

Facilitating and Learning Materials

NATIONAL CERTIFICATE II

TRADE AREA:

CASHEW VALUE CHAIN

UNIT: OPTIONAL LEARNING UNITS

Cashew nut shell liquid (CNSL) extraction

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INTRODUCTION AND PRELIMINARY NOTES

This module aims to equip participants with the basic knowledge and skills on how to extract cashew nut shell liquid, crushing a cashew shell, expelling cashew nut shell oil. Extraction processes and composition of cashew nut shell liquid (CNSL), modification and conversion processes, as well as environmental impact and controls of the liquid as petrochemical feedstock.

Cashew nut processing can be divided into different steps: **cleaning, soaking, steaming, shelling, grading, drying** etc. Among these steps, cashew nut shelling is the key of success of the production and this is the most difficult operation in cashew processing, too. The objective of shelling is to produce clean, whole kernels free of cracks.

Before



After



LO 1. DEMONSTRATE SKILLS IN EXPELLING CASHEW NUT SHELL OIL

PC (a) Cashew Shell Crushing

Shelling of the cashew nut is the act of removing the kernel from the cashew nut. Shelling is perhaps the greatest bottleneck along the processing line. Local shelling is carried out by hand with a hammer or using mortar and pestle.

The shelling methods employed by cashew nut processing industries are the use of simple shelling devices, which usually are not efficient in their performances, and in few cases use of complex and expensive shelling machinery, which are usually imported. Shelling is the most difficult operation in cashew processing. There are different methods for manual cashew shelling.

PC (b) Importance of Cashew Shell Crushing

The objective of shelling is to produce clean, whole kernels free of cracks. Therefore the importance of the shell crushing process is to ensure that the kernels are;

- To remove the shell from the kernel
- To ensure that the kernel is not crushed or damaged
- The kernels are cleaned and free of any debris
- Ensure that kernels are kept crack free



PC(c) Factors to Consider In Cashew Shell Crushing

1) Personal health and safety

Chemicals found in the cashew shells are highly reactive and harmful to human skin and cannot be digested. These chemicals *Anacardic acids* are *phenolic lipids*, chemical compounds found in the shell of the cashew nut (*Anacardium occidentale*).

NOTE:

Chemical formula:
 $C_{22}H_{30}O_3$

2) Shelling Process

The objective of shelling is to produce clean, whole kernels free of cracks. This operation are done manually.

During the shelling process the nuts produce a caustic liquid that burns the skin. This chemical leaves burnt marks that damage and cause pain. It is advisable to wear gloves. Try avoiding direct contact with liquid.



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During this process one needs to take precautions with the use of PPE- Personal Protective Equipment.

PPE- Personal Protective Equipment for shelling Cashew Nuts.	
<p>The gloves are to protect your hands from the harmful liquid from the shell. This can cause serious damage to skin like the pictures demonstrated above.</p>	<p style="text-align: center;"><u>Gloves</u></p> 
<p>The apron is used to protect your body from the harmful liquid from the shell.</p>	<p style="text-align: center;"><u>Aprons</u></p> 



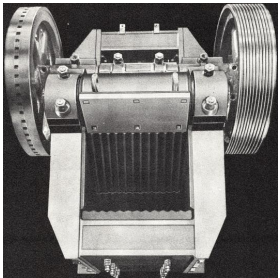
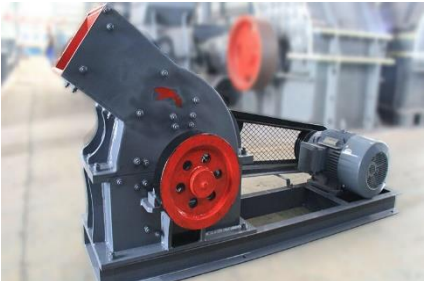
PC (d) Explain operations of crushers

Shell crushing can be done through two methods;

- 1) Manually
- 2) Mechanically

The following equipment in the table below explain the type, uses and process.

