

LEARNING FACILITATING MATERIALS

NATIONAL CERTIFICATE LEVEL 1

TRADE AREA: **CASHEW PROCESSING**

UNIT 8

RAW CASHEW NUT PROCESSING MACHINE OPERATION AND MAINTENANCE



Source: Gayathri Industries; cashewmachines.com

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UNIT INTRODUCTION

Welcome to Unit 8 of your learning journey in cashew nut processing. This guide explains the main steps involved in operating and properly maintaining machines in processing Raw Cashew Nuts.

As a general principle, the right handling and maintenance of Raw Cashew Nut processing machines has a lot of benefits. Can you remember a few from the previous unit?

If you follow the steps for operating and maintaining Raw Cashew Nut processing machines, you will not only be efficient in producing high-quality cashew kernels, but also ensure your safety in using them. Do not miss a step! Apply your knowledge and skills accurately to achieve a safe product for the final consumer and a safe working experience for yourself.



In this unit, you will learn about the main steps involved in the operation and maintenance of some machines in the processing of raw cashew nuts. The learning material covers four sub-units:

- 1) Demonstrate skills for operating Calibrator in RCN processing.
- 2) Demonstrate skills for operating Pre-treatment Equipment in RCN processing.
- 3) Demonstrate skills for operating Shelling Machine in RCN processing.
- 4) Demonstrate skills for operating Shell and Kernel Separator in RCN processing

Each unit contains theoretical and practical exercises. Each module includes written materials, visuals as well as self-assessments to test your knowledge and skills.

The benefit of learning this information is to ensure safe and efficient use of raw cashew nut processing machines and assure continuous production of high-quality cashew kernel. Remember that the meticulous application of knowledge and skills from this unit impacts your personal safety and the quality of your final product.

Take note: the right use and maintenance of your raw cashew nut processing machine, the longer it will last for your use, the better the chance that it will remain efficient in your process, and the greater it will impact positively on your final product. Ultimately, if you produce good quality, your customers will always buy from you which will ensure you remain profitable!

Even though, this learning material provides essential information on operating and maintaining raw cashew nut processing machines, for the National Certificate Level 1, you should also look out for new information, innovations and technological advances during your practical work that expand your knowledge and skills.

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ICONS



LEARNING
OBJECTIVES



ATTENTION



PRACTICALS
HANDS ON



SELF
ASSESSMENT



WELL DONE!



TAKE A BREAK!

ABBREVIATIONS

Here are some commonly used abbreviations.

SOP	Standard Operating Procedure
PPE	Personal Protective Equipment
GMP	Good Manufacturing Practices
RCN	Raw Cashew Nuts
PM	Preventive Maintenance
VFD	Variable Frequency Drive

1. DEMONSTRATE SKILLS FOR OPERATING CALIBRATOR IN RAW CASHEW NUT PROCESSING

a) Identify the parts of raw cashew nut calibrator

The raw cashew nut calibrator is simply a device that is used to remove foreign materials and divides the nuts into different grades by size. Calibrators will usually grade nuts into three, four, five or eight different sizes depending on their design. For example, nuts can be graded into different sizes of 18mm, 20mm, 22mm and 24mm.



Figure 8.1. Mechanized Calibrator – Rotating Cylinder Screens.

Source : <http://www.mekongmachine.com/product/raw-cashew-cleaning-calibration-machine/>



Figure 8.2. RCN Calibrator – Vibratory Sieves.

Source : <https://dir.indiamart.com/impcat/cashew-sizing-machine.html>

Major parts of a RCN Calibrator:

For the proper and easy use of a machine, operators must be able to identify and understand the purpose of the various parts of the machine.

From Figure 8.1 and 8.2 above, the major parts of a RCN Calibrator are as follows:

1. **Main machine frame:** structure that supports other components of machine
2. **Hopper:** Container that receives RCN into Rotating Cylinder.
3. **Rotating Cylinder:** Main cylindrical structure with holes (perforations) and has a gentle slope (towards the end opposite the hopper) and has screens of different sizes used for grading of RCN.
4. **Chute:** sloping channel slide for transporting graded RCN from rotating cylinder into designated receiver.
5. **Hand Wheel:** attached to cylinder for manual rotation of cylinder. In figure 8.1, this is located to the end of the rotating cylinder as shown by the arrow A.
6. **Drive motor, belt and pulley:** this is for driving mechanised calibrators.



For mechanised calibrators, Variable Frequency Drives (VFDs) are usually available to start the motor and also control speed of rotation to achieve desired rotation for proper grading.

b) Explain the Working Principle of RCN Calibrator

All machines make use of certain mechanisms in order to achieve their purpose. Therefore, the parts of the machine work together in a certain order to achieve that purpose.

