A Study on Processing and Environmental Aspects of Cashew Industry in Srikakulam District of Andhra Pradesh

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Abstract: - Cashew is a crop of marginal lands and can be grown under rain fed conditions. It is one of the most delicious and nutritious nuts of the world, cashew contains 5.9% moisture, 21.2% protein, 46.9 fat, 22.3% carbohydrates, 0.45 % phosphorus, 0.05% calcium, 5.0mg/100g iron, 2.4% minerals and amino acids. Each bag of cashew nut (80 kg) processed either by roasting or cooking process generates about 47-50 kg of roasted shell or de-oiled cake. None of the units have needed to store these wastes as they have been used as fuel immediately or sold in the market. The testa generated from the peeling section has continuous market demand where it is used as vegetable tanning agent in tanneries. The sulphur Dioxide and Nitrogen Oxide emissions from the air pollution source in the cashew nut industry are less than 0.1 kg/hr and for phenolic compounds it is less than 0.0l kg/hr. The emission loads of these parameters are very low and there are no proven technologies for Control at such lower magnitudes. The waste water generation from cashew nut industry is of batch types for 2 to 4 hours in a day. It is too small a quantity 200 lit/day at a BOD of 5000 mg/l. COD of 10000 mg/l and Oil & Gease (Extractable, mostly in the form of phenolics compounds) at 200 mg/1. The board Characteristics indicate high in nature. Even though the cashew nut units are discharging for years the effluent directly on ground without any treatment.

Key words: Cooking, Boiling, Testa, Borma,

INTRODUCTION

India is the largest producer of cashew nut in the world as well as in Asia accounting for 39.47 per cent of world cashew production in 2010.It has the largest area harvested under the raw cashew nuts in the world. It is an important plantation crop in wasteland development programme due to its utility in soil conservation and to build up of balanced ecosystem. The major cashew nut producing states in India are Maharashtra, Kerala, Andhra Pradesh, Orissa, Karnataka, Tamil Nadu, Goa and West Bengal.

The cashew industry in India employed different unit operations/ methodology for processing depends on variety of raw material, location, technological mechanization and availability of secured energy supply. It has the potential to provide source of livelihood for the cashew growers, empower rural women in the processing sector, create employment opportunities and generate foreign exchange through exports.

Since these industries are small and cottage category units and no conventional and techno-

economically cost-effective pollution abatement systems are in operation elsewhere, it has become necessary to study the entire cashew nut processing industry sector in India to suggest techniques economically feasible complying with environmental standards. Even though the pollution load from individual unit is relatively low, the magnitude of pollution problem from the cluster of units is very high. Keeping in view of the small-scale category of the industry, it is necessary to study the industry in detail before establishing environmental standards

Cashew is a crop of marginal lands and can be grown under rain fed conditions. It is one of the most delicious and nutritious nuts of the world, cashew contains 5.9% moisture, 21.2% protein, 46.9 fat, 22.3% carbohydrates, 0.45 % phosphorus, 0.05% calcium, 5.0mg/100g iron, 2.4% minerals and amino acids.

In the beginning cashew was mainly considered as a crop for afforestation. As it can adapt to varied agro climatic conditions, it has become a crop of high economy and commercial value. The cultivation and marketing of cashew nuts involve a considerable amount of manpower and hence play a vital role in the economic activities in India.

In view of this, this work is proposed to study the methodologies employed in cashew nut unit in Palasa-Kasibugga in Srikakulam district which is engaged in the production of 198kgs of cashew per day and the study has the following objectives:

OBJECTIVES OF THE STUDY:

- To study the Air emissions, effluents produced and the solid waste generated for 1 kg of product.
- To recommend the eco-friendly suggestions, if necessary.

A REVIEW OF LITERATURE

Cashew (*AnacardiumOccidentale*L.) is one of the important tropical crops called as“poor man’s crop, rich man’s food”. The term “Cashew” has originated from the Brazilian name “Acajaiba” and the Tupi name “Acaju” which the Portuguese converted into “Caju” and is commonly known as “Kaju” in India. It is known as “ParagiAndi”in Kerala meaning foreign nut, “Lanka Beeja” in Orissa assuming its introduction from Sri Lanka, “Mundri” indicating the shape of the nut in Tamil Nadu and “Jeedi” in Andhra Pradesh. The cashew nut isnative of Brazil from where Portuguese travelers tookthe cashew tree to colonize in India, first recorded atCochinin 1578, at Goa in 1598 (Smith *et al*., 1992).