Various Equipment That Can Be Used For Operation of Crushers

<ul style="list-style-type: none"> • This equipment is manually operated. • The nuts are placed on a flat stone and cracked with a wooden mallet. • In most cases it is made out of wood. • Wooden mallet needs to be frequently cleaned and dried properly. 	<p style="text-align: center;"><u>Wooden Mallet</u></p> 
<ul style="list-style-type: none"> • This equipment is manually operated. • In most cases it is made out of wood. • The mortar and pestle is a hand operated crusher/grinder. • A wooden mortar and pestle need to be frequently cleaned and dried properly. 	<p style="text-align: center;"><u>Mortar & Pestle</u></p> 
<ul style="list-style-type: none"> • This equipment is mechanically powered. • Plate crusher is used to support movable jaw plate and transmit crushing force to the back of body frame. • The Plate crusher needs to be oiled frequently to avoid rust and for it operated smoothly. • Store and keep dry. 	<p style="text-align: center;"><u>Plate Crusher</u></p> 
<ul style="list-style-type: none"> • This equipment is manually operated. • A hammer mill is a rock crusher that employs a rain of hammer blows to shatter and break a variety of materials such as the cashew shell. • Hammer crusher needs to be oiled frequently to avoid rust and for it operated smoothly. 	<p style="text-align: center;"><u>Hammer Crusher</u></p> 

PC (e) Describe the procedure in cashew shell crushing.

Manual

In the manual shelling process, the nuts are placed on a flat stone and cracked with a wooden mallet. As mentioned above, because of the residue CNSL, wood ash for covering the shells or gloves are required. An average sheller can open one nut in about six seconds or ten nuts per minute. In an eight-hour working day, this amounts to about 4,800 nuts or about 5kg of kernels

Mechanically

The nuts are fed into the machine . Mechanical knives separate the shell form the nuts automatically. The nuts are then separated from the shells

PC (f) Carryout cashew shell crushing



Job Task 1: Shelling a Cashew Shell

Situation: You are the co-owner of a small Cashew agriculture business. The next process is to shell the cashew nuts. Your job is to demonstrate to your employer how to shell a cashew nut manually and effectively without cracking the kernel.

Instructions:

1. Select the equipment to manually shell the cashew nuts
2. Select the cashew nuts that is ready to be shelled
3. Shell the cashew nuts
4. You have **1 hour**

Use the checklist to follow the stated steps to shell a cashew nuts manually and effectively. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Daily PM Activities	Rate
1. Correct tools were selected for the activity	
2. Correct and prepared cashew nuts was selected	
3. The procedure for shelling the cashew is correctly done.	
4. The time limit is adhered to	

Self-Assessment

PC(a) What is cashew shell crushing?

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PC(b) What is the importance of cashew shell crushing?

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PC(c) List the needed PPE equipment.

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PC(d) What is the various equipment that are used to crush cashew shells?

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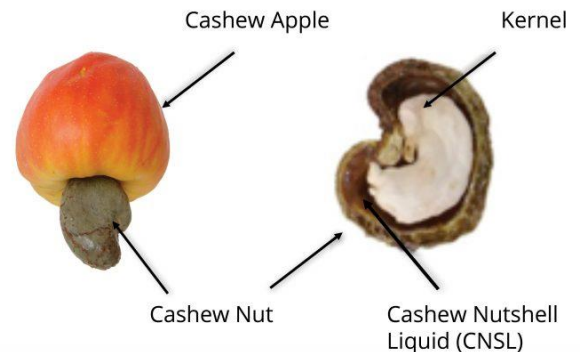
LO 2. DEMONSTRATE SKILLS FOR EXPELLING CASHEW NUT SHELL OIL

PC (a) Explain oil expelling from cashew nut shell

The oil extracted from cashew nut shells (CNSL) is a natural resin with a yellowish sheen found in the honeycomb structure of the cashew nutshell and is a by-product of processing cashew nuts, it is a raw material of multiple uses in developing drugs, antioxidants, fungicides and biomaterials.

For you to be able to extract cashew nut shells liquid you must be able to:

- Identify high quality produce shells, to ensure quality CNSL.
- Protect yourself during extracting is very important.
- Be able to distinguish the liquid from the nut shell.
- Having the correct equipment to perform the task effectively.
- Have the necessary packaging.



