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# Cashew Nut Processing Equipment Study: Indian Perspective



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Study conducted by  
**CashewInfo.com**

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**Introduction:**

A tropical crop cashew (*Anacardium dentale*) is commonly used in culinary not only among tropical human diet and medicines but also in diet of subtropical and temperate region population. Thus, cashew is demanded all over the world.

In African countries, till now, cashew processing is a small scale activity. Africa is keen on adopting new technologies for cashew processing in order to add value, employment and profitability. With this view, the African Cashew Alliance (ACA) an association of African and international businesses with an interest in promoting a globally competitive African cashew industry has come forward with a project proposal to **cashewinfo.com** to provide ACA an information update with respect to cashew processing technology, equipments and new innovations in India.

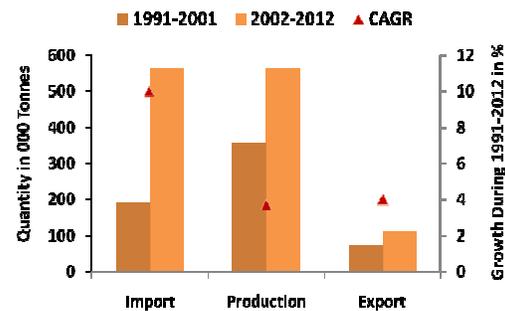
**Indian cashew processing snapshot**

India process about 1.5 million tonnes of RCN (0.7 million tonnes own production and 0.8 million tonnes import during the year 2011-12) which is almost 60% of the total RCN produced in the world (2.5 million tonnes in the year 2011-12).

It is interesting to note that the Indian cashew processing industry has changed dramatically in the last two decades. Compounded annual growth in Indian RCN production during the period of 1991-2001 and 2002-2012 has been 4.8% and 3.8% respectively. In terms of volume, the average annual RCN production during 1991-2001 was 357,000 tonnes which

has grown up to 565,000 tonnes annually during the period 2002-2012. Similarly, in case of RCN import, Indian import of RCN during 1991-2001 was 193,000 tonnes which has grown up by at a compounded annual rate of 6.25% to 565,000 tonnes during the period 2002-2012.

**Fig 1: Indian Cashew Industry Outlook**

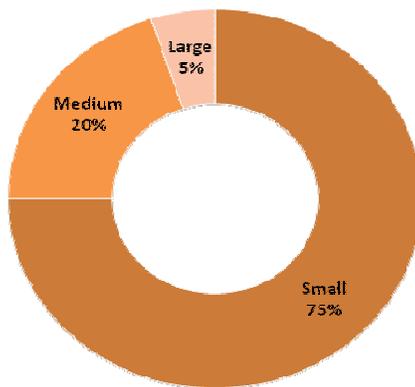


**Industry-size Classification**

The Micro, Small and Medium Enterprises Development Act, 2006 of government of India classifies industries in manufacturing sector based on the investments in plant and machinery. Accordingly, any manufacturing unit with an investment of up to INR 2.5 million in plant and machinery is classified as a Micro enterprise. An enterprise with investment between INR 2.5 million and up to INR 50 million in plant and machinery is classified as small scale enterprise, while industries with investments between INR 50 million and upto INR 100 million is classified as medium enterprise. As per this classification, most of the cashew processing industry in India would fall under small scale industry category (note, as of 10 September, 2013 one USD equals 63 INR).

As per the plant and machinery suppliers point of view, the industry has been classified into three categories as per the capacity, i.e. the processors having RCN processing capacity up to 25 bags (of 80 kg each) per day as small, 25-40 bags per day as medium and above 40 bags per day as large scale processing units. Around 70-75% of the total cashew processing units will come in small scale, 15-20% as medium scale and only 5-10% as large scale in terms of number.

**Fig 2: Industry Classification as per the Processing Capacity**



**Table 1: Yield, Nuts Count and Quality assessment of RCN of the various Origins**

| Origin           | Nut Count/KG | Kernel Yield in 100 kg | Quality      |
|------------------|--------------|------------------------|--------------|
| India            | bellow 200   | 24                     | Best         |
| Indonesia        | bellow 200   | 24                     | Best         |
| BENIN            | 175-180      | 22-23                  | Good         |
| G. Bissaue       | 215-220      | 24                     | Fair         |
| Tanzania         | 210-215      | 24                     | Fair         |
| Ghana            | 185-190      | 23                     | Fair         |
| IVC Bonduku Area | 195          | 23                     | Satisfactory |
| IVC general      | 195          | 22                     | Medium       |
| Nigeria          | Bellow 200   | 22                     | Least        |

### Processing Technology

India started cashew processing as cottage industry where almost all the operations were manual. Indian State of Kerala (Kollam) and Karnataka (Mangalore) were the hubs for raw cashew processing but now it has been spread across the states of Tamil Nadu, Andhra Pradesh, Odisha, Maharashtra, West Bengal, Gujarat and Chhattisgarh. Traditionally, cashew processing was fully manual in India but in recent years cashew processing has become semi-automatic. Increasing wages, labour compliance requirements, food safety and hygiene compliances and labour shortage (due to migration of educated labour force to urban centers) and cost control measures are a few of the important reasons for the shift from manual to mechanical operation. However, the some of the traditional processors still believe that manual operation is more effective than the mechanical.