CASHEW NUT PROCESSING

The cashew industries in India employed different unit operations/ methodology for processing depend on variety of raw material, location, technological mechanization and availability of secured energy supply. There are two commonly followed methods of cashew nut processing, viz. Roasting process and Steam cooking process. The cashew nut processing is highly manpower intensive, generally carried out during 06:00– 18:00 hours. The major steps in cashew nut processing are

Roasting Process

- Roasting
- Shelling
- Borma
- Peeling
- Grading & Packing

Cooking Process

* Cooking
* Cutting
* CNSL extraction
* Borma
* Peeling
* Grading & Packing

MATERIALS AND METHODS

The method employed for processing Cashew nuts in study site is "COOKING (STEAM ROASTING) PROCESS". The air emissions and Effluent produced and the solid waste generated. In this unit 9 bags of raw cashew nuts are processed in a day. Each bag contains 80 kilograms of cashew raw nuts. Total of 720 kilograms of raw cashew nuts are processed in a day. The time taken for cooking of four bags is 20 minutes. Total time taken for cooking (steam roasting) of 9 bags of cashew raw nuts is 45minutes.

The following process is taking place in the Palasa unit:

Steam generation: The steam required by the cookers is generated in a vertical fire tube boiler (7kg/cm^2 and 50kg/hr.). 25 kilograms of Roasted cashew shell or de-oiled cake is fed manually with shovels at the fire grate of the boiler. The hot combustion gases travel vertically by natural draft created by the stack (12 – 15m high) at the top of the boiler. The flue gas emissions from the boiler are the source of air pollution. Time taken for steam generation is 20 minutes. The process is carried out in the morning hours of the day (6:00 a.m.)

Cooking Process: A Cylindrical steam cooker with provision of cashew nut feeding at the top and discharging of cooked nuts from the side near bottom, has a capacity of holding 4 bags (80 kg each) of cashew nut in a batch. The Cooking process is carried out in two batches. Nine bags of each containing 80 kilograms of cashew raw nuts are cooked in a day. The Once the cashew nut is loaded, steam from a boiler is introduced into cooker at a pressure of 7 kg/cm^2. The cashew nuts in the cooker are steam cooked and when all the nuts are sufficiently cooked, the excess steam starts releasing near the bottom outlet. The steam is injected into the cooker till the steam starts escaping form the outlet mouth of the cooker. This process takes about 20 minutes of time. Then the steam injection into the cooker is stopped and the condensed water at the bottom of the cooker is discharged in to a container and disposed on ground through septic tank. The Cooking process is also carried out in the morning for 45minutes.

The cooked cashew nut is removed from the bottom of the cooker and spread on the floor for cooling. The cooled nuts are sent for cutting section to cut open and collect the kernel.

RAW MATERIALS USED AND PRODUCTS GENERATED IN THE WHOLE COOKING PROCESS:

About 720 kilograms of cashew nuts are processed in a day using 225 litres of water for cooking. The process results in 22 kilograms of cashew kernels per bag and 198 kilograms from 9 bags of cashew raw nuts. The cashew shells weights around 423 kilograms and testa 9 kilogram from 9bags.

WASTE GENERATED IN THE COOKING (STEAM ROASTING) PROCESS:

About 47 kilograms of cashew shells are produced during the process for 80 kilogram of raw cashew nuts. Around 423 kilograms of shells are produced from9 bags. These shells are sold outside at a cost of Rs.350.00 for 50 kilograms of shells i.e., 423 kilograms of shells for Rs.3975.00. The Water evaporated in the cooking process is about 15 liters per bag. Total of 135 litres of water is evaporated from cooking of 9 cashew bags. The effluent generated from the cooking process of 9 cashew bag is 90 liters.

AIR EMISSIONS AND EFFLUENT QUALITY:

According to central pollution control board (CPCB) report 2010, the Air emissions and waste water quality is as follows:

Baby Boiler Stack Emissions:

Fuel Fired	**Flow Rate of Gases NM^3/hr**	**Temp oC**	**SO_2**	**NOx**	**OH^-**	**PM**	**CO2 %**
Roasted Shell	181 - 182	340 - 367	21 – 30 (0.004 – 0.005)	227 – 593 (0.04 – 0.11)	3.2 - 4.3 (< 0.001)	992 – 1270 (0.18 – 0.23)	4.2-5.7
De – Oiled Cake	193 – 495	340 – 720	12 – 29 0.003 – 0.006)	124 – 645 (0.03 – 0.1)	0.24 – 0.6 (<0.001)	382 – 535 (0.08 – 0.1)	13 - 15