Knowing and understanding the working principle of the RCN Calibrator will help operators and technicians to properly use and maintain it.



Think carefully about the above statement. Do you agree with it?

The working principle of the rotating RCN Calibrator is as follows:

- The rotation of a Cylinder with different screens of different hole sizes results in agitation of the RCN leading to the removal of foreign matter. This allows nuts of different sizes to fall through permitting screens. Nuts are thus segregated and collected separately.
- In the rotating cylinder calibrator, speed of rotation must be just enough to allow the nuts to fall through without being stuck to the sides of the rotating cylinder. This also allows for the right force of agitation to enhance grading.
- Vibratory sieves calibrators also work on the agitation of nuts principle except that the mechanism used to achieve this is through vibration of the sieves. In both instances, the activity is to cause agitation or shaking of the RCN (as in a winnowing activity), but the ways of achieving this (agitation) vary.



Can you identify other differences between the two machines in figures 8.1 and 8.2?

c) Explain Product Requirements after calibration

Calibration is also called size grading and pre-cleaning of the RCN. As explained in the preceding section, dried RCN is separated as per nut sizes and impurities like dust, plant stalks, mud/stones etc. are removed. The products that is obtained after this process is essentially clean and graded RCN. Graded in the sense that nuts of about the same sizes are grouped together.

Calibration is very useful as it ensures easy shelling by both people and machines. Sizing of RCN improves the efficient utilization of shelling machine and enhances the manual cutting/shelling rate also. This means that it helps to reduce waste and ensures that more RCN is shelled successfully at the shelling stage.

d) Operate raw cashew nut calibrator



In the previous unit, some reasons were given for why it is important to pay attention to the steps given on how to properly use a machine. Can you think of two reasons why this will also be important for the calibrator?

A typical step-by-step process involved in operating and properly using RCN calibrator is as follows:

1. Pour RCN into machine hopper.
2. For mechanised machines, press start (green) button on the VFD to start motor ensuring that it is at the lowest speed. If manual, turn attached hand wheel.
3. Turn VFD knob clockwise to increase speed of rotation to desired level.
4. As required, pour more RCN into hopper with machine running.



Practical Exercise: Go to a Calibrator and follow the steps given to operate it.

Use the checklist and follow the stated steps in operating an RCN calibrator. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Steps for operating the RCN Calibrator	Rate
1. Pour RCN into machine hopper	
2. For mechanised machines, press start (green) button on the VFD to start motor ensuring that it is at the lowest speed. If manual, turn attached hand wheel	
3. Turn VFD knob clockwise to increase speed of rotation to desired level.	
4. As required, pour more RCN into hopper with machine running until you have completed the batch	

e) Maintain raw cashew nut calibrator



From the previous unit, can you remember the advantages that good maintenance practices will have on your machine, users and final product? What should be the attitude of maintenance technicians and operators with regards to machine manuals and preparation for maintenance.

In maintaining the Calibrator, the following steps are considered:

Daily PM Activities

1. Before operating, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners
2. Manually turn rotating cylinder and clean screens by brushing to remove debris after each production day
3. Clean hopper and chutes after each production day.

Weekly PM Activities

1. Check drive belt to ensure tension is good, where necessary
2. Manually turn rotating cylinder in alternating sequence of clockwise and anticlockwise directions to ensure that it can move freely. Pay attention to unusual and squeaky sounds; lubricate pulleys

Monthly PM Activities

1. Look out for rusting parts (main structure, joints) and paint.



It is always important to remember and have in mind that maintenance activities are carried out while the machine is in good working condition, so that it does not break down unexpectedly or impact the quality of kernel negatively. What are such maintenance activities called?



Practical Exercise: Go to a factory and go through the needed steps for a calibrator maintenance.

Use the checklist and follow the stated steps in maintaining an RCN calibrator. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Daily Preventive Maintenance (PM) Activities	Rate
4. Before operating, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners.	
5. Manually turn rotating cylinder and clean screens by brushing to remove debris after each production day.	
6. Clean hopper and chutes after each production day.	
Weekly PM Activities	Rate
1. Check drive belt to ensure tension is good, where necessary.	
2. Manually turn rotating cylinder in alternating sequence of clockwise and anticlockwise directions to ensure that it can move freely. Pay attention to unusual and squeaky sounds; lubricate pulleys.	
Monthly PM Activities	Rate
1. Look out for rusting parts (main structure, joints) and paint.	



SELF ASSESSMENT

1. Outline the working principle of a RCN Calibrator.

2. State the steps involved in maintaining an RCN Calibrator

3. Outline the step by step process involved in operating an RCN Calibrator.



Well done! You have completed the first set of questions. This is very encouraging. Let's move on to the next section.