In initial time, RCN was roasted on a tray kept directly on the firewood stove, then the roasted RCN used to be cracked using hammer like tool. The kernels thus obtained were dried using tray dryers fired by fire wood, after which they were peeled using knife. The peeled kernels were then sorted (wholes from broken) and graded (based on whiteness) manually. Finally, it was pack in Tin boxes of 25 lb each (about 11.35 kg).

However, of late, steam cooking has replaced roasting. Mini-boilers are operated to generate steam. Hand tool de-shelling replaced the cracking and recently auto de-shelling has replaced the hand tool de-shelling. In case of drying, firewood dryers were replaced by electric dryers and then dryers that use steam,

vertical tray dryers were changed to surrounded circulating dryers. Practice of peeling done by knife shifted to hand rubbing and of late the auto peeler has replaced manual peeling process. Size grading still done manually even now but color grading which was done by visual inspection has been replaced with color sorters. Separating/sorting the baby bits or small broken of cashew kernels, which is fast growing category used by the food industry, has become much easier by using color sorting machine. In terms of packaging, as many countries do not allow tin, poly bags are in used, simple ploy packaging is now being upgraded with nitrogen flushed and vaccumised packaging.

Extant of the replacement is subject to various factors such as availability of labour, capacity of the processing units, market for disposing the final produce etc.

In terms of technology adoption by the processing as per the capacity, medium scale units are moving towards semi-automatic plants, while small scale industries are adopting mechanization selectively. Auto cashew kernel peeler is the most demanded equipment across cashew processing industries. The auto-peelers are available from the capacity ranges from 50 kg/hr to 250/kg per which are suitable for all size of processing units. The small scale processors are still not very comfortable with adopting auto RCN de-sheller; it is more popular among medium and large scale processing units. One of the major reasons for low adoption is that huge variation in the quality of RCN due to difference in size, moisture, foreign matter and so on. RCN de-shelling machine is currently available for capacities ranging from 20 Kg/hr to 50-60 Kg/hr.

RCN calibration is still non-popular phenomena among the India processors; there is not much development from the machineries manufacturers' side. Some prototype machines have been developed and are under test run.

Currently, Indian processors do not use continuous kernel drying system as most of them are processing small volume i.e. around 2.5 to 3.0 tonnes of RCN or 0.65 to 0.75 tonnes of cashew kernel per day. Batch-processing is a common method adopted by the most of the small and medium scale processors. Even, the large scale processors use continuous dryers only during the peak season as it is unviable during the off-season when the total volume of RCN process reduced.

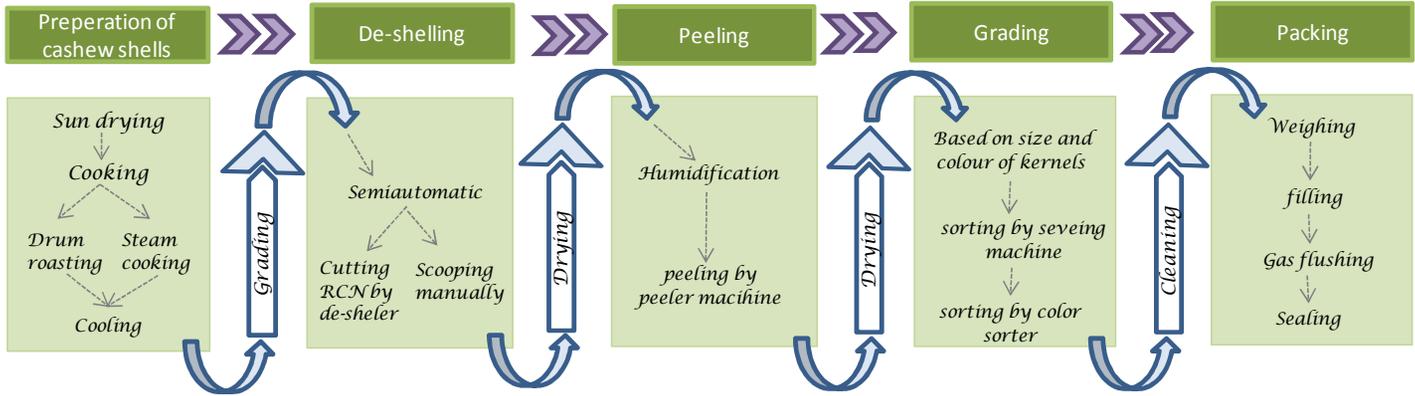
At present, the machinery manufacturers in India, who are also exporters to other countries, need not have any kind of certification and accreditations for export. In case required, the processors will get the certification from the concerned authority.