PC(b) Importance of cashews nut oil expelling

The liquid inside the shell represent 15% of the gross weight and has some attractive medicinal and industrial uses. The liquid is one of the natural resin that is highly heat resistant and is used in braking systems and in paint manufacturing.

The extraction of CNSL reduces the chemical effects they could have on the environment if it was to be disposed incorrectly. E.g. If a manufacturing company has to dispose of it in the was nearest water source or ocean that would contaminate the water, this could threaten the health of human, animal and marine life.



The importance of CNSL or CASHEW NUT SHELL LIQUID OIL is the uses in manufacturing:

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| <ul style="list-style-type: none"> • CNSL Resin • Cardanol or Card Phenol or Cashew Phenol • Cashew Friction Dust • Anti-corrosive hiring (lining) chemicals • Paints • Varnishes • Enamels • Insecticides and Fungicides • Cashew Lacquers | <ul style="list-style-type: none"> • Bakelite • Electrical conductress • Cashew Cements • Core Oil • Red Oxide • Wood • Fuel • Specialty Chemicals • Foundry Chemicals and many other Industries. |
|--|--|

PC(c) Methods For Cashew Nut Shell Oil Expelling

There are two different methods generally used in extracting cashew nut shell liquid from cashew nuts, namely mechanical and roasting method.

The processes used are mainly hot-oil and roasting in which the CNSL oozes out from the shell. In oil bath roasting, the nuts get roasted by means of screw or belt conveyor in a bath or cashew shell liquid in a tank heated furnace.

Various Methods Of CNSL Extraction	
<ul style="list-style-type: none"> • This method is done mechanically. • Less to little manual labor is needed • Knowledge of machine operation is needed. • The machine is expensive and produces the final liquid form of the cashew nut shell liquid. 	<p><u>Mechanical</u></p> 
<ul style="list-style-type: none"> • This method can be done on open fire or oven. • Liquid oozes out of the shells when heated • Makes shells brittle • Facilitating extraction of the kernel when breaking the shell open. 	<p><u>Roasting</u></p> 

WARNING-

Always Use PPE- Personal Protective Equipment
for shelling Cashew Nuts.

PC (d) Describe the procedure expelling oil from cashew nut shell

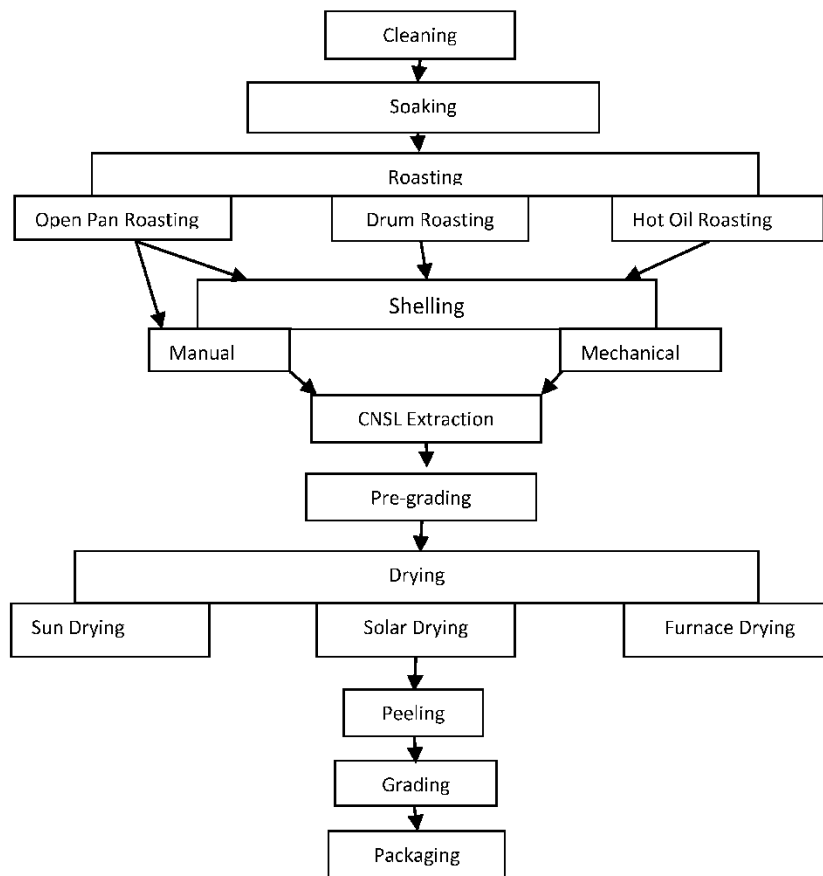
Basic physical operations before extraction are required on the samples of cashew nuts to ensure a high degree of purity and the quality of the product. These operations constitute the basic pretreatment on samples and include;