2. DEMONSTRATE SKILLS FOR OPERATING PRE-TREATMENT EQUIPMENT IN RAW CASHEW NUT PROCESSING

a) Identify parts of an RCN processing Pre-treatment Equipment

Cooking of RCN represents the early stage of RCN processing. This activity helps in softening the outer cashew shell so that cutting or shelling can be done easily.

In-shell nuts are steamed in batches usually 320kgs with pressures ranging between 0.75 – 1bar for periods ranging from 25-35 minutes to make the nuts easier to cut and to reduce breakage of nuts.

Bar is unit of pressure. Its symbol is *bar*. Other units of pressure include Pascal (*Pa*), Standard atmosphere (*atm*), Pond per square inch (*psi*), kilogram per Square Centimeter (*kg/cm²*). Certain charts and mathematical equations are available to help convert one unit to another.



Figure 8.3. Steam Cooker and Boiler

Source: <http://www.equestplast.com/images/BOILER.jpg>

Major parts of a Steam Cooker:



Do you remember why it is important for users of any machine or equipment to be able to identify and understand the use of the various parts?

The major parts of a Steam Cooker are as follows:

1. **Steam Lines:** Pipes through which steam passes into the steam Cooker.
2. **Furnace:** Internal enclosure of steam generator where fuel is burned to very high temperatures. This will usually have a mechanised blower (controlled by motor) installed.
3. **Pressure Relief Valve:** Safety device that limits the pressure of steam generated by opening to discharge excess pressure.
4. **Manhole:** Covered openings into steam cooker and generator.
5. **Raw water lines:** Pipe lines for transferring water into steam generator/boiler.
6. **Hand Valves:** Devices that control the flow of water and steam.
7. **Steam Cooker:** The structure inside which RCN are admitted to be cooked with steam
8. **Boiler:** The main structure that boils liquid water and converts it into steam
9. **Gauges:** Instruments that show pressure generated and supplied to steam cooker and the temperature in steam cooker.

b) Explain the working principle of raw cashew nut pre-treatment equipment

The steam Cooker is made up of a Steam Generation Section (boiler) and the steaming/cooking section. The boiler burns fuel to generate hot water to generate steam which is supplied at a specified pressure into a steaming chamber of the cooker to cook RCN for a specified period of time. Cooking makes the outer shell of the RCN easier to cut, to reduce breakage and to protect workers hands.

The right cooking will stick the viscous CNSL liquid in the fibrous structure of the shell so that it will not flow out while cutting, reducing exposure of workers' hands. Finally, steaming can cause an osmosis process in the kernel, pushing and expanding the peel and facilitating the removal in later stages.

The cooking process flow consists of two steps: The raw nuts are first cooked with steam to soften the shells. After cooking, they are naturally cooled in order to make the shell brittle.

c) Explain Product Requirement after Pre-Treatment

After steam cooking, steamed RCN is cooled down at room temperature for usually between 18-24 hours. The main objective of cooking RCN is to get the RCN outer shell soft and easier to cut at the shelling section to reduce kernel breakage. It is always important to follow the steps and the specified number of minutes or hours for cooking and cooling to attain the required RCN quality for the next section.

d) Operate RCN pre-treatment Equipment



Paying attention to the steps given on how to properly use a RCN Steam cooker will ensure it is safe for use and assure quality of end product for the next section. Can you give another good reason?

A typical step-by-step process involved in operating and properly using a RCN Steam Cooker is as follows:

1. Fill water chamber of steam generator.
2. Ensure fuel is available in furnace, then start fire and turn on blower.
3. Fill steam cooker with required quantity of RCN through its manhole and ensure manhole is properly closed up.
4. Build up steam to 4bar (8-10kg/cm²) on pressure gauge.(depends upon the capacity of te boiler).
5. After 10-12 minutes when steam starts coming out through the bottom exit, start counting minutes
6. Open steam supply valve to the steam cooker ensuring that the supply line pressure gauge is within the specified pressure range (0.7 – 1bar).
7. Continue supply of steam to steam cooker for specified amount of time.
8. Close steam supply valve to chamber.
9. Open manhole and take out trays to retrieve cooked RCN for cooling
10. This process repeats again & again for desired quantity.

The entire process takes about 20 to 25 minutes

Follow these guidelines for proper cooling:

- Cool the nuts naturally by spreading them out on the drying floor in the shade.
- Leave them until they are cooled.
- This takes 12 – 24 hours



The best performance steaming is at high pressure and at reduced time, the pressurized steam has a very high temperature which gives a thermal shock to the shell, making it brittle and volatilizing CNSL so that it sticks to the shell.



- Make sure to have continuous burning of the fuel during steaming in order to maintain the steam pressure in the boiler at least 3 kg /cm².
- Control the water level in the boiler.
- Control maximum & minimum steam pressure in the boiler.