#### **Fully Automatic RCN Processing in India**

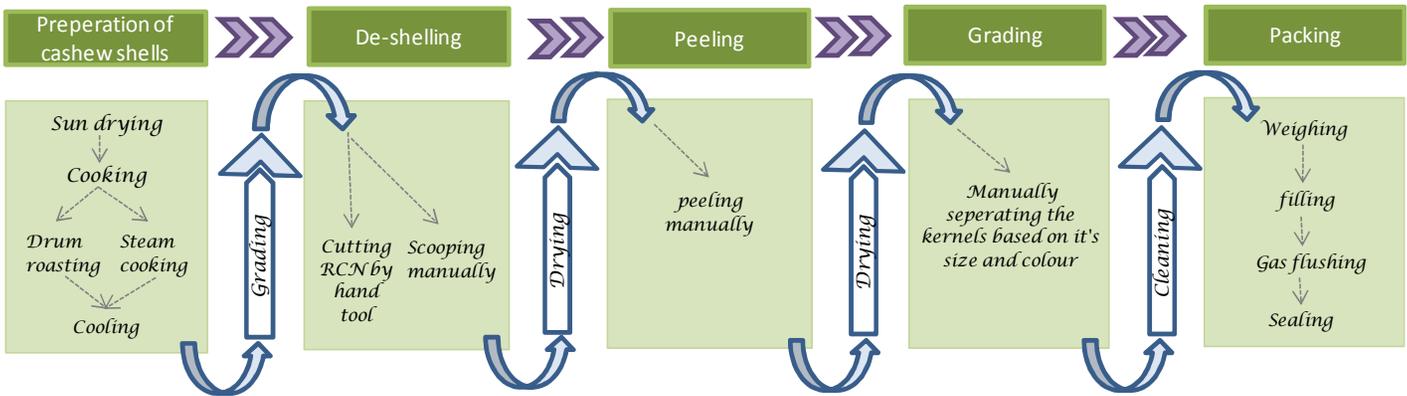
The concept is still in the hands of a few multinational large processors. The average capacity of such plants is minimum 300 bags per day which is unviable for the most of the medium size RCN processors in India. On the other hand, processors feel that it is highly impossible to replace 100% labour from the operation unless you have strong backward integration and robust forward tie-up. In terms of operations, the automatic plants would require highly skilled labour which is again a costly affair as either one need to hire from the existing industry or have to invest heavily on the training and skill development.

**Flow Chart of cashew processing:**

**Mechanical method of cashew processing:**



**Manual method of cashew processing:**



### Section 1- Preliminary Handling of Raw Cashew Nuts (RCN)

**Raw Cashew Nut (RCN) Drying:** It is a process of reducing the moisture content in raw cashew nuts. Well dried RCN can be stored longer with less quality loss. Sun drying is the most preferred method.

**Sun drying of raw cashew nuts:** It is a process of drying raw cashew nuts under the sun in a spacious cemented area usually called as drying yard within the premises of the cashew processing plant.

**Indian Practices:** Indian processors procure raw cashew nuts (RCN) from both imported and domestic sources. Imports are mainly from west African countries and countries like Indonesia etc, while domestic procurement are from Kerala, Goa, Maharashtra, Karnataka, Orissa, WB and Andhra Pradesh. The fresh harvested raw cashew nuts carry between 15 % and 18% moisture. The fresh harvested domestic RCN are generally sun dried for 3-5 days to reduce the moisture content to the range of 7-8 percent. The imported nuts do not require much drying because those nuts are dried at the origin itself. But, during voyage from country to country nuts will absorb some moisture. Thus, imported nuts are also sun dried for 1 or 2 days. In India, the processors will do the drying just after procurement (it happen during the months of February and April which is starting of summer season) before storing.

**Fig 3: Sun Drying of RCN**



**Cleaning & Calibration (Grader):** Dried RCN is calibrated as per the size of the nuts and cleaned (removing some impurities like stones, plant stalks and other foreign material before sending it for cooking or storing. Calibrated RCN is helpful in efficient utilization of auto-shelling machine.

**Fig 4: RCN Grading/Calibration Process**



**Indian Practice:** Small processors who does manual de-shelling of RCN generally do not go for the calibration, even some medium size of processors do not opt for this process either due to space constraints or not willing to invest on such machineries. However, learning from the technology suppliers that calibrated nut enhance the shelling efficiency, now most of the processors having auto-sheller are gradually shifting for calibration machineries.

**Selection of Machineries:** Medium and large size processors who uses multi origin RCN will adopt grader or calibration equipment. Capacity of the equipment depends of the processors to processors, generally, the size or capacity of this equipment is 3-4 times higher of the processing capacity.

**Indian Equipment Suppliers:** Kindly refer Annex 1 & Annex 2

## Section 2- Cooking of Raw Cashew Nuts (RCN)

**Fig 5: RCN Stored at Godown**



**Cooking:** Cooking or heating of RCN is done to make it easier for de-shelling. It is done 12-24 hours before de-shelling of nuts. There are two methods of preparing the RCN for de-shelling;

- Drum roasting method
- Steam cooking method

**Drum roasting method:** In this method, RCN is fed into a rotating drum which is heated initially (by using fire wood or shell as fuel) and once the drum is ignited there is no need for further heating of drum as it maintains the temperature out of burning the oozed out oil from cashew shells during heating. After 3-5 minutes of roasting, RCN is removed from a discharge end of the drum and will be covered with dry ash immediately to absorb the oozed out CSNL. In this process the roasted RCN become brittle which facilitate easy de-shelling. The advantage of this method of cooking is that kernels inside the roasted RCN obtain better color, aroma and taste. On the other hand it suffers from higher percent broken (>10%) and lose of CSNL which has a commercial value as a by-product of cashew processing industry. This method also

generates air pollution and unacceptable odor and now has very limited operation in India.

**Steam cooking method:** In this method of cooking, raw cashew nuts (RCN) are fed into steam fueled vessels which are mostly operated through the boiler. The RCN is cooked for about 15–20 minutes in vessels and are allowed to cool down to reduce its temperature. Then these cooled nuts are taken for de-shelling the next day. Advantages of this method are development of a fine white color of kernels inside the nut shell, lesser breakage (10-12)% during de-shelling and retention of CSNL in shells.