Table:1 AIR EMISSIONS AND EFFLUENT QUALITY

Note: Avg concentrations are in mg/Nm^3 and values in parenthesis are kg/hr

Cooker – Wastewater Discharge

Waste Water Qty Litre/100kg of cashew Nut Cooked	**PH**	**TSS**	**TDS**	**O & G**	**BOD**	**COD**	**OH^-**
0.8 – 5.0	5.3 – 7.3	350 – 720 (0.001 – 0.006)	6028 – 13,416 (0.03 – 0.16)	24 – 52 (0.00002 – 0.00006) 0.03 *	2800 – 5000 (0.014 – 0.046)	6080 – 18,000 (0.045 – 0.098)	4.2 – 10.2 (0.00003 – 0.00009)

Note: Avg concentrations are in mg/liter and the values in parenthesis are kg/batch

Table: 2 Cooker – Wastewater Discharge

Borma Oven - Flue Gas Emissions

The hot air oven is fired with Roasted shell or Deoiled caked, where the flue gases transfer the heat to the air flow over the fire tubes. The flue gases are drawn from the oven by natural draft stack. The emissions from three Borma ovens at three different units were studied. All the three ovens were fired with roasted cashew shell. The Borma oven firing continues for 4 to 6 hrs in day depending on the moisture content in the cashew kernels. The range of emission parameters

as given below:

Borma' Oven - Flue Gas Emissions:

Flow Rate of Gases NM3/hr	**Temp oc**	**SO_2**	**NOx**	**OH-**	**PM**	**CO2 %**
186 - 996	190 – 352	10 – 48 (0.001 – 0.05)	55 – 146 (0.01 – 0.09)	0.4 – 0.8 (< 0.001)	363 – 587 (0.1 - 0.36)	1.0 – 2.7

Table: 3 Borma' Oven - Flue Gas Emissions

Note: Avg concentrations are in mg/Nm3 and values in parenthesis are kg/hr

However, the Electric Borma Ovens, which are used by some of the small capacity units are pollution free.

Solid Waste Management

Each bag of cashew nut (80 kg) processed either by roasting or cooking process generates about 47 – 50 kg of roasted shell or de-oiled cake. None of the units have needed to store these wastes as they have been used as fuel immediately or sold in the market. The 'testa' generated from the peeling section has continuous market demand where it is used as vegetable tanning agent in tanneries. The CNSL and the oil mud generated from the oil expeller units have export market in resin and paint industry. The ash generated from the initial drum heating is used in sprinkling over the roasted and quenched nut to prevent sticking. However, the bottom ash from the Borma air heater and the steam boiler in the cooking process is land filled within the unit premises.

ENVIRONMENTAL STANDARDS PRESCRIBED BY CPCB FOR CASHEW NUT INDUSTRIES

Cooking Process and Borma Operation

Even though these processes are batch type, the steam or hot air required for the process is generated continuously for 4 to 6 hrs in a day by firing cashew nut roasted shell or deoiled cake. Since both the air heater in Borma operation and the steam boiler in cooking process are manually fired with natural draft stack with similar firing practices, the particulate emissions with roasted shell and de-oiled cake fired in cooker steam boiler and Borma air heater are given in the tables which are normalized to 12% CO_2 as follows:

Process	**PM emission With Roasted Shell firing mg/NM3 at**		**PM emission with De-oiled cake firing mg/NM3 at**	
	Actual (CO2%)	**12% CO2**	**Actual**	**12% CO2**
Steam Boiler in cooking Process	1270 (4.2%) 992 (5.7%)	3269 2088	535 (14.3%) 382 (12.9%) 397 (15.0%)	449 355 318
Air Heater in Borma operation	587 (2.0%) 363 (0.6%) 405 (6.7%)	3522 7260 725	-	-
Average emission factor	723	3373	438	374

Table: 4 Cooking Process and Borma Operation

The stack heights of these processes are varying from industry to industry from 12 to 15m. A stack

height of 15m is commonly proposed for these operations for better dispersion of pollution emissions. The above average particulate emission factors for the Steam Boiler in cooking process and Air Heater in Borma operation are taken as emission standards for the processes as given below:

Baby Boiler and Borma Oven emission limits

Parameter	**Cooking Process – Steam Boiler**		**Borma Oven Heater**	
	Roasted Shell	**Deoiled Cake**	**Roasted Shell**	**De-oiled Cake**
Particulate Matter	350 mg/M^3 at 12% CO2	350 mg/NM^3 at 12% CO2	350 mg/NM^3 at 12% CO2	350mg/NM^3 At 12% CO2
Minimum Stack Height, m	15m from ground level or 2m above the height of the nearest building, which ever is higher		15m from ground level or 2m above the height of the nearest building, Which ever is higher	