- Liberate steam after use in the empty cooker to wash it & to avoid condensation of steam in the steam chamber.
- Make sure that there is no water left in the steam chamber when restarting the process.



Practical Exercise: Operate Steam Cooker.

Use the checklist and follow the stated steps in operating a steam cooker. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Steps for operating the RCN Calibrator	Rate
1. Fill water chamber of steam generator	
2. Ensure fuel is available in furnace, then start fire and turn on blower	
3. Fill steam cooker with required quantity of RCN through its manhole and ensure manhole is properly closed up	
4. Build up steam to 4bar on pressure gauge	
5. Open steam supply valve to the steam cooker ensuring that the supply line pressure gauge is within the specified pressure range (0.7 – 1bar).	
6. Continue supply of steam to steam cooker for specified amount of time.	
7. Close steam supply valve to chamber	
8. Open manhole and take out trays to retrieve cooked RCN	

e) Maintain RCN pre-treatment Equipment



An important notice with this machine is that because it works with high temperatures and pressures, technicians must ensure that it cools down well enough before working on it. Basic PPEs like hand gloves, overalls and hairnets must be worn.

Below are the key maintenance steps

Daily PM Activities

- 1). Before operating, visually inspect whole equipment paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners
- 2). During operation look out for possible steam leakage and correct at cool down.

Weekly PM Activities

1. Clean furnace of soot and debris from burning fuel.
2. Clean inner chamber of steam cooker of debris and remains of RCN

Monthly PM Activities

1. Clean the chimney on a monthly basis for proper exit of the gases

Annual PM Activities

1. Comply with regulatory inspection. Invite the department of factories inspectorate to have your boiler checked and certified
2. Calibrate all gauges to ensure they are working well
3. Inspect furnace and carry out any repair works on



Inspection and certification of pressure equipment like the boiler is mandatory and regulated by law. Such inspections will certify your boiler to be safe for use and the certificate usually lasts for 12 months.



Practical Exercise: go to a factory and try out the steam cooker maintenance activities you have learned.

Use the checklist provided and follow the stated steps in maintaining RCN Steam Cooker. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Daily PM Activities	Rate
1. Before operating, visually inspect whole equipment paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners.	
2. During operation look out for possible steam leakage and correct at cool down.	
Weekly PM Activities	Rate
3. Clean furnace of soot and debris from burning fuel.	
4. Clean inner chamber of steam cooker of debris and remains of RCN	
Monthly PM Activities	
1. Clean the chimney on a monthly basis for proper exit of the gases	
Annual PM Activities	Rate
1. Comply with regulatory inspection. Invite the department of factories inspectorate to have your boiler checked and certified.	
2. Calibrate all gauges to ensure they are working well.	
3. Inspect furnace and carry out any repair works on it.	

There is so much you can accomplish when you decide to. Keep on working hard and thinking positively.



SELF ASSESSMENT

1. Outline the working principle of the RCN pre-treatment equipment.

2. State the steps involved in maintaining the RCN pre-treatment equipment making mention of safety precaution that are required.

3. Outline the step by step process involved in operating the RCN pre-treatment equipment safely.



*Congratulations! You have completed the second set of questions.
Let's move on to the next section.*



3. DEMONSTRATE SKILLS FOR OPERATING SHELLING MACHINE IN RAW CASHEW NUT PROCESSING

Two types of shelling machines exist today: manual as well as mechanised. Whether manual or mechanical the objective remains to extract the kernels out of the raw nuts and avoid breaking them.

Manual shelling consists of cutting the raw cashew nut and subsequently scooping out the kernel. The required amount of workers is substantial and a multiple of the number in mechanical shelling. Below (Figures 8.1 and 8.2), we shall take a look at the parts of the manual shelling machine:

a) Identify parts of a raw cashew nut shelling Machine

After cooking and cooling the RCN, the shell is removed. This process is called shelling or de-shelling. Machines are designed for this activity and have different operating mechanisms.