**Fig 6: RCN Steam Cooking Process**



**Indian practices:** Roasting has been the traditional method. However, as pollution regulations become operational, the popularity of roasting technology declined. In recent years processors have shifting into steam method of cooking by looking into other advantages over drum roasting method. Especially to reduce the percentage of kernel breakage, to retain white ivory color of kernels and CSNL recovery that has high commercial value in the market. Irrespective of the plant

capacity, all units are now using steam cooking method.

**Equipment details:** The processors will typically use Mild Steel (MS) vessels having RCN carrying capacity of 320-350 Kg (4 bags), these vessels are coupled (fueled) with a boiler. The number of vessels to be used depends upon the plant capacity (in general, a medium scale 30-40 bags/day RCN processing capacity unit will have 4-6 cooking vessels). The capacity of the boiler will also change based on the number of vessels.

Usually, fire wood and CNSL extracted cake is used for heating boilers. About 100-150 kg of fire wood would be required for heating boiler. Now-a-days boilers according to the size of the steam cooker is available, these boiler can be installed easily in the small scale units without any compliance hassle. After cooking, cooked cashew nuts will be allowed to cool down by spreading in a room with proper ventilation for about 12-14 hours or by keeping in a humidifier for about 1-2 hours.

**Fig 7: Steam Cooked RCN Receiving Point**



**Selection of Steam cooking Equipment:** As stated above, steam cooking method is adopted by the most of the Indian cashew processors. All sizes of vessels and capable boilers are available which suits even 10 bags per day RCN processors. Among the large scale operators, vessels having RCN carrying capacity of 350 Kg are very popular; while choosing the boilers for such big size of cooking operation it is mandatory that it should have accreditation from Indian Boiler Regulatory (IBR).

**Fig 8: High Capacity Boiler for RCN Cooking**



**Leading Steam Cooker suppliers in India:**

For further details of suppliers, machinery features and specifications kindly refer Annex 1 & Annex 2

### Section 3- De-Shelling of Raw Cashew Nuts (RCN)

**De-shelling:** It is a process of cutting the shells and recovering the kernels from the RCN. Thus, as it sounds it has basically two steps first cutting the outer shell and then taking out the kernel or edible part of the nut from the shell. De-shelling can be done in two ways.

- Manual method of de-shelling- Hand Tool Operated
- Auto de-shelling

**Manual method of de-shelling:** It is a human energy driven process where in the raw shells are cut using a hand tool. The hand tool will be similar to that of scissor and can cut the hard brittle nut shell by pressing the nut shell between the two sharp edges of scissor. Once the nut shell is cut kernels inside the nut will be taken off by stretching cut portion of the shell manually. To hasten this process usually two labours will be employed for the purpose. One performs the cutting and the other performs removing kernel from the cut nut shell. Female labours are mostly used for de-shelling the RCN. The processors provide rubber or plastic made gloves to protect the labourer's hand from the injuries to be caused from CNSL oil. However, labour will prefer coconut oil or other thick vegetable oil to protect from CNSL rather using gloves.

**Auto shelling:** It is a machine driven process of cutting and removing of kernels from the shell. Raw nuts will be fed into the conical shaped hopper towards rotating blades. When the RCN passes across these blades, it gets cut. The kernels will then be scooped out from

the cut shells by the scooper. Later, the cut shells get ejected from one side of the machine and the kernels gets ejected from other end of the machine.

**Fig 9: Manual De-shelling of RCN**



**Fig 10: RCN Auto-shelling Machine**



**Fig 11: RCN Auto-shelling Line**



**Fig 12: Manual Scooping of Shelled Cashew**



**Indian practices:** Manual method of de-shelling is traditionally followed in India and it is found to be more advantageous over machine driven type of de-shelling. Based on experience, processors believe that there is higher percentage of broken (10-12%) in machine type of de-shelling compared to manual method of de-shelling (<10%). However, increasing wages, shortage of skilled labours and higher investment in training and maintenance of labour force has made to change the thought to those processors who were advocating manual shelling method. In terms of productivity, a labour (or a group of two, in which one will be cutting and another will scoop) can shell around 35-40 kg of RCN in a 8-hour shift while similar amount of RCN can be de-shelled in a machine in an hour.

**Equipment Details:** In India, local manufacturers have developed two types of auto-shelling machine viz. 2 blade machine having capacity of de-shelling 18-22 kg RCN in an hour and 4 bladed machines with capacity of shelling 30-35 kg of RCN per hour. The unshelled RCN recovery is 3-4%. The unshelled nuts are usually small size, de-shaped or damaged raw nuts which cannot be shelled in a fixed size sheller. Due to this, hand tool machine is used for de-shelling

these RCN. These machines are operated using electrical energy.

**Selection of De-shelling Machine:** The selection of machine is again, matter of unit's processing capacity, type of RCN used (single origin nut in a batch or mixed origin) and amount of labour available. Indian small scale processors are still reluctant to go for auto-shellers as they still have sufficient numbers of labour available and due to variable recovery of unshelled nuts. However, medium and large scale operators are conducting various trials to overcome the constraints related to dealing with multiple origin nuts. The equipment has adjusters to accommodate different nut sizes.

