removed once a week and cleaned thoroughly.
- The huller should not be run with the rolls engaged without feed on the huller.
- When turned off there should be no grains between the rollers because they would deform the rubber.

Procedure:

- Take the paddy sample and weigh it.
- The sample is input inside the feed hopper.
- At the shelling unit, there will be a fixed roll, and the sample passes in between another rotating rubber roll, where the sample gets shelled and will be separated by air from the aspirator.
- The chaff will be collected at an outlet as well as the rice grains will be collected at another outlet.
- By weighing the chaff and the rice grain obtained, the shelling efficiency of the rubber roll sheller can be calculated.

Result:

The Shelling efficiency of the rubber roll sheller is found to be =

11. DETERMINING THE OIL CONTENT OF OIL SEEDS

Aim:

To study the performance of the mini oil expeller.

Apparatus required:

- Mini oil expeller,
- Measuring cylinder (25ml),
- Oil seed sample,
- Weighing balance

Formula used:

i. Quantity of oil extracted, EQ (kg) = mass of container and oil – mass of the container

ii. Extraction rate, Er (kg/s) = $\dfrac{massofoil}{pressingduration}$

iii. Extraction Efficiency, Ee %= [{$\dfrac{\text{mass of oil}}{\text{Percentage oil content of seed}}$x100}x 100]

iv. Machine throughput Capacity, C (kg/s) = $\dfrac{\text{mass of paste}}{\text{pressing duration}}$

The energy consumption for extraction per kilogram of oil was calculated by considering the power consumed by the machine. The electric current consumed by the machine during the extraction operation was measured by clip-on ampere meter (KYORITSU, Model 2608A). The line voltage was assumed as 440 V, and the power consumed by the machine was calculated using following equation.

P=VI

Where, P is the power (W),

V is the voltage (V),

I is the ampere (A).

Description:

The oil expeller comprises of feed hopper for the input of feed (oil seed). There is a screw press located perpendicular to the feed hopper, where the feed gets pressed and squeezed for the oil to be extracted at the oil outlet hole. The paste or the meal comes out through the nozzle provided as an extruded product. A heating element is attached with the screw press unit for the efficient oil production.

Drilled holes oil drain system.
Nozzle type choke system.
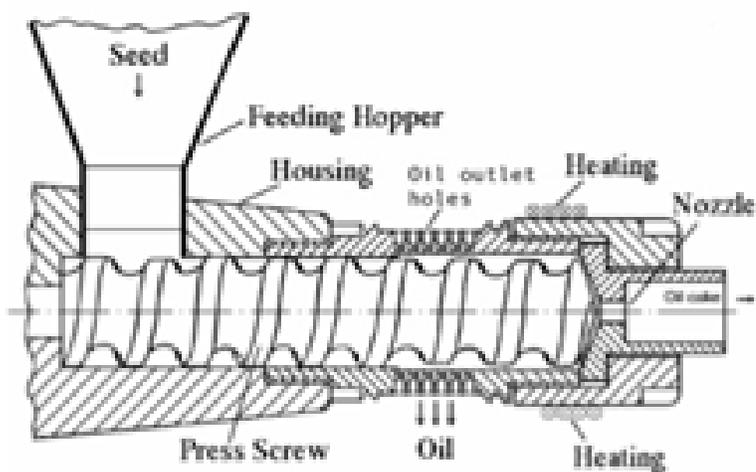
Procedure:

- Weigh the given oil seed sample (W).
- Now drop the oil seed in the feed hopper after switching the machine on.
- While dropping the feed, simultaneously switch on the heater switch, so that the extraction unit gets heated, for efficient oil extraction.
- Now measure the amount of oil that is extracted.
- Also weigh the oil as well as the meal extracted

Calculation:

i. Quantity of oil extracted, EQ (kg) = mass of container and oil − mass of the container

ii. Extraction rate, Er (kg/s) $= \dfrac{mass\,of\,oil}{pressing\,duration}$

iii. Extraction Efficiency, Ee % $= [\{\dfrac{mass\ of\ oil}{Percentage\ oil\ content\ of\ seed}x100\}x\ 100]$

iv. Machine throughput Capacity, C (kg/s) $= \dfrac{mass\ of\ paste}{pressing\ duration}$

Result:

1.   Quantity of oil extracted, EQ (kg)   is   =

2.   Extraction rate, Er (kg/s)   is   =

3.   Extraction Efficiency, Ee %   is   =

4.   Machine throughput Capacity, C (kg/s)   is   =