- 1) washing,
- 2) drying,
- 3) shelling and
- 4) size reduction.

Sometimes, washing may involve the use of detergents to remove likely contaminants.

Drying is purposely to make the nuts moisture-free. Both sun- and oven-drying have been found effective. Size reduction creates a better contacting surface area for the shell and solvent to enhance removal of the CNSL.

Traditionally, the kernel is removed manually for the CNS. However, to improve the deshelling process, several methods have been adopted which include, among others, soaking the nuts in water to improve the moisture content thereby reducing the scorching and cracking tendencies during roasting. Roasting the nuts makes the shell brittle and loosens the kernel from the shell easily. In addition, CNSL is released during the roasting. Then Figure below shows the nut-processing stages.



Two methods are used to extract the CNSL;

- 1) Hot methods
- 2) Cold methods

Various **hot methods** are used for the extraction of CNSL from cashew nut shells (CNS) and it include,

- open pan roasting,
- drum roasting and
- hot oil roasting,

Cold methods

- cold extrusion,
- solvent extraction

PC (e) Expel oil from cashew nuts



Job Task 1: Extract oil from a cashew shell

Situation: You are the co-owner of a small Cashew agriculture business. The next process extract oil from a cashew shell. Your job is to demonstrate to your employer how to extract oil from a cashew shell manually and effectively.

Instructions:

1. Select the equipment to extract oil from a cashew shell
2. Select the cashew nut that is ready to be shelled
3. Extract oil from a cashew shell
4. You have 1 hour

Performance Criteria

1. Method is correctly identified
2. Equipment selected correctly
3. Nuts prepared correctly
4. Process correctly implemented
5. PPE correctly used
6. Health and safety procedures correctly adhere to.
7. Oil extracted correctly and effectively
8. Time limit adhere to.

Use the checklist to follow the stated steps to extract oil from a cashew shell effectively. Rate your own performance critically and honestly after you have completed each activity.



Excellent



Okay



Try Again

Cashew nut shell liquid (CNSL) extraction	Rate
1. Method is correctly identified	
2. Equipment selected correctly	
3. Nuts prepared correctly	
4. Process correctly implemented	
5. PPE correctly used	
6. Health and safety procedures correctly adhere to.	
7. Oil extracted correctly and effectively	
8. Time limit adhere to.	

Self-Assessment

PC(a) Explain oil expelling from cashew nut shell.

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PC(b) What is the importance of cashew nut shell oil extraction?

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PC(c) Name the methods used to extract CNSL.

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PC(d) Explain the procedure used to extract CNSL.

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References

- <https://www.linkedin.com/pulse/indian-cashew-nut-shelling-method-lana-chen>
- <https://www.shellingmachine.com/application/cashew-processing-India.html>
- www.everestblowers.com/cashew-nut-shell-oil-distillation-cnsl-cardanol-oil-extraction.html
- <https://www.entrepreneurindia.co/Document/Download/Cashew%20Nut%20Shell%20Oil%20Production-140770-.pdf>
- <https://pdfs.semanticscholar.org/d626/367bbeffc7b1ddd174a4e607af7c362e63e7.pdf>
- <https://www.dcmsme.gov.in/publications/pmryprof/food/ch4.pdf>