**To make the de-shelling more effective, it is advisable that the RCN should be graded (as per the size) first and then fed to the de-shelling machine. In this way, de-shelling machine can be set as per the size of RCN hence the yield of unshelled nuts and broken can be reduced to a great extent.**

Scooping is done after de-shelling the RCN to recover the kernel. In general, the scooping is done manually; a labour can scoop around 20-22 kg of RCN in a day. A scooping machine is recently been launched in India, it has capacity of 30-40 kg/hr but it has drawback of not able to stop the spreading of oozed CNSL in the machine and kernels.

**Indian Auto-shelling machinery suppliers:**  
Kindly refer Annex 1 & Annex 2

#### Section 4- Pre-Peeling Process of Cashew Kernels

**Preparation for Peeling/Drying:** Kernel will be intact with an outer thin layer of skin called testa, this layer need to be loosened to ease the process of removing it in further step. For this purpose, the kernels are roasted or dried using hot air system or hot plate for stipulated time.

There is three types of system available for drying the nuts before peeling given below. The dryers are like large chamber or metal box in which metal trays are placed, it is also called tray dryers. These systems or method different source of fuel is used.

- Heat exchanger
- Steam hot house and
- Electric hot house

**Heat exchanger:** Heat exchanger basically has five parts namely, insulated chamber, heat exchanger, ignition chamber/furnace and insulated pipes and a chimney. Cashew kernels are kept in aluminum trays stacked in a portable trolley in an insulated hot Chamber. The Blower maintains a uniform circulation of air at desired temperature 75-85 ° c inside the hot chamber. And Heat Exchanger fired by Cashew Shell cake in furnace heats up the air.

**Fig 13: Cashew Drying Hot House (Steam)**



**Steam hot house:** Steam cooking of cashew shells has an advantage of using the same hot steam for heating up the hot chamber where the de-shelled kernels are fed into the trays inside the hot chamber and thus maintains the temperature inside.

**Electric hot house:** In this method, electric power is used to heat up the hot chamber which holds the aluminum trays fed with cashew kernels.

Fuels used for the purpose are firewood, cashew shell cakes and power/electricity.

**Fig 13: Cashew Drying Hot House (Firewood)**



**Indian practices:** In India steam hot house or dryers with steam as the source of heat, are mostly used for the purpose. After de-shelling kernels will be fed into a hot chamber and heated at 75-80° c for about 8-7 hrs then allowed to cool for a day. By doing so, testa of kernels become shriveled and slightly detaches from kernel.

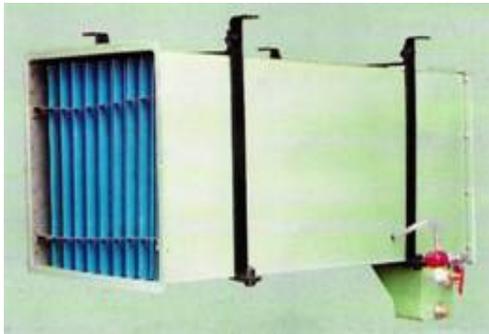
Steam hot house is newly introduced machine for the Indian cashew processing industry. In the last 5-6 years, it has become very popular among the processors as it can be operated with the same boiler used for steam cooking.

**Equipment details-** the dryers comes in various sizes which can be either operated through the steam generated by the same boiler used for the steam cooking or using electric heat and fire.

**Selection of Drying Equipment:** processors will select the equipment as per their processing capacity. A processor who has space and can install high capacity boiler will select steam operated dryer rather going for other type of dryer.

**Humidification:** It is a process of moistening the cashew kernels.

**Fig 13: Humidification Chamber**



**Fig 14: Water Sprayer inside Humidifier**



**Indian Practice:** While drying the de-shelled kernels in a hot chamber (borma treatment) the moisture level becomes around 3%. Those processors who are using peeling machine needs to humidify the kernels to enhance the moisture level (from 3% to 4%) so that the breakage while peeling is minimum. The humidification can be done in two ways by either spreading the kernels under shade to absorb the moisture present in environment or using humidifier. The processors located in coastal region adopt the natural process whereas processors located in non-coastal region uses humidifier. On the other hand, those processors do manual peeling of kernels will not raise the moisture instead retain at 3 percent moisture only.

**Indian machinery suppliers:** Kindly refer Annex 1 & Annex 2

### Section 5- Peeling of Cashew Kernels

**Peeling:** It is a process of removing the outer skin or *Testa* of the kernel. The skin over the kernels will be shriveled and slightly detached by previous heating and drying. There are two methods of peeling;

- Manual method
- Peeling by machine

Manual method of peeling: It is a process of removing skin portion of the kernel by human effort either by rubbing it between palms or by peeling using figures. *Testa* adhere to the middle part of the cashew is difficult to be removed by hand so knife is used to scratch that particular parts.

**Fig 15: Manual Peeling of Cashew Kernel**



**Peeling by machine (Auto-Peelers):** It is a machine driven process of removing the outer skin on the kernel. Air compressor is mainly used as source to blow out the *Testa* from the kernel.