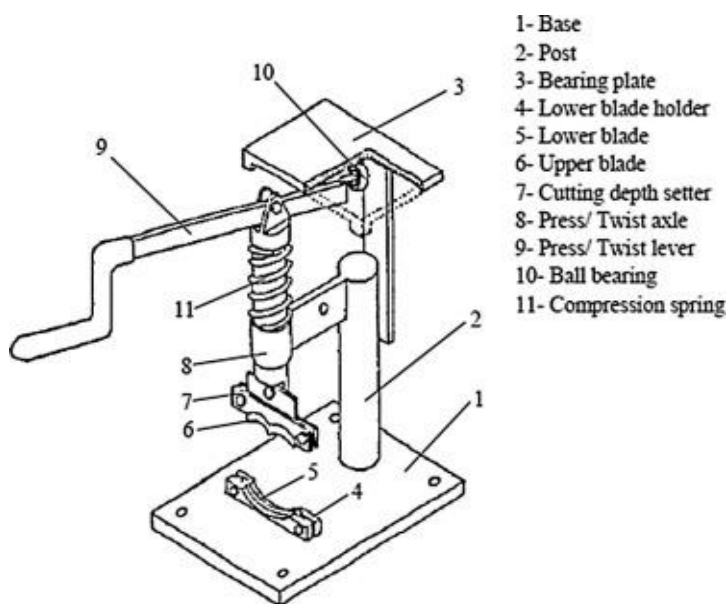


Figure 8.4. Schematic Drawing of a Hand Operated Cashew nut shelling machine.
 Source: <https://www.sciencedirect.com/science/article/pii/S1658077X17300036>

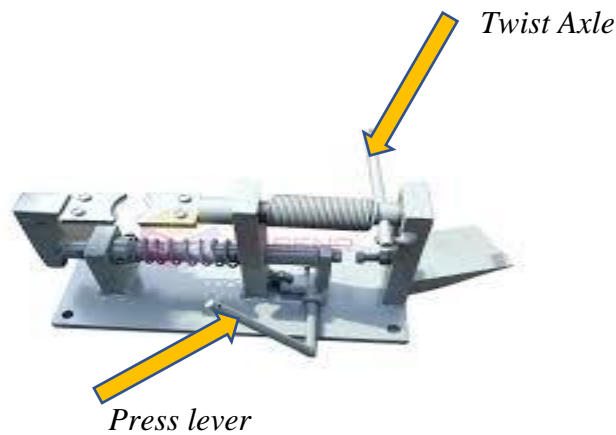


Figure 8.5. Hand-Operated Cashew Nut Shelling machine.
Source: <https://www.aosenr.com/aplus/sku/0717x/1.jpg>

Major parts of a manual Cashew Nut Shelling Machine:

The major parts of Hand Operated Filling machine from figures 8.4 & 8.5 are as follows:

1. **Base:** structure that supports other components of machine.
2. **Post:** metal structure set upright on base to support top portions of machine.
3. **Bearing plate:** supports the compression action of the press lever.
4. **Lower Blade Holder:** The cashew nut receptacle where nuts are positioned to be shelled.
5. **Lower blade:** flat cutting edge attached to the base which cuts into nut shell.
6. **Upper Blade:** flat cutting edge attached to the upper portion of hand lever which cuts into shell.
7. **Cutting Depth Setter:** Attached to upper cutting blade and adjusted to determine the depth of cut by blade into shell and also allows nuts of different sizes to be shelled by machine.
8. **Twist axle:** lever that is twisted to open up cracked/cut shell.
9. **Press lever:** lever depressed to move upper blade towards lower blade.
10. **Ball bearing:** rolling component that helps to give smooth movement of press lever horizontally and vertically.
11. **Compression Springs:** Elastic device that is connected to the press to return it to the rest position when it is released.

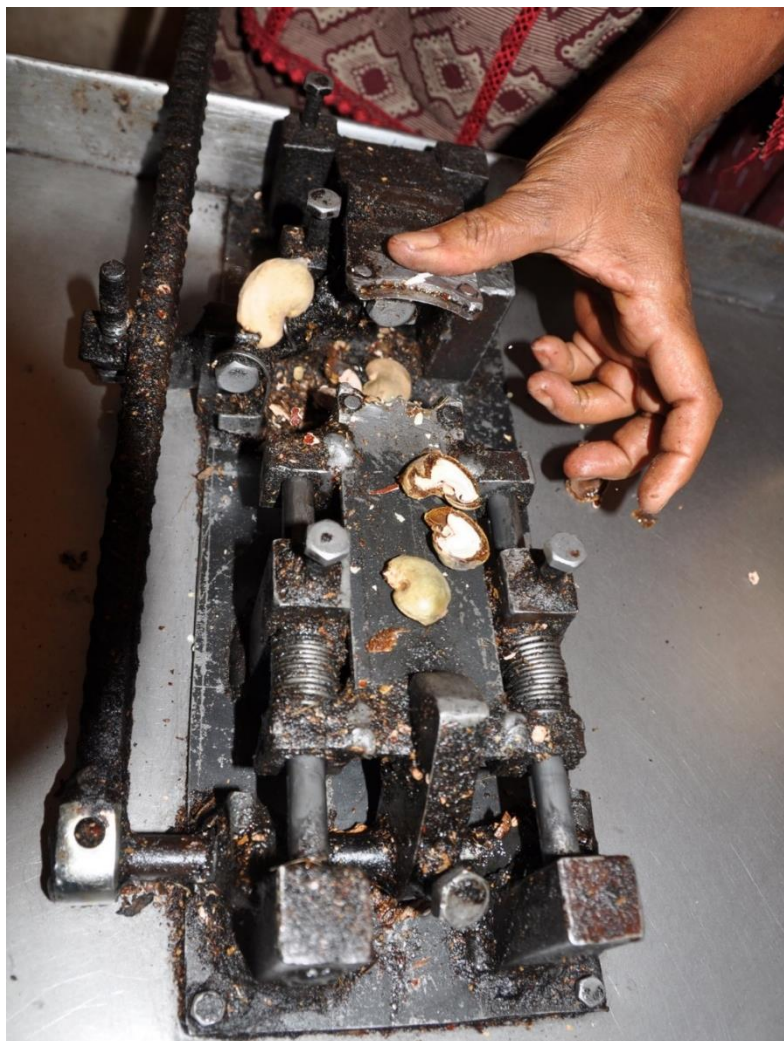
b) Explain the working principle of a Cashew Nut Shelling machine