Table: 5 Baby Boiler and Borma Oven emission limits

Sulphur Dioxide, Nitrogen Oxides and Phenolic Compounds

The sulfur Dioxide and Nitrogen Oxide emissions from the air pollution sources in the cashew nut industry are less than 0.1 kg/hr and for phenolic compounds it is less than 0.01 kg/hr. The emission loads of these parameters are very low and there are no proven technologies for control at such lower magnitudes. Furthermore, the suggested stack heights are more than adequate for better dispersion of these pollutants into atmosphere. Hence no separate emission standards are proposed for these parameters.

Wastewater Discharge Standards

The wastewater generation from cashew nut industry is of batch type for 2 to 4 hours in a day.

It is too small a quantity 200 lit/day at a BOD of 5000 mg/l, COD of 10000 mg/l and Oil & Grease (Extractable, mostly in the form of phenolics compounds) at 2000 mg/l.. The broad characteristics indicate high strength and of phenolic in nature. Even though the cashew nut units are discharging for years the effluent directly on ground without any treatment, the ground water analysis in and around the units indicated that the ground water quality is still meeting the norms. However, keeping in view of the clean environment, the following alternate treatment methods (Annexure-VI) are suggested to comply with the following surface water discharge standards by CPCB, which can be reused for gardening.

Waste Water Discharge Standards

S.No	Parameter	Limit, mg/lit
1	BOD (27 ^{o}C and 3 days)	100
2	Oil & Grease	10
3	Suspended Solids	100
4	Phenol	1.0
5	PH	6.5 – 8.5

Table: 6 Waste Water Discharge Standards

Noise Pollution Standards

The study reveals that noise pollution is not an issue associated with cashew nut processing industry. However, the general ambient noise standards as per EP Act are applicable for cashew industry also.

AMBIENT AIR QUALITY STANDARDS IN RESPECT OF NOISE

Environment (Protection) Rules, 1986

Area Code	Category of Area	Limits in dB (A) Leq	
		Day / Time	*Night / Time*
(A)	**Industrial Area**	**75**	**70**
(B)	**Commercial Area**	**65**	**55**
(C)	**Residential Area**	**55**	**45**
(D)	**Silence Zone**	**50**	**40**

Table: 7 Waste Water Discharge Standards

Note:

(i) Day time is reckoned in between 6 a.m and 9 p.m

(ii) Night time is reckoned in between 9 p.m and 6 a.m

(iii) Silence zone is defined as areas upto 100 meters around such premises as hospitals, educational institutions and courts.

The Environmental aspects of Sai sree Cashew Nut Processing unit, being a small unit, emits low amounts of air pollutants and less quantity of water effluents which result in prescribed limits of CPCB.

According to CPCB report, the sulfur Dioxide and Nitrogen Oxide emissions from the air pollution sources in the cashew nut industry are less than 0.1 kg/hour and phenolic compounds is less than 0.01 kg/hour. Even though the cashew nut units are discharging for years the effluent directly on ground without any treatment, the ground water analysis in and around the units indicated that the ground water quality is still meeting the norms. The study reveals that noise pollution is not an issue with cashew nut processing industry.

RECOMMENDATIONS AND SUGGESTIONS

- The ash generated at the bottom of Borma air heater as well as the Steam Boiler has to be properly land filled with necessary precautions so that there are no secondary air emissions.
- The cashew shell generated both by cooking process, which is presently used as fuel by the industry, has to go through bio gasification route to convert in to less polluting fuel gas as a elong-term measure.
- However, directions may be given to the industries that the cashew shell should not be sold to retail users for domestic and commercial firing purposes, due to the obnoxious odor generation by the flue gases.
- The 'Testa', which is removed from the surface of the cashew kernel after Borma is also a source of solid waste. In all the cashew nut industries t
- he testa produced has market value, which is used as vegetable tanning agent in tanneries.

REFERENCES;

- CENTRAL POLLUTION CONTROL BOARD
  MINISTRY OF ENVIRONMENTAL SCIENCES
- Cashew nut Processing: Sources of Environmental Pollution and
  Standards,
- BIOINFO Environment and Pollution
  Vol -1,issue 1,2011,PP 5- 11.
- Autal Mohod, Sudhir Jain, Power.A.G