**Fig 16: Auto-Peeler of Cashew Kernel**



**Fig 17: Auto-Peeler of Elevator Chain**



**Indian practices:** Traditionally, in India manual method of peeling has been followed. Generally women are employed for this process. In recent years due to scarcity of labors processors proportionately divide the total quantity to be peeled between manual labors and machine peeling in order to maintain the factory capacity on daily basis. As the peeler machine does not yield 100%

peeled kernels, the half peeled kernels will be peeled manually. In terms of capacity mechanical operation is more effective than the manual; a labour on an average can peel 12-15 kg of kernel in a day, on the other hand peeling machines of capacity ranges from 50-200 Kg per hour. In the manual processing, recovery of whole kernel is 80-82% while in the machine it is 72-75%. In general, the processors have observed 10-15% recovery un-peeled kernels in the machine operation.

The processors supplying kernel to the domestic, mid segment markets generally allows using knife like tool for peeling. On the other hand, the premium/export market suppliers does with hand only because while using the knife it gives scratches marks in the skin of the kernel which is considered as down quality.

**Equipment Details:** Auto peeler comes with variable capacities starting from 50 kg/hr to 250 kg/hr of kernel, which is suitable for the Indian processing units. Variable speed compressor is a new addition in the auto peeler as it can control the power consumption by adjusting the speed according to the peeling need. Auto peelers come in one, two and three feeding head system also it can be fed using conveyors to minimise the human interference.

Usually auto peeler machines require 2 operators, one skilled labor to operate the machine and one unskilled labor to put kernels into the machine and to collect yield. Now, the peeling process is driven by the conveyor system (for both feeding and receiving). At the receiving end, the conveyor will be partitioned with 0.5 or 1.0 inch high rubber walls in two

sides where the unpeeled kernels are placed and it will fall in the separate collection bins. This system is helpful to do continues sorting of the unpeeled or partially peeled nuts.

**Fig 18: Sorting the Un-peeled nuts in Conveyor**



**Selection of Peeling Equipment:** Manufacturers have various claims over recovery of fully peeled nuts and broken, processor will select the machineries as per the trial run demonstrated to them. Peeler having variable speed compressor is more acceptable among the users. Auto peelers are most adopted/replaced machine in the cashew processing segment, there are processors who also does peeling job-work by installing higher capacity machineries on the contract or user fee basis. Selection of the machinery with conveyor or without is depending on the space available in the factory.

**Indian peeling machinery suppliers:** Kindly refer Annex 1 & Annex 2

## Section 6- Conditioning of Peeled Cashew Kernels

**Conditioning:** It is a process of adjusting moisture content of kernels. For the purpose cashew kernel driers are used

**Drier:** The mechanism of drier machine is same as that of pre-peeling drying system. The hot air from the heat exchanger moves into the hot chamber where kernels are placed. The blower maintains the constant circulation of hot air in the chamber. Even heat exchanger, electric hot house serves the purpose.

Fuels used to run the machine are power, firewood and cashew shell cakes.

**Fig 19: Cashew Kernel Conditioning tray**



**Indian practices:** In order to reduce the breakage during machine peeling of kernels, moisture content of kernels will be raised to three and half to four percent by humidification process. Once peeling of *Testa* from kernels using peeler machine is done the moisture content in kernels need to be reduced to three percent (as per the export standard norm). Thus, machine peeled kernels are dried in the drier at 40-50°C for about two to three hours.

But, those processors who do manual peeling of kernels will not raise the moisture instead retain three percent moisture only. Thus, does not require drying of kernels after manual peeling.

Usually drier machine is used for this purpose. A capacity range of 30kg to 1 tonne volume driers are available in the market and accordingly prices vary. Some processors will

Also use the same borma machine earlier used for drying the de-shelled nuts. The only difference will be the temperature setting (below 65 °C).

*In general, the cashew kernels (after peeling) will have moisture level of 2.3-2.4 percent and to increase it to three percent add weight and thus the monetary value.*

**Indian drying machinery suppliers:** Kindly refer Annex 1 & Annex 2

## Section 7- Grading and Sorting of Cashew Kernels

**Grading:** The process of sorting cashew kernels based on their size and color is called grading. Based on size kernels are graded as wholes, splits, butts, pieces and bits. Based on size kernels are graded as white and scorched. Grading is done both manually and mechanically.

**Manual method of grading:** On basis of visual inspection, matching the set standards labors do sorting of cashew kernels.

**Fig 20: Manual Grading of Cashew Kernel**



**Machine grading:** There are two types of machine for the purpose, one for grading on size basis and the other on color basis.

**Size Grader:** The machine that performs grading on size basis is called grader. It consists of sieves with different holes or sizes through which kernels passes through. The wholes remain on the sieve plate the broken one's and further smaller pieces move through different sieves one below the other thus, kernels of different sizes get separated.

**Fig 21: Small Cashew Kernel Size grading**



**Indian cashew grading machinery suppliers:** Kindly refer Annex 1 & Annex 2

**Color sorter:** It sorts kernels on the basis of diagnosing color difference among kernels. Currently two types of color sorters are used by Indian processors viz. camera based and a sensor system. The sensor color sorter is found to be more effective among the users. Capability of sorting the broken cashew (baby bits) as per the requirement of specialized user industry like chocolate, biscuits, snack food etc is one of the major advantages of color sorter. India being one of the largest market of broken cashew has benefited from using color sorter.

**Fig 22: Cashew Kernel Color Sorter**



**Indian practices:** Grading is done both manually and by machine in India. On an average each skilled labor can grade 50-60 kg of kernels per day. And wage rate for the purpose is ranging between INR. 170-210 per labor per day (US\$ 2.78 –US\$ 3.44) whereas grader can grade 100-120 kg of kernels/hr and require one skilled labor to look into the operation. At present, the machine graders (sizer) are used for sorting the initial bigger grades while color sorter is very effecting in sorting small size grades like baby bits, SWP, SSP etc. Also, the color sorter is very useful for color based sorting (scorched and white).