The best performing shelling machines on the market work via cutting technology where the RCN are cut into two halves in order to separate them from the kernels. Kernels are then extracted via a vibrating platform, empty shells are sucked away by an aspirator function and unscooped and unshelled nuts are separated. Some shelling machines have an additional calibrating function separating wholes from pieces facilitating a separate oven treatment in the next step.

Reciprocating motion from depressing and release of the press forces the cutter against nuts cutting into the shell. With cut achieved, the twisting of the twist axle lever causes the cut shell to open up, releasing kernel. In figure 8.1, the twist action is done with the same lever for pressing down the blade. In figure 8.2, the twist action is achieved by a second lever. As noted in the previous sections, the principle is the same, the mechanism employed is different.



Look at figures 8.4 & 8.5 and notice the different ways by which both machines achieve the purpose of shelling.



*Figure 8.6: Manual de-shelling equipment
Source: GIZ/ComCashew*



Workers are required in the manual recovery and revision of shelling. Workers in scooping need a small knife and oil to protect their hands from CNSL exposure. Coconut oil is the most effective way to avoid CNSL contact with the skin and needs to be rubbed around the fingers every 10-15 minutes. A small bowl with oil should be on the table for every worker. Before putting them in the bowl workers should wipe off their hands with a tissue as CNSL on hands can contaminate the oil in the bowl.

c) Explain the product requirement after shelling

The desired goal for the shelling activity is to get whole kernels with minimum breakage. Experience and practise of operators over time will help improve their efficiency and rate of producing whole kernels from the shelling machine.



Constant use helps improve skills and ability of operating the shelling machine. Do think it is true for all machines?

Note Guidelines on Output:



- Output of the section depends on the kernel yield (average. 26% of the weight of the RCN)
- Minimum productivity at 35kg RCN per day per worker for combined cutting and scooping
 - Minimum productivity at 70kg RCN per day per worker for scooping only

d) Operate cashew nut shelling machine

A typical step-by-step process involved in operating and properly using a cashew nut shelling machine is as follows:

1. Set the depth of cutting into shell based on nut grade
2. Position nut with the "C" curve into the scrapper.
3. Hold press lever and push down so that the blade forces nut unto scrapper cutting through the shell.
4. Turn twist lever left and right until shell opens up to expose kernel.



- Make sure the cutting blades are correctly aligned to make a proper cut
- Make sure the cutting blades have the right gap between them for the grade to be cut



Practical Exercise: Go to a nut shelling section for some practical exercise.

Use the checklist and follow the stated steps in shelling cashew nut. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Step-by-step process in operating the manual shelling machine	Rate
1. Inspect your machine to ensure the blades is properly adjusted based on RCN size to be shelled, Set the depth of cutting into shell based on nut grade	
2. Position nut with the "C" curve into the scrapper	
3. Hold press lever and push down so that the blade forces nut unto scrapper cutting through the shell.	
4. Turn twist lever left and right until shell opens up to expose kernel.	
5. For kernels not coming out authomatically, use a scooping pin to gently remove it from the shell, ensuring tht it does not break	
6. Continue the cutting process until the entire RCN batch is shelled	

e) **Maintaining cashew nut shelling machine**

The maintenance activities of the shelling machine involves the following:

Daily PM Activities

1. Before operating the shelling machine, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, rust, loose fasteners (bolts, screws), joints, cutting blade and springs. Tighten all loose fasteners and change defective parts.
2. Ensure cutting area is clean. Machine must be cleaned after every production day
3. Inspect cutting blade and sharpen when blunt.