**Indian cashew color sorting machinery suppliers:** Kindly refer Annex 1 & Annex 2

### Section 8- Packaging of Cashew Kernels

**Packing:** It is a process of cleaning, weighing and packing the cashew kernels into a specific/ required packets or pouches or tins.

Vita packing machine or vacuum packing machine: The machine consists of vibrating tray or a vibrating passage by the process of which kernels get separated from dust and clean kernels free from dust drops into the tin box below at the exit end. This filled tin box will be further moved through the conveyer belt towards sealer where top opening of the tin box is sealed.

**Indian practices:** Packing is done mechanically using vita packing machine or vacuum packing machine. In India cashew kernels are preferably packed in 10 kg metal boxes (made of tinfoil) for domestic markets. Two 10 kg tin boxes are packed in a single carton which is a standard SKU for bulk marketing of cashew. Tin boxes and cartons are locally purchased by processors. Each tin box costs INR 70-75 (US \$1.15 - US \$1.23) and cost INR28-30/carton (US\$ 0.46 –US\$ 0.49).

**Fig 23: Tin Packing Process Cashew Kernel**



**Indian cashew packing machinery suppliers:** Kindly refer Annex 1 & Annex 2

**Fig 24: Tin Packing Process Cashew Kernel**



**Packaging material-** The cashew kernels are packed in “modified atmosphere packaging”. As per the standard norms, the cashew kernel packaging should be in an “inert atmosphere”. An inert atmosphere is created by removal of air which makes the inside of the container free of oxygen. This can be done by having a vacuum pack or infusing it with an inert gas, such as nitrogen. Vacuum Packaging Bags are mostly used for bulk packing the cashew kernels. The material is manufactured by using various technology of Multilayer Co-extrusion with a blend of various HI-tech polymers. The bags are vacuumised and flushed with Nitrogen. The common specification of the packaging material is 19 inch X 27 inch X 160 & 175 micron for 25 lbs. Also, 23 inch X 31 inch X 160 & 175 micron for 50 lbs packing bag for high barrier properties nylon content bag.

**Fig 25: Vacuum Packed Cashew Kernel**



In Indian market, the bulk kernels are packed in tin boxes (made of tinplate) and are infused with carbon-dioxide to create the required inert atmosphere. The tin packaging is not allowed in USA and other countries hence the bulk cashew kernel is packed in multi-layer plastic films.

**Fig 26: Cashew Kernel Pouch Packing Line**



The price and demand of the material varies from customer to customer. Generally the major differences or various specifications are based on size, thickness, color, printing or logo etc.

**Fig 27: Cashew Kernel Pouch Packing Line**



**Fig 28: Cashew Kernel Pouch Packing Line**



**Major packaging material supplier:** Kindly refer Annex 1 & Annex 2

### Section 9 - Choosing criterion of machineries suppliers

The Indian cashew processors have asked to rank various criteria based on which they select or choose any machine from the particular machinery supplier. The criteria on which the processors have been asked to rank for features including-

**Price-** equipment Cost

**Performance-** Broken, Unshelled or Unpeeled nuts

**Capacity-** Size of the machine

**Energy Consumption-** Power unit consumption or diesel requirement.

**Maintenance and parts replacement-** frequency of the maintenance, cost of the frequent changing spare parts

**Training and Operational hand holding-** necessary to train the personal to operate and on job training

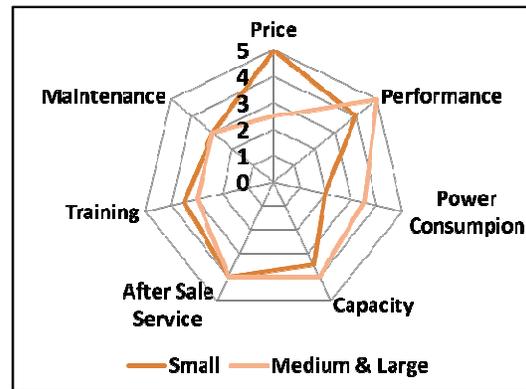
**After sale service-** response on the complaints of breakdown and time taken for attending and resolving such breakdowns

The responses received have been divided between small (up to 20 bags per day RCN processors) and medium-large (above 25 bags per RCN processors) processors.

The small processors have said that price of the equipment is the leading criteria followed by performance, capacity, after sale service,

maintenance and training while selecting any machine. On the other hand, for medium and large scale processors performance is the major criteria of selection followed by capacity, after sale service, power consumption, maintenance and training. Price is least selecting parameters among the medium and large processors.

**Fig 29: Machinery Supplier Selection Parameters**



### Selection of Supplier-

The cashew processing machinery suppliers are based within or nearby regions where the large number of RCN processing takes place. For the buyers, any machinery suppliers located near to their regions is most preferable. In case of India, most of the machinery supplying companies have established service network which is accessible to most of their customers.

Opinion leaders (processors who are already using the machineries supplied by the particular suppliers) are another important mean to select the suppliers.

We have also observed regional preference for the machinery suppliers among the cashew processors. Gayathri is a leading in the Kerala

region whereas Abhay Engineers is a leading machinery suppliers in the Karnataka region. However, other important players like NexGen, Best Engineering, Rotex, Muskan etc also have bigger presence in all the processing regions.

maintenance, after sale service among the leading suppliers, however, pricing is an important tool which the machinery supplier will use to get entry in the processing units. As per the information supplied by the leading machinery suppliers on the existing customers in India are following.

**Which Supplier is the Most preferred?**

Again, the processors have said that they have not found any major difference in terms of machinery’s performance, capacity,

**Table 2: Leading Machinery Suppliers and No. of Installation in India**

|  | RCN Grader   | Steam Cooker | Auto-Sheller       | Auto-peeler | Drying          | Grader         | Color sorter | Filling machine | Packing machine |
|--|--------------|--------------|--------------------|-------------|-----------------|----------------|--------------|-----------------|-----------------|
| <b>Abhay Engineers</b>                   | 65           | >1000        | >2000              | >300        | >500            | >200           | NA           | NA              | >500            |
| <b>Gayathri Industries</b>               | ND           | ND           | ND                 | ND          | ND              | ND             | ND           | ND              | ND              |
| <b>Nexgen</b>                            | ND           | ND           | 250                | 200         | ND              | ND             | NA           | ND              | ND              |
| <b>Best Engineering</b>                  | ND           | ND           | ND                 | 200         | ND              | ND             | ND           | ND              | ND              |
| <b>Rotex Transmission</b>                | ND           | ND           | ND                 | 200         | ND              | ND             | ND           | ND              | ND              |
| <b>I&amp;EC</b>                          |              | 50           |                    | 25          |                 | 15             |              |                 |                 |
| <b>Krishna industries</b>                | 5            | 40           | 500                |             |                 |                |              |                 |                 |
| <b>SKGL</b>                              |              |              |                    | ~600        |                 |                |              |                 |                 |
| <b>Accurate Engineering</b>              |              |              |                    |             |                 |                |              |                 |                 |
| <b>Vinayaka engineering works</b>        |              | 1600         | 100                | 50          | 530             | >100           |              | ~250            | 100             |
| <b>Muskaan Tradex Pvt Ltd</b>            | 2-in India   | 4-in India   | Nil- in India      | 3- in India | 3- in India     | Nil – in India |              |                 | 2- in India     |
|  | 20-in Africa | ~80- Africa  | >80 in West Africa |             | >100- in Africa | >12- in Africa |              |                 | >50- in Africa  |
| <b>Libra Innovations Private Limited</b> |              |              | 5                  |             |                 | 5              |              |                 | 220             |
| <b>Hi-tech Machinery</b>                 |              |              | 112                | 85          |                 |                |              |                 |                 |
| <b>Danush Enterprises</b>                |              |              |                    | 30          |                 |                | 78           |                 |                 |
| <b>Nicrome</b>                           |              |              |                    |             |                 |                |              |                 | 4000            |
| <b>Falcon craft</b>                      |              |              |                    | >40         |                 |                |              |                 |                 |

ND= Not Disclosed, NA= Not Available

**Annexure 1**

**List of Major Cashew Processing Machinery Suppliers in India**

| RCN grader             | IBR Boilers                | Steam cooker               | Auto - Sheller                    | Auto-peeler                      | Dryer                            | Grader                            | Color sorter        | Filling& Packing Machine          |
|------------------------|----------------------------|----------------------------|-----------------------------------|----------------------------------|----------------------------------|-----------------------------------|---------------------|-----------------------------------|
| Abhay Engineers        | Vinayaka engineering works | Vinayaka engineering works | Nexgen                            | Instruments & Equipments Company | Vinayaka engineering works       | Vinayaka engineering works        | Spectrum Industries | BOSCH                             |
| Muskaan Tradex Pvt Ltd | Abhay Engineers            | Abhay Engineers            | Vinayaka engineering works        | Nexgen                           | Abhay Engineers                  | Libra Innovations Private Limited | Spectrum Industries | Libra Innovations Private Limited |
| Krishna industries     | Rotex                      | Muskaan                    | Libra Innovations Private Limited | Vinayaka engineering works       | Muskaan Tradex Pvt Ltd           | Abhay Engineers                   |                     | Savanna                           |
| Gayathri Industries    | Gayathri Industries        | Krishna industries         | Abhay Engineers                   | Dhanush Enterprises              | Instruments & Equipments Company | Muskaan                           |                     | Rotex Transmission                |
|                        |                            | Rotex Transmission         | hi-tech machinery                 | Abhay Engineers                  | Rotex                            | Rotex                             |                     | Vinayaka engineering              |
|                        |                            | Rotex                      | Muskaan                           | hi-tech machinery                | Gayathri Industries              | Gayathri Industries               |                     | Abhay Engineers                   |
|                        |                            | Gayathri Industries        | Krishna industries                | SKGL                             |                                  |                                   |                     | hi-tech machinery                 |
|                        |                            |                            | Rotex                             | Falcon craft                     |                                  |                                   |                     | Muskaan                           |
|                        |                            |                            | Gayathri Industries               | Muskaan                          |                                  |                                   |                     | Rotex                             |
|                        |                            |                            |                                   | Rotex                            |                                  |                                   |                     | Gayathri Industries               |
|                        |                            |                            |                                   | Gayathri Industries              |                                  |                                   |                     |                                   |