Weekly PM Activities

1. Oil fulcrum points of machine (this includes bearings and all points where machine levers turn).

Semi-Annual Activities

1. Pay attention to main structure and metal parts for rusts and paint required portions



Practical Exercise: Go to the shelling section and carry out maintenance activities on the shelling machine.

Use the checklist and follow the stated steps in maintaining cashew nut shelling machine. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Daily PM Activities	Rate
1. Before operating the shelling machine, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, rust, loose fasteners (bolts, screws), joints, cutting blade and springs. Tighten all loose fasteners and change defective parts.	
2. Ensure cutting area is clean. Machine must be cleaned after every production day.	
3. Inspect cutting blade and sharpen when blunt.	
Weekly PM Activities	Rate
1. Oil fulcrum points of machine (this includes bearings and all points where machine levers turn).	
Semi-annual PM Activities	Rate
1. Pay attention to main structure and metal parts for rusts and paint required portions.	
2. Inspect springs and tension them if weak.	

Keep on working hard. Take a break if you have to, but never give up.



SELF ASSESSMENT

1. Explain the working principle of cashew nut shelling machine and give steps for how to operate it.

2. What in your opinion is the most important maintenance activity carried out on the nut shelling machine?

3. Name the major parts of the shelling machine and explain their purpose.

4. Name the major parts of the shelling machine and explain how to maintain them.



You are making great progress! You have completed another set of questions. Take a break or go ahead and start with the next section.

4. DEMONSTRATE SKILLS FOR OPERATING SHELL AND KERNEL SEPARATOR IN RAW CASHEW NUT PROCESSING

a) Identify parts of a Shell and Kernel Separator

After manual cashew nut shelling, the kernel and shells form a mixture which is separated with the shells collected together for other uses such as fuel for burning. The cashew kernels are collected for peeling. Cashew nuts and shells can be separated by people or by machines. In this section, we focus on machines that separate the cashew nut and shell mixture. These can be mechanised or manually operated.

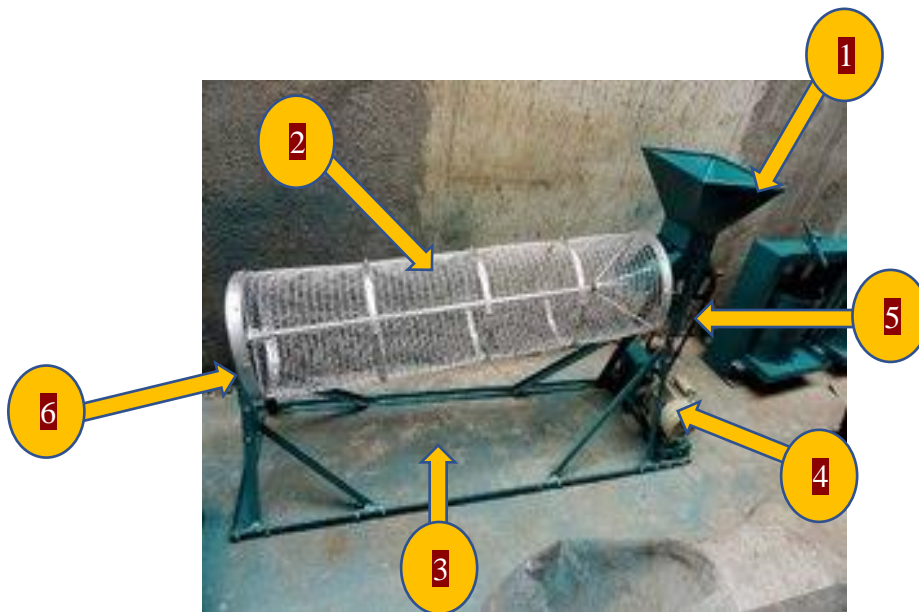


Figure 8.7. Mechanised Shell and Kernel Separator. Source: Google Search



Figure 8.8. Hand Operated Shell and Kernel Separator. Source: Google Search

Major parts of a Shell and Kernel Separator:

The major parts of Shell and Kernel Separator are as follows:

1. **Hopper:** Container that receives shell and kernel mixture and discharges them into the rotating sieve
2. **Rotating Sieve:** inclined cylindrical structure that has sppecific size screen and revolves for kernels to escape by falling through and allows shells to travel along to collection chute. The rotating sieve can be changed depending on the grade or size of kernels that come from the previous stage for separation.
3. **Kernel Collector:** tray-like structure that collects kernels falling through the rotating sieve.
4. **Motor:** Electric device that gives force for turning the rotating sieve. Manually operated machines come with a hand wheel for rotation. Mechanised ones will usually have VFDs for starting motors and controlling speed.
5. **Drive Belt:** connects motor to rotating sieve to cause sieve to rotate.
6. **Shell Collection chute:** sloping channel slide for transporting shells into desiganted containers.

Please see photo illustrations in Figures 8.7 and 8.8 above

b) Explain the working principle of Shell and Kernel Separator

The working principle of the shell and kernel separator is similar to that of the rotating RCN Calibrator. In this machine also, the rotation of a cylindrical structure which acts as sieve results in the separation of shell from kernels.

The action of rotation generates what is referred to as centrifugal force which moves the mixture away from the centre towards the sides of the rotating sieve. The speed of rotation is set just enough to allow the mixture to fall back to the bottom when it reaches the top of the rotating sieve without making a complete circle as shown in figure 8.9. This also allows for the right force of agitation to enable the mixture to loosen up well for easy separation.

So as the mixture moves from hopper end of the machine to kernel collection end, all the shells escape from the cylindrical screen while kernels are collected from the collection end of machine.

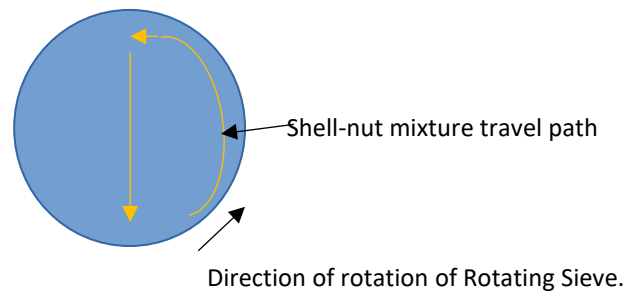


Figure 8.9. Schematic of how shell-nut mixture travels under centrifugal forces generated by set speed
Source: Illustration by Asa Addo-Danquah, 2019.



Do you notice the similarity between shell and nut separator and the RCN Calibrator? Similar to the RCN calibrator, vibratory screens can also be used.

c) Explain the product requirement after separation

The desired goal for the separation activity is to get whole kernels without any impurities or shell debris for the next stage of kernel peeling. Some sort of grading occurs at this stage as kernels that are collected depends on the screen size used. Broken kernels may fall through sieve together with whole ones.

d) Operate a Shell and Kernel separator

A typical step-by-step process involved in operating and properly using shell and kernel separator is as follows:

1. Ensure to fix the required screen size as per the grade of RCN from the shelling stage.
2. Pour the shell and kernel mixture into machine hopper.
3. For mechanised machines press start (green) button on the VFD to start motor ensuring that it is at the lowest speed. If hand manual, turn attached hand wheel.
4. Turn VFD knob to clockwise; while increasing speed of rotation to desired level.
5. As required continue to pour shell-kernel mixture into hopper with machine running for continuous separation.



Practical Exercise: Go to a shell-kernel separator for some hands-on practise on operating it.

e) Maintain Shell and Kernel Separator



Can you remember some important measures to take before maintaining the shell and kernel separator?

The key maintenance steps for the separator are as follows:

Daily PM Activities

1. Before operating, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners.
2. Manually turn rotating cylinder and clean screens by brushing to remove debris after each production day
3. Clean hopper and chutes after each production day.

Weekly PM Activities

1. Check drive belt to ensure tension is good. Tighten belt if it is loose.
2. Manually turn rotating cylinder in alternating sequence of clockwise and anticlockwise directions to ensure that it can move freely. Pay attention to unusual and squeaky sounds; lubricate pulleys and bearings.

Monthly PM Activities

1. Look out for rusting parts (main structure, joints) and paint



Practical Exercise: Go to a shell and nut separator for some practical hands-on exercise.

Use the checklist and follow the stated steps in maintaining Shell and Kernel Separator. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Daily PM Activities	Rate
1. Before operating, visually inspect machine paying attention to main structure and other major parts for defects, wear and tear, and loose fasteners (bolts, screws). Tighten all loose fasteners.	
2. Manually turn rotating cylinder and clean screens by brushing to remove debris after each production day.	
3. Clean hopper and chutes after each production day.	
Weekly PM Activities	Rate
1. Check drive belt to ensure tension is good. Tighten belt if it is loose.	
2. Manually turn rotating cylinder in alternating sequence of clockwise and anticlockwise directions to ensure that it can move freely. Pay attention to unusual and squeaky sounds; lubricate pulleys and bearings.	
Monthly PM Activities	Rate
1. Look out for rusting parts (main structure, joints) and paint.	

Always bear in mind that everything you need to accomplish your goals is already in you. Keep on working hard.



SELF ASSESSMENT

1. Explain the working principle of shell and nut separator.

2. Explain the objective of using the shell and nut separator.

3. Outline the activities required for maintaining the shell and nut separator.

4. Give the steps necessary for operating the shell and nut separator.



You are making great progress! You have completed another set of questions. Take a break or go ahead and start with